

# Regenerating Soils, Empowering Farmers

FIPS Africa's innovations in soil health in western Kenya



Inception report - December 2025

## Acknowledgements

This report represents the culmination of extensive research, farmer engagement, institutional collaboration and cocreation processes undertaken over multiple years. The work would not have been possible without the dedication and support of numerous individuals and partner organisations committed to advancing sustainable agriculture and soil health in Western Kenya.

FIPS extend our deepest gratitude to the smallholder farmers, **Farmer Research Networks, Village-based Advisors**, and **local communities** whose insights, participation, and resilience have driven the progress reported here. Their willingness to innovate, adapt, and lead within their landscapes continues to provide invaluable learning and inspiration.

FIPS values the contributions of the collaborating institutions. The extension agents, and agricultural teams at the **county government of Kakamega, Busia and Bungoma, Manor House Agricultural Centre**, and the **Kenya Agricultural and Livestock Research Organization (KALRO)**, **Dr. Beth Medvecky PhD (Cornell University)**, former Associate Director, Cornell International Institute for Food, Agriculture and Development (CIIFAD) and **Dr. Steve Vanek**, PhD (Research Scientist II at **Colorado State University**). The commercial partners, **Homa Lime Company Ltd** and **AgRevive Africa Ltd**, and the agrodealers, whose partnership has enabled a responsive and market-linked approach to improving soil health.

FIPS acknowledges with appreciation the generous support of our funding and implementation partners - **McKnight Foundation, Seeds of Change**, the **Kenya Crops and Dairy Market Systems** (a programme of USAID) and **The Conservation, Food & Health Foundation (linked to Manor House Agricultural Centre)**. Their commitment to inclusive agricultural transformation and systems-based thinking has shaped both the vision and the outcomes of this work.

Finally, special thanks are due to the dedicated staff, board and field teams at **FIPS**, whose tireless efforts in research, field trials, training delivery, and community facilitation kept the momentum behind this work

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Suggested citation:

**FIPS Africa (2025). *Regenerating Soils, Empowering Farmers: Innovations in Soil Health for Western Kenya*. Nairobi, Kenya.**

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## Executive Summary

For decades, the smallholder farmers of Western Kenya - particularly in counties such as Bungoma, Busia, Siaya, Homa Bay, and Kakamega - have battled declining yields, rising input costs, and unpredictable weather. Beneath these challenges lies a common but often overlooked root cause of low yields - poor soil health, specifically high soil acidity, declining soil organic matter, and low nutrient efficiency.

Between 2018 and 2025, FIPS Africa and its partners delivered an ambitious work programme to regenerate soil health through four strategic innovations:

- **Soil pH testing and lime microdosing**
- **Bokashi composting**
- **WonderGro soil conditioning, and**
- **Market systems facilitation.**

This report presents the collective findings, insights, and system-wide lessons from that seven-year journey. The work programme centred on restoring soil function, whilst building farmer agency and transforming behaviour within the input market.

FIPS has long recognised the foundational role soil health plays in transitioning farmers and agrifood systems from surviving to thriving. FIPS led an intense soil health campaign including training 109,000 farmers on the impact of soil acidity.

FIPS signed Memoranda of Understanding on soil health with the Kenya Agricultural and Livestock Research Organization (KALRO) and the county governments. KALRO validated the Extech pH-meter technology manufactured by Extech Instruments and introduced to FIPS by the McKnight Foundation. Distribution of the pH meters resulted in 87,976 soil samples from Western Kenya being analysed. The data was incorporated into a World Bank-funded soil-mapping exercise led by KALRO using the GPS coordinates collected by the team.

Widespread soil pH testing has been enabled by logistical support through a network of Village-based Advisors (VBAs) and the Farmer Research Network (FRN). A total of 254 pH meters were supplied to 28 networks, including 30 FRN groups. FIPS will provide ten pH meters per network, increasing the total number of meters to 280.

FIPS plans to collaborate with another McKnight Foundation soils project, using the same GPS-mapped soil samples to test soil texture and particulate organic matter, and to provide training. It will also seek to validate a hand-held UV spectrophotometer to enable rapid measurement of soil organic carbon.

### **Diagnosing the Problem: Soil pH testing and lime microdosing**

At the heart of the intervention was a paradigm-shifting innovation: combining precise soil pH diagnostics with a simple, targeted lime-microdosing method that delivered visible benefits within a single planting season.

Using affordable handheld soil pH meters, Village-based Advisors and extension agents tested over 87,000 soil samples, revealing widespread and severe soil acidity (pH below 5.5) that critically impaired root growth, nutrient uptake, and fertiliser efficiency. Critically farmers were able to see the pH meter readings for themselves and were motivated to act.

The challenge was that traditional liming recommendations involved costly, labour-intensive broadcast applications of 800-1,600 kg (16-32 bags) of lime per acre. This method is out of reach for most smallholder farmers. FIPS demonstrated that correcting soil pH only within the planting hole - the root zone- is sufficient to improve root development and nutrient uptake. By microdosing just 5 grams of lime per planting hole, farmers reduced total lime use to about 100 kg (2 bags) per acre, significantly lowering both input and labour costs.

Microdosing lime combined clear diagnostic information with an actionable, low-cost recommendation, empowering farmers to see the direct connection between soil acidity and poor yields, motivating adoption.

As a result, farmers adopting lime microdosing consistently increased yields with value-to-cost ratios from seven up to 15 on severely acidic soils. Agrodealers stocking of lime surged from three to 45 businesses in two years, fueled by pH testing, training and local demand generation, cementing this innovation as both scalable and transformative.

### **Restoring Soil Life: Bokashi composting**

Beyond soil acidity, most soils in the target counties had organic matter levels below 2%, limiting biological activity and water retention. FIPS introduced Bokashi, a fast-decomposing, carbon-rich compost made from locally available organic waste. Applying the compost can help restore organic content and offered a low-cost, locally appropriate alternative to expensive synthetic fertilisers

Experimentation by Farmer Research Networks led to labour- and cost-saving adaptations that made the technology easier to implement. Trials showed that the compost could be produced with less turning than originally recommended. Inputs could also be substituted - for example, homemade sourdough yeast and sugar replacing packet yeast and molasses. This reduced production cost per batch from KSh 1,150 (\$9 USD) to KSh 300–500 (\$2-4 USD)

Between 2021 and 2025, 31,569 farmers were trained on making bokashi, 12,589 of whom have gone on to make 2,428 tonnes of compost. Farmers trials showed that, when applied alongside just 2.5g of diammonium phosphate (DAP) per planting hole,

Bokashi delivered yield increases of up to 60%. The approach saved farmers an estimated **KSh. 12 million (\$93,000 USD)** in fertiliser costs. Bokashi emerged as a cost-saving innovation that reinforced soil structure and microbial life. It gained traction among women managing household gardens.

### **Optimising fertiliser use: WonderGro soil conditioner**

FIPS introduced WonderGro, a locally manufactured soil conditioner made from natural minerals. The product was positioned not as a replacement for fertiliser but as a booster that enhances nutrient-use efficiency, particularly in acidic soils. Farmers applied WonderGro across more than 700 demonstration plots - often in combination with half-doses of DAP or nitrogen, phosphorus and potassium (NPK) - with consistently positive results.

WonderGro's affordability, visible benefits and ease of use made it highly popular among trial farmers. Commercial uptake expanded through partnerships with Village-based Advisors, agrodealers, and AgRevive, the product's manufacturer, which introduced small-pack formats to stimulate retail sales.

At an application rate of 250 g per coffee bush, the quantity supplied would cover approximately 6,667 acres (assuming 900 bushes per acre). Research showed that integrating WonderGro with half the recommended fertiliser rate generated an additional profit of KSh 368,478 (USD 2,840) per acre compared to full conventional fertiliser use. Applied across the treated acreage, this represents an estimated economic gain of around KSh 2.45 billion (USD 18.9 million) for coffee farmers - demonstrating the substantial income benefits of optimising fertiliser use with WonderGro in coffee production. Farmers have collectively purchased more than 3,000 tonnes of WonderGro soil conditioner, with roughly half (1,500 tonnes) delivered through smallholder coffee cooperatives.

### **Building farmer confidence and market systems: enabling system change**

The most significant impact of the programme was behavioural change. Farmers are now willing to test soils and increasingly recognise the benefits of microdosing lime.

Farmers engaged in demonstrations consistently report improved yields, which is driving wider uptake. Once farmers could see, test, and understand their soil conditions, they shifted from input dependence to informed, adaptive soil management. This change was driven by a network of over 1,200 Village-based Advisors and farmer-led trials, supported by technical training and locally adapted extension materials.

To sustain these shifts, FIPS worked to embed regenerative soil practices within the agro-input market system. This required active engagement at county level and private sector involvement. FIPS is supporting agrodealers to stock lime by enabling Homa Lime to supply products on credit. FIPS derisks the arrangement, while Homa Lime offers discounted prices and collects payments after sales. This model is making lime more accessible and helping the system move toward long-term commercial sustainability.

In 2025 FIPS convened a soil-health workshop with 32 partner organisations operating in Western Kenya. Attendees including KALRO, GIZ, FAO, Biovision, and the county governments of Bungoma, Busia, and Kakamega. Partners shared progress, aligned approaches, and committed to continue meeting as a community of practice. This collaborative platform provides a basis for scaling the soil improvement approach into counties and where FIPS is not currently present.

Several learning questions remain, including:

- Which factors most strongly influence lime adoption?
- What business opportunities exist around scaled pH testing?
- How effective is Bokashi in different contexts, and what is the optimal recipe?
- What are the commercialisation pathways for Bokashi and other regenerative inputs?

Stronger evidence will enable FIPS to refine its models, deepen impact, and support more smallholder farmers to transition from surviving to thriving.

## 1. Introduction

### 1.1 Project Background

The report includes results from Molo in South Central Kenya - where WonderGro was tested on potatoes – however, the focal point of this work is Western Kenya, particularly the counties of, Bungoma, Busia, Homa Bay, Kakamega and Siaya. These counties are characterised by high rainfall and widespread soil acidity. Acidic soil significantly impairs nutrient availability, reduces crop yields, and undermines household food security.

FIPS Africa's work aimed to develop and test low-cost, scalable soil management strategies that are practical, farmer-friendly, and suitable for smallholder systems.

The work described in this report transforms food systems by enabling thriving and resilient smallholder farmers, through co-created, low-cost, and scalable soil management strategies. The impact of improved soil health is increase productivity and a strengthening of farmers' capacity to adapt to environmental challenges. Smallholder farmers' needs and knowledge were central to the development and testing process.

**As a result, FIPS has been able to design and deliver sustainable agricultural practices that contribute to long-term food security and economic resilience in the communities served.**

This report presents the outcomes of a collaborative soil health initiative led by FIPS Africa, with the support of the McKnight Foundation, Seeds of Change, and USAID's Kenya Crops and Dairy Market Systems (KCDMS) programme.

## 1.2 Significance of Soil Health

Soil health is a fundamental determinant of agricultural productivity, resilience, ecosystem services, and environmental sustainability. It encompasses a range of biological, chemical, and physical attributes that together determine the soil's capacity to support plant growth. These include the soil organic matter, nutrient cycling, water-holding capacity, soil structure, below ground bio-diversity and microbial activity.

Soil is essential for sustainable agriculture; however, prevailing agricultural practices have commonly led to the depletion and degradation of soils.

This has resulted in declining soil fertility, loss of soil biodiversity, erosion, and reduced water-holding capacity, threatening the long-term viability of agricultural land.

In regions such as Western Kenya, the combination of intensive cultivation and high rainfall exacerbates soil acidification, especially where nitrogen-based fertilisers - such as diammonium phosphate (DAP) - are commonly used. Whilst fertiliser has undoubtedly enabled increased food availability for hundreds of thousands of people, its use results in the release of hydrogen ions during decomposition, which lowers soil pH. If this is repeated over decades, without restorative action, the gradual acidification causes nutrient fixation, particularly of phosphorus.

The chemical change in soil from acidification renders essential nutrients inaccessible to crops, further undermining root growth, productivity and resilience.

### **Pause and Reflect**

Imagine investing in fertiliser season after season, only to see your yields fall or stagnate. This is the reality for thousands of smallholder farmers in Western Kenya - locked in a silent struggle with soils that no longer serve them.

In the short term, farmers typically benefit from using DAP fertiliser with noticeable yield improvements. However, it is only after repeated use over a decade or more that the negative effects on soil health and subsequent yield declines begin to emerge.

Many farmers respond to the declining soil health by increasing the amount of fertiliser applied, rather than tackling the underlying acidity. The consequence is investing more in fertiliser that is giving ever smaller returns. Other farmers give up applying nutrients altogether and become trapped in a cycle of low productivity and poverty. Neither response is effective.

### 1.3 Rationale for Innovation

The conventional remedy for soil acidity involves applying large quantities of agricultural lime to restore optimal pH levels. Recommendations vary by soil type, but farmers are often encouraged to apply between 800 kg and 1,600 kg (16 to 32 bags) of lime per acre. While this can be feasible and profitable for large-scale commercial farms, it remains impractical and unaffordable for many smallholder farmers in Kenya.

The high cost of lime, the labour needed to apply it and limited access to mechanised transport to deliver the product – all work against its application. To address these challenges, FIPS piloted and scaled a set of innovative technical and system solutions.

Technical solutions include farmer-led pH testing, lime microdosing, and the integration of organic soil amendments such as Bokashi-fast-compost and WonderGro. These approaches offer context-appropriate, cost-effective alternatives that improve both short-term crop performance -that can be observed within a single season - and long-term soil resilience.

The systemic innovations, particularly for lime, required an awareness of the needs of farmers, agrodealers, transporters and input suppliers alongside the aspirations of the county governments. All these parties needed to be involved in the cocreation of practical

In the areas where FIPS has worked, sustainable, private sector-led activity is now improving farmers' access to lime. This has been enabled by large-scale awareness campaigns that stimulate demand, alongside incentives and de-risking mechanisms that encourage agrodealers to expand supply.

FIPS delivers technical and systemic innovations by combining global scientific principles with a commitment to co-creating and adapting solutions to local realities in ways that remain scalable and adoptable for resource-constrained smallholder farmers. At the core of this work are two guiding questions: **What will work?** and **What will make this adoptable?**

This report documents the basis, methodology, key findings, and practical recommendations derived from the soil health programme. It provides actionable insights for development practitioners, policymakers, agrodealers, researchers, and farmers seeking to improve soil health and productivity in similar agro-ecological contexts across Africa, and beyond.

## 2. Framing The Soil Health Challenge

### 2.1 Understanding Soil Health

Soil health refers to the soil's sustained capacity to function as a living ecosystem that supports plants, animals, and humans. It is influenced by a multitude of interacting processes, including nutrient cycling, soil structure development, carbon dynamics, microbial activity and biological pest suppression; soil degradation shifts balance toward pathogens like nematodes. Healthy soils contribute to improved crop yields, reduced production costs, increased water holding capacity and resilience

Researchers have highlighted the importance of maintaining soil health. According to Stott and Moebius-Clune (2017), soil health underpins the resilience of farming systems to environmental shocks. Kibblewhite et al. (2008) further emphasise the complexity of soil systems, noting that their degradation can undermine long-term food security.

### 2.2 Degradation Linked to Conventional Practices

The adoption of conventional farming practices - including excessive tillage and heavy reliance on synthetic fertilisers - has been associated with soil degradation across many parts of sub-Saharan Africa. Alori et al. (2020) argue that these practices contribute to soil erosion, a decline in soil organic matter, and the disruption of microbial communities essential for nutrient cycling.

Such degradation has long-term implications. As soil structure weakens and soil biodiversity declines, the ability of soils to store nutrients and moisture diminishes, further intensifying the vulnerability of smallholder farmers to climate variability and input price volatility.

### 2.3 The Problem of Soil Acidity in Western Kenya

The continuous use of nitrogen-based fertilisers, especially DAP, contributes significantly to soil acidification. This process occurs when ammonium and hydrogen ions are released during the fertiliser's breakdown in the soil. The resultant acidic environment inhibits root development and reduces the bioavailability of key nutrients, especially phosphorus.

Hengl et al (2021) noted soil acidity is particularly problematic in humid and high-rainfall regions such as Western Kenya. It is also problematic in Central and North Rift regions of Kenya and much of Sub-Saharan Africa.

Soils with a pH below 5.5 are considered acidic, and in many parts of Western Kenya, pH levels often fall within the 4.5 - 5.5 range. This directly impairs plant health, leading to stunted growth, weak root systems, and suboptimal yields. Moreover, acidic conditions immobilise phosphorus by forming insoluble compounds, a condition commonly referred to as phosphorus fixation. Acidic soils below pH 5 also result in the release of toxic aluminum ions from the soil that directly harm plant growth.

## 2.4 Limitations of Conventional Liming

The standard agronomic recommendation to combat soil acidity is the application of lime, often in quantities exceeding one tonne per acre. While this approach is effective in theory, it is rarely adopted in practice by smallholder farmers due to the high cost of lime and the logistical burden of transporting bulky materials across rural landscapes.

In addition, many farmers lack awareness about the importance of soil testing and the specific benefits of lime application. As a result, lime remains underutilised, despite its proven effectiveness in raising soil pH and improving fertiliser efficiency.

## 2.5 A Need for Context-Responsive Innovation

In response to these limitations, FIPS and its partners have focused on developing practical, evidence-based innovations to address soil acidity at scale. Techniques such as microdosing lime directly into planting holes, promoting rapid composting via Bokashi, and using the soil conditioners WonderGro offer affordable, scalable, and environmentally friendly alternatives that restore soil fertility.

These strategies are aligned with the principles of Integrated Soil Fertility Management (ISFM), which advocate for the combined use of organic and synthetic nutrient sources tailored to specific agro-ecological contexts (Vanlauwe et al., 2015; Guto et al., 2012). By building farmer capacity and improving access to soil inputs, such innovations can contribute meaningfully to the resilience and profitability of smallholder farming system

### Insight Box: Behaviour Change Matters

Long-term soil health requires more than new inputs - it demands a shift in farmer practice, agrodealer incentives, and institutional support. FIPS' model embeds behaviour change at its core, empowering agrodealers, and enabled Homa Lime suppliers enabling a systemic behavior change and empowering farmers not just with tools, but with trust, confidence, and choice.

## 3. Research Methodology and Objectives

### 3.1 Overview

FIPS soil health initiative was grounded in a multi-disciplinary and participatory research approach. A range of experimental methods were employed to test soil management innovations under both controlled and real-world conditions. These included microdosing trials in farmers' fields, controlled bucket experiments in laboratory-like environments, and large-scale farmer training and outreach programmes. The initiative also integrated market system development and policy engagement to promote the uptake and institutionalisation of soil health innovations.

The methodology prioritised both scientific rigour and practical applicability, ensuring that findings were directly relevant and scalable within smallholder farming systems.

## 3.2 Key Objectives

The research and implementation activities were designed to meet the following objectives:

- 1. Farmer Education and Empowerment and demand creation**  
To develop farmer-friendly training materials, toolkits, and demonstration sites aimed at increasing knowledge and adoption of soil health practices. This included the dissemination of pH meters and training on soil testing procedures.
- 2. Adapt Lime Application Methods**  
To develop and assess the effectiveness of microdosing techniques for lime application to reduce soil acidity and improve crop productivity.
- 3. Co-create Organic Matter Management**  
To promote the use of organic soil amendments, including manure and Bokashi compost, as complementary inputs for enhancing soil structure, microbial activity, and nutrient cycling
- 4. Optimise Fertiliser Use**  
To test the integration of lime with fertilisers (particularly DAP) and assess the efficacy of soil conditioners such as WonderGro in improving nutrient availability and uptake.
- 5. Enable Market and food system** to work with agrodealers, input manufacturers (e.g., Homa Lime and AgRevive), and public institutions (e.g., Kenya Agricultural and Livestock Research Organization - KALRO) to enhance access to soil inputs and embed soil testing services in public extension systems.

## 3.3 Research Design

The initiative utilised a mixed-methods research design tailored to each intervention type. The primary elements included:

- **Conceptual design for lime:** Having recognised that the application of 800 kg of lime per acre was not feasible for smallholder farmers, FIPS asked 'what would make lime adoptable?' The answer was that farmers need a solution that they can carry into the village on a bicycle or motorbike (the way they carry in fertiliser) which is 50 to 100 kg/acre.

FIPS recognised that roots are most vulnerable during the early stages and that applied nutrition (fertiliser/ manure) exists in the planting hole, estimated to be 15 cm x 15 cm (or 0.0225 m<sup>2</sup>). Through desk studies, it was calculated that 800 kg spread over 4,000 square meters (an acre) was 0.2 kg/ m<sup>2</sup> and that this was equivalent to 4.5 g in a planting hole of 0.0225 m<sup>2</sup>. FIPS hypothesized that 5 g of lime per planting whole would neutralise the soil in the planting hole and that this would be sufficient to provide meaningful benefits for crop growth. Coincidentally, a water bottle top measures 5 g of lime per. Applying 5g per planting hole, for the recommended spacing for maize, equates to 100 kg of lime per acre, which is the amount that a bicycle can carry.

- **Microdosing Field Trials:** Conducted with over 690 farmers in Bungoma and Kakamega counties, testing various lime types (e.g., Calcium Carbonate, Calcium Oxide, WonderGro) applied at 5g per planting hole. The yield results in the first season disaggregated by four categories of starting pH of soil (<pH 5; pH 5 to 5.5; pH 5.5 to 6.0; > pH 6.0).
- **Controlled Bucket Experiments:** To simulate whether microdosing lime could change soil pH and phosphorus availability within a season in planting hole, FIPS carried out controlled laboratory-style trials in buckets (approximately the size of a planting hole).

FIPS hypothesised that microdosed lime would change pH and phosphorus availability within physiologically meaningful ranges within 16 weeks. The interaction between lime, DAP fertiliser, and manure was assessed on soil pH and phosphorus availability over a 16-week period. These trials used a randomised design with 11 treatments and three replications.

- **Farmer Training and Demonstrations:** Over 109,000 farmers participated in hands-on workshops, receiving training on lime application, soil acidity management, and the use of soil health toolkits. **87,976** soil pH tests were conducted on farmers' fields during these sessions. Results were mapped using GIS.
- **Bokashi-fast-compost adaptation:** Training farmers on Bokashi-fast-compost method, learned from Manor House Agricultural Centre. Assessing proportion testing within 6 months. Adapting and co-creating method with farmers to address disablers and enablers. Repeating training and uptake of Bokashi-fast-compost. Assessing yield benefits from using Bokashi. Scaling into wider FIPS program.
- **Market Systems Facilitation:** Engagement with agrodealers and local suppliers focused on addressing supply-side constraints and increasing the distribution and stocking of lime. FIPS supported market actors by sharing soil pH data to show where farmers recognised acidity problems, facilitating bulk or group orders from agrodealers to lime suppliers, and de-risking supply to encourage greater market participation.
- **Institutional Partnerships:** Ensuring actions were firmly responding to local government priorities included formal collaboration with government research system KALRO for pH meter validation and integration into county-level agricultural extension systems.

Through this rigorous system approach, FIPS sought to generate actionable insights and practical solutions to restore soil fertility and enhance resilience across smallholder farming systems in Western Kenya.

## 4. Results and Analysis

This section presents the results, categorised by intervention type, and highlights key agronomic impacts, cost-benefit outcomes, and implications for scale-up.

### 4.1 Microdosing Lime Field Trials

#### Objective

Soil acidity is a major constraint to agricultural productivity for smallholder farmers in Western Kenya. Conventional approaches – requiring at least 800 kg (16 bags) of lime per acre broadcast and incorporated into the soil - are prohibitively expensive and labor-intensive. In response, FIPS-Africa promoted a low-cost, scalable, and context-specific strategy centered on microdosing lime and targeted application based on soil pH, crop type, and soil description, fully embodying the principles of the *Options by Context* approach in agronomy.

As articulated by Sinclair and Coe (2019), the *Options by Context* paradigm represents a fundamental shift from one-size-fits-all recommendations to understanding how agricultural innovations perform differently across diverse biophysical and socio-economic contexts. This approach emphasises that the success of an intervention - such as liming - depends on the interaction between the *option* (e.g., lime type, rate, method), the *context* (e.g., soil pH, soil type, crop, farmer capacity), and multiple dimensions of *performance* (e.g., yield, cost-benefit, ease of adoption, observable change).

FIPS' multi-year work on lime application, spanning maize and groundnut trials from 2018 - 2022, provides compelling evidence of how this approach can transform soil health interventions into affordable, adoptable, and high-impact practices.

#### Methodology

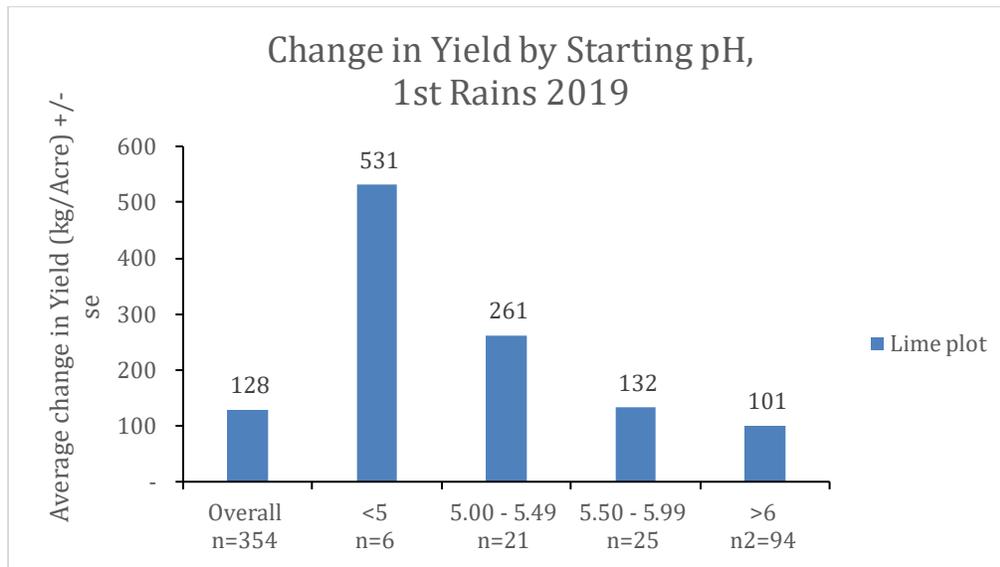
To determine the impact of applying small, targeted quantities of lime directly into planting holes on soil pH, crop growth, and maize yields.

- Trials were conducted with 692 farmers, with complete data collected from 539 participants across Bungoma and Kakamega counties.
- Four treatment groups were tested: control (no lime), Calcium Carbonate ( $\text{CaCO}_3$ ), Calcium Oxide (CaO), and WonderGro.
- Each treatment involved 5g of lime per planting hole, approximately equivalent to 100 kg (2 bags) per acre.

#### Findings

- 44% strong business case (15:1)
- 33% moderate business case (7:1)
- 23% weak business case (3:1)

## Microdosing lime- business case for farmers



Economic analysis reinforced this insight. Value-Cost Ratios (VCR) showed: assuming a 90kg bag of bag retail at Ksh 3,000 (\$23 USD).

Soil pH	Value-Cost Ratios	Business case for lime application
Where the pH is unknown	VCR = 1:4	Modest business case Ksh 4,300 (\$33 USD)
Soil pH < 5	VCR = 1:15	Very strong business case Ksh 17,700 (\$136 USD)
Soil pH > 5 - 5.	VCR = 1:7	Strong business case Ksh 8,700 (\$67 USD)
Soil pH > 5.5 – 6	VCR = 1:4	Modest business case Ksh 4,400 (\$34 USD)
Soil pH > 6	VCR = 1:3	Weak business case Ksh 3,350 (\$26 USD)

These results demonstrate that the targeted application of lime to acidic soils is agronomically sound and economically viable.

Data from the 2019 trials showed measurable increases in soil pH just four months after microdosing - confirming the approach delivers rapid, detectable change. This is critical because farmers are more likely to invest in soil health when they see results within a single season.

## Conclusion

Microdosing lime is an agronomically effective and economically viable strategy, particularly when targeted to soils with a pH below 5.0. The results support the use of calcium carbonate ( $\text{CaCO}_3$ ) as the preferred lime source, and this approach is scalable for smallholders facing resource constraints.

## 4.2 Controlled Bucket Experiments

### Objective

To examine the combined effects of lime, manure, and DAP on soil pH and phosphorus availability under controlled conditions.

### Methodology

- Soil sourced from Kisa Central Ward, Kakamega County (initial pH 4.89, P = 4.48 mg/kg).
- 11 treatment combinations (lime at 5g or 10g, DAP at 2.5g or 5g, with and without manure).
- Three replications, with pH and Olsen P levels recorded biweekly over 16 weeks.

### Findings

- **Soil pH increase:** All amended treatments showed rising pH, with the greatest increases observed in treatments combining lime, manure, and DAP.
- **Phosphorus availability:** The best-performing treatment (5g lime + 2.5g DAP + manure) achieved P levels of 19.66 mg/kg compared to 6.35 mg/kg in the control.
- **Correlation:** A strong positive correlation ( $r = 0.80$ ) was observed between rising pH and phosphorus availability.

### Conclusion

Simultaneously applying lime, manure, and DAP significantly enhances soil chemistry and crop potential. These results validate the role of integrated soil fertility management in restoring acidic and nutrient-deficient soils.

## 4.3 Farmer Training and Soil Testing

### Objective

To disseminate soil health knowledge and build farmer capacity through training and diagnostic tools.

### Outcomes

- **109,000 farmers trained** in lime microdosing and soil health practices.
- **87,976 pH tests conducted** using handheld meters.
- Farmers subsequently **applied 267 tonnes of lime**, demonstrating behavioural change and increased adoption.

### Conclusion

Training interventions have led to a marked improvement in farmer knowledge, input use, and crop outcomes. Handheld pH meters proved critical for enabling data-driven decision-making at the farm level.

**Insight Box:** Behaviour Adoption

Farmer interviews revealed that many previously assumed poor seed quality or low rainfall were to blame for poor yields. Seeing their soil's pH, and witnessing the lime response on nearby plots, fundamentally altered perceptions. This “aha moment” was often cited as the turning point for adoption.

## 5. Innovations in Soil Management

The findings of the FIPS soil health initiative have informed the development and promotion of several innovative soil management practices. These approaches are designed to be cost-effective, scalable, and adapted to the realities faced by smallholder farmers in Western Kenya. The section outlines four key innovations: lime microdosing, pH testing and mapping, integration of organic matter, and the use of soil conditioners.

### 5.1 pH Testing and Soil Mapping

To facilitate targeted lime use, FIPS distributed handheld pH meters to networks to enable farmers to find out their soil acidity independently and in real time. This innovation addresses the inefficiencies of conventional soil testing services, which are often expensive, time-consuming, and inaccessible.

Since 2019, **87,976 soil pH tests** have been conducted with support from two projects:

- 66,298 tests by Kenya Crops and Dairy Market Systems
- 21,678 tests (2023–2025) by Seeds of Change

A total of **445 handheld pH meters** were distributed with support from: McKnight Foundation (45), Kenya Crops and Dairy Market Systems (200) and Seeds of Change (200) The immediacy of the results has enabled farmers to make timely and informed decisions regarding lime application and fertiliser use, thus enhancing efficiency and yield outcomes.

### 5.2 Microdosing with Lime

Traditional recommendations for managing soil acidity involve applying 800 kg (16 bags) or more of lime per acre every five years. However, this method is prohibitively expensive and logistically unfeasible for most smallholder farmers due to transport and labour constraints.

FIPS has introduced a **microdosing technique**, which involves placing a small amount of lime - roughly equivalent to a water bottle cap (5g) - directly into each planting hole. This approach requires only 100 kg (2 bags) of lime per acre, significantly reducing the financial burden for farmers while improving soil pH and crop productivity. Field trials have shown this method to be both effective and economical. Yield increases of several bags of maize per acre were recorded, particularly in soils with an initial pH below 5.

### 5.3 Integration with Organic Matter

FIPS promotes the use of **organic inputs** such as **manure** and **Bokashi compost** to further improve soil health. Organic matter plays a crucial role in enhancing soil structure, microbial diversity, and water retention, while mitigating the effects of acidity.

#### Bokashi Composting

FIPS also responded to the limitations of synthetic fertilisers - both in terms of cost and long-term soil health - by scaling up the use of, a locally adaptable, rapid organic composting method. Bokashi is a rapid, anaerobic composting technique that converts organic waste into a nutrient-rich amendment within 14 days. Trials across Bungoma, Busia, and Kakamega have shown that

- Integrating Bokashi with 2.5g DAP (instead of 5g DAP without Bokashi) increased maize yields from 900 kg (10 bags) per acre to 1440 kg (16 bags) per acre.

Bokashi production has been scaled through Farmer Research Networks (FRNs). They reduced production costs by simplifying the composting process - requiring fewer turns and using locally available inputs - thus making it more accessible for labour- and resource-constrained households.

- Farmer Research Networks reduced production cost per batch from 1,150 (\$9 USD) to KSh 300–500 (\$2-\$4 USD)
- **20,735 farmers trained** in Western and Coast
- Technology scaled to **12,000 farmers** making **2,428 metric tonnes** of compost
- Enough to apply across **4,046 acres** (at 600 kg per acre) - saving an estimated **2,023 (50kg) bags of fertiliser** and KSh 12 million (\$93,000 USD) in input costs.

#### Pause and Reflect:

Unlike fertilisers, which offer short-term nutrient boosts, organic matter builds the soil's long-term capacity to regenerate and respond.

### 5.4 Use of Soil Conditioners: WonderGro

**WonderGro** is an organic soil conditioner developed by AgRevive Africa Ltd. and approved by the USDA National Organics Programme and the Kenya Bureau of Standards (KEBS). It is formulated from locally sourced minerals suitable for organic farming and is registered as a soil conditioner.

## Key Benefits

- Enhances root development and crop resilience
- Improves fertiliser efficiency and nutrient uptake
- Reduces dependence on imported synthetic fertilisers
- Promotes microbial activity and suppresses nematodes

## Product Use and Farmer Uptake

FIPS supported the promotion of WonderGro in over 700 demonstration plots, working with Village-based Advisors and agrodealers across the five target counties. Farmers were trained to apply WonderGro in combination with half doses of DAP or NPK fertilisers - typically 2.5g per planting hole - thereby reducing input costs while maintaining or improving yields.

Demonstration and field trial results showed:

<p><b>Potatoes</b> <b>(Molo &amp; Western Kenya)</b></p>	<ul style="list-style-type: none"> <li>• Combination of WonderGro (5g) and DAP (5g) led to substantial yield increases across varieties. For example, the Unica variety saw yield increase from 0.9 kg to 1.4 kg per plant, translating to 10 additional tonnes per acre and KSh 300,000 (\$2,325USD) in added income.</li> <li>• Combining WonderGro and DAP increased tuber yield compared to standalone DAP. For example, adding 2.5g WonderGro to 2.5g DAP increased yields by 1.6 tonnes (18 bags) per acre for Shangi 2.9 tonnes (39 bags) per acre for Unica 1.7 tonnes (19 bags) per acre for Wanjiku</li> </ul> <p>Combining WonderGro and DAP value cost ratio was implied through increased returns with lower input costs when WonderGro was combined with reduced DAP rates. FIPS recommend using the combination of 2.5g DAP + 2.5g WonderGro instead of 5g DAP alone for enhanced productivity, profitability, and reduced costs. This demonstrates that WonderGro as a soil conditioner in combination with DAP fertiliser enhances potato growth parameters, yield, and profit margins effectively under the tested field conditions.</p>
<p><b>Maize</b></p>	<ul style="list-style-type: none"> <li>• A 50% reduction in fertiliser combined with WonderGro maintained or improved yields. FIPS also observed in phosphorus deficient soils there was <b>enhanced phosphorus</b> use following the combined application of DAP and WonderGro</li> </ul>
<p><b>Tomatoes</b> <b>(Pot Trials)</b></p>	<ul style="list-style-type: none"> <li>• WonderGro <b>suppressed nematode</b> populations comparably to commercial nematicides.</li> </ul>
<p><b>Coffee</b></p>	<ul style="list-style-type: none"> <li>• Field trials with IITA indicated an <b>83% yield increase</b> and reduced nematode infestation.</li> </ul>

## Economic Return

WonderGro has demonstrated high return on investment (ROI):

- Application cost: Approx. KSh 6,000 (\$46 USD) per acre
- Additional income: Up to KSh 960,000(\$742 USD) per acre
- ROI: As high as 160:1

## Summary

Addressing soil health at scale requires more than technical interventions - it necessitates a deliberate focus on the enabling environment. By targeting supply chain gaps, facilitating private sector incentives, and embedding innovations in public institutions, FIPS has laid the foundation for a sustainable and responsive soil health delivery system.

The integrated soil technology bundle proposed by FIPS addresses key constraints faced by smallholder farmers - particularly soil acidity, high input costs, and knowledge gaps. By combining low-dose, high-impact technologies such real-time pH testing and lime microdosing, Bokashi composting, and WonderGro application, the project has developed an integrated, farmer-led soil management model that is practical, scalable, and aligned with the principles of sustainable agriculture.

## 6. Implementation Challenges and Market Systems Approaches

Despite the demonstrated success of the soil health interventions piloted by FIPS, several systemic and operational challenges continue to hinder the widespread adoption of improved soil management practices. This section outlines these constraints and the strategies adopted to address them through market-based and institutional approaches.

### 6.1 Supply Chain Constraints

#### Limited Availability of Lime

A significant obstacle encountered was the low availability of agricultural lime at local agrodealerships. Most agrodealers in Western Kenya have historically refrained from stocking lime due to:

- Perceived low demand.
- High transport and handling costs.
- Storage challenges.
- The bulky nature of lime, especially at traditional application rates 800-1,600 kg (16–32 bags) per acre.

These factors disincentivise retailers from investing in lime inventories, effectively limiting farmers' access even where awareness of the benefits exists.

## 6.2 Market Systems Intervention: Facilitating Lime Access

In response to market inefficiencies, FIPS employed a facilitative approach to stimulate both **demand** and **supply** for agricultural lime and WonderGro, through systemic partnerships.

### Partnership with Homa Lime

FIPS brokered a relationship between agrodealers and Homa Lime, a regional lime producer based in Kisumu. Key innovations included:

- **Microdosing demonstrations**, reducing lime application rates to just 100 kg (2 bags) per acre, making the product more manageable and affordable.
- **Risk-sharing mechanisms**, allowing agrodealers to access lime on credit.
- **Preferential pricing** and deferred payment arrangements, improving liquidity and investment incentives.

### Highlights from the data

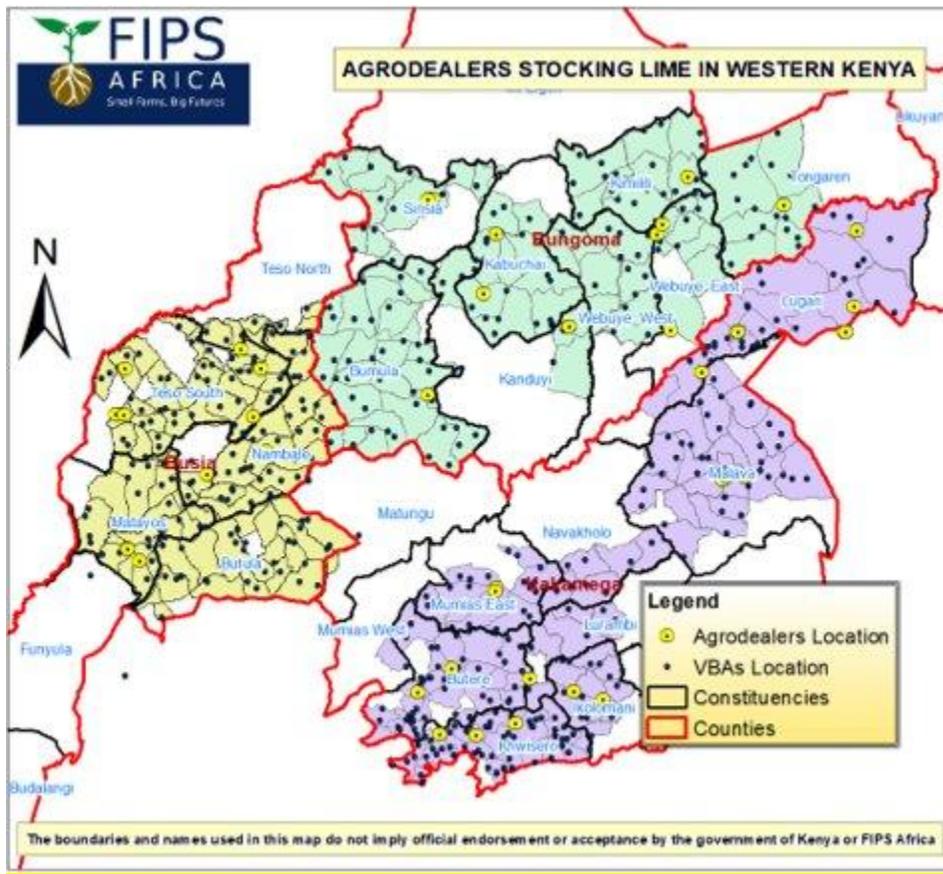
#### Agrodealers: Rapid Enterprise Expansion in countries where FIPS is present

Agrodealers stocking lime by location	2022	2025
Bungoma	1	12
Busia	0	17
Kakamega	2	16
<b>Total</b>	<b>3</b>	<b>45</b>

### Sales growth

- Lime sales have expanded from 69 tonnes in 2022 to 534 tonnes in 2025.
- Bungoma county lime sales showed an eight-fold increase (21 tonnes to 178 tonnes)
- Kakamega county lime sales showed an six-fold increase (48 tonnes to 290 tonnes)

The interventions were successful in shifting market incentives and establishing a more viable commercial ecosystem for lime distribution and marketing.



### Partnerships With AgRevive

FIPS partnered directly with AgRevive, who manufacture **WonderGro.**, through this collaboration:

- 1 kg packs were made available to match farmer purchasing power
- Agrodealers received product training and trial packs to build confidence
- Village-based advisors were engaged in **community-led demos** to drive awareness and peer-to-peer promotion

These efforts helped overcome the reluctance among agrodealers to stock new products and built a **visible demand base** that supported early commercial traction.

#### **Insight Box:** Systems Thinking

It is not enough to tell farmers what to use. If they can't buy it locally and affordably, behaviour change stalls. Market facilitation ensures that supply meets demand in real time.

## 6.4 Institutional Engagement: KALRO Collaboration

Recognising the need for institutional sustainability, FIPS signed a memorandum of understanding with the **Kenya Agricultural and Livestock Research Organization (KALRO)**. This strategic collaboration focused on:

- **Validation and certification** of handheld pH meters to ensure quality and accuracy.
- **Capacity building** of 150 **Ward Agricultural Officers (WAOs)** across Bungoma, Busia and Kakamega to embed soil pH testing into county extension services.
- **Geo-referenced data collection**, contributing to a national soil pH mapping initiative for more precise policy and investment targeting.

This approach supports the **institutionalisation** of soil health diagnostics and ensures continuity of the approaches championed by rooting innovations in public systems.

## 7. Lessons Learned: Insights from Practice

Over more than five years of designing, testing, and scaling soil health interventions in Western Kenya, FIPS generated a wealth of insight into what works, what does not, and what is needed to sustain long-term change. These lessons go beyond field-level findings - they speak to the deeper dynamics of farmer decision-making, market responsiveness, institutional alignment, and systems transformation.

This section captures the key takeaways across technical, behavioural, and systemic dimensions, offering a foundation for learning, reflection, and replication.

### Lesson 1: Knowledge is Power – and a Catalyst for Change

The introduction of **handheld pH meters** was a turning point in farmer empowerment. By allowing farmers to see and understand their soil conditions in real time, unlocked a major behavioural shift:

- **Problem recognition** replaced guesswork
- **Curiosity** replaced passivity
- **Demand** for appropriate inputs replaced dependence on advice alone

**Key Insight:** Practical diagnostic tools transform learning into action. Farmers act differently when they understand what their soil needs, and why.

## Lesson 2: Behaviour Change Requires Simplicity, Visibility, and Trust

**Lime microdosing, Bokashi, and WonderGro** - shared several characteristics:

- They were **simple to implement** with little labour or land disruption
- They delivered **visible results** within one season
- They were introduced by **trusted local peers (Village-based Advisors)**

These traits are essential in low-trust, high-risk contexts where resources are scarce and every shilling counts.

**Food for Thought:** Behaviour change in agriculture is not solely about knowledge – it is about confidence, low risk, and visible proof.

## Lesson 3: Integration Beats Isolation

No single input, product, or tool can restore soil health alone. The most effective results came when practices were **integrated**:

- **Lime** corrected pH, enabling nutrient uptake
- **Bokashi** rebuilt soil carbon and biology
- **WonderGro** enhanced nutrient retention and root zone health
- **Half-rate fertiliser** conserved cost while maintaining yield

**Key Insight:** Regenerative agriculture is not a singular product, it is a system of practices. Supporting farmers to integrate inputs is key to success.

## Lesson 4: Markets Must Be Facilitated, Not Assumed

FIPS learned that **creating demand among farmers is not enough** - inputs must also be available, affordable, and trusted. This required:

- **Brokered partnerships** with input suppliers like Homa Lime and WonderGro Ltd
- **Training and incentivising agrodealers**
- **De-risking market entry** through credit cover and small packaging options

**Market Learning:** Agrodealers are more likely to stock unfamiliar products when farmer demand is visible and supply chain risk is shared.

## Lesson 5: Inclusion Is Not Automatic – It Must Be Designed

Women and youth often face **structural and social barriers** in accessing inputs, training, and decision-making roles. FIPS proactively addressed this by:

- Training **women VBAs** and peer leaders
- Promoting **kitchen garden composting (Bokashi)** as a household entry point

**Equity Lesson:** Inclusion is about tailoring delivery to ensure access, agency, and benefits for all.

## Lesson 6: Systems Change Requires Institutional Ownership

While farmer trials and market linkages had strong impact, FIPS understood that **policy and institutional embedding** are essential for long-term sustainability. By engaging:

- **KALRO** for pH mapping and tool validation
- **County agriculture departments** for training and outreach
- **Public-private platforms** for joint promotion

The evidence and partnership building work outlined in this report will help ensure that technologies will be supported and scaled up by FIPS and others.

**Policy Learning:** Lasting change occurs when interventions are absorbed into the mandate and operations of national and county systems.

## Lesson 7: Feedback Loops Build Farmer Confidence

Regular monitoring, yield tracking, and farmer feedback sessions made learning iterative. Farmers who saw even small yield gains were more likely to:

- Expand treatment areas the following season
- Convince neighbours to join
- Explore new practices or input blends

**Behavioural Loop:** Confidence leads to experimentation. Experimentation leads to learning. Learning drives deeper and wider adoption.

Summary Table: What Worked and Why

<b>Element</b>	<b>What Worked</b>	<b>Why</b>
pH Testing	Handheld, instant, visual	Made soil acidity visible and actionable
Lime Microdosing	5g per hole	Affordable, low-risk, and demonstrably effective
Bokashi	Fast, local, composting	Fit smallholder realities and saved on inputs
WonderGro	With reduced fertiliser	Delivered a high return on investment and restored degraded soils
Village-based Advisors	Trusted farmer peers	Anchored behaviour change in community trust
Market Facilitation	Linkages, credit cover	Addressed input availability and dealer hesitation
Gender-Inclusive Design	Tailored outreach	Improved access and uptake by women and youth

**Final Reflections:** FIPS' experience underscores a powerful principle: **regenerating soils is as much about people as it is about products**. By blending agronomic precision with behavioural insight and systems design, FIPS catalysed change that farmers could see, feel, and sustain. It is not enough to promote regenerative agriculture; regenerative systems must be intentionally designed from the soil pit to the policy table.

## 8. Policy Recommendations and Future Directions

The evidence generated by FIPS' soil health interventions underscores the need for strategic, multi-level engagement to institutionalise sustainable agricultural practices among smallholder farmers. This section provides actionable recommendations for policymakers, development partners, and agricultural stakeholders, followed by a forward-looking agenda for scaling and sustaining soil health innovations across Kenya and the broader sub-Saharan region.

### 8.1 Recommendations for Partners and Stakeholders

#### 1. Invest in Farmer and Agrodealer Education

There is a pressing need to enhance training programmes aimed at both farmers and input suppliers. Practical demonstrations, field-based extension services, and regular capacity-building workshops should be prioritised to:

- Reinforce knowledge of soil acidity and liming practices;
- Encourage consistent use of soil pH testing tools;
- Promote integrated nutrient management practices.

#### 2. Strengthen Input Supply Chains

Policymakers and market actors should collaborate to ensure consistent availability of key inputs such as:

- Agricultural lime in small, affordable units;
- Handheld soil pH testing meters;
- Locally manufactured organic soil amendments (e.g., WonderGro and Bokashi).

Subsidies or credit facilities may be considered to reduce the cost burden and improve uptake.

#### 3. Promote Sustainable, Integrated Practices

To foster long-term soil regeneration and resilience, stakeholders should advocate for:

- The combined use of organic matter (e.g., Bokashi and manure) with lime;
- The reduction of reliance on synthetic fertilisers by promoting soil conditioners and composting techniques;
- Circular economy models that transform farm waste into value-added soil inputs.

#### 4. Leverage Data and Research for Precision Targeting

Evidence-based decision-making should be strengthened by:

- Scaling up geo-referenced soil pH testing and mapping;
- Sharing research insights across stakeholders to improve targeting of resources;
- Using cost-benefit data to identify high-impact zones for intervention.

#### 5. Foster Collaboration Across Sectors

Cross-sectoral partnerships are essential for mainstreaming soil health innovations.

Collaboration between government institutions, NGOs, private input suppliers, and research organisations should be institutionalised through:

- Public-private partnerships for distribution and service delivery;
- Joint validation of tools and methodologies;
- Shared investment in monitoring and evaluation systems.

### 8.2 Future Directions

#### 1. Scale Microdosing Beyond Western Kenya

Given the proven success of lime microdosing and associated practices, there is strong justification for extending these interventions to other agro-ecological zones in Kenya and beyond. This includes:

- Regions with similarly acidic soils;
- Areas experiencing high fertiliser costs or climate stress.

#### 2. Expand Access to Soil Health Toolkits

FIPS' toolkit - comprising handheld pH meters, educational brochures, and farmer guides - should be scaled through:

- Integration into county extension programmes;
- Distribution via agrodealers and Village-based Advisors (VBAs);
- Digital innovations to support diagnostic decision-making.

#### 3. Embed Innovations in Policy and Practice

FIPS' approach demonstrates that behavioural change, input access, and institutional collaboration are all critical to achieving sustainable soil health. Therefore:

- National policies should support decentralised pH testing;
- Fertiliser subsidy schemes should incentivise integrated approaches (e.g., DAP + Bokashi);

Extension services should be retooled to include soil diagnostic support and farmer-led experimentation.

- Build on the August 2025 convening of 32 soil partners in Western Kenya.
- Implement soil pH maps following the county launch of the mapping exercise with KALRO by the governors in Busia, Bungoma, and Kakamega.
- Build on soil carbon measurement tools with KALRO.
- Promote soil carbon increases with Bokashi Fast Compost (learned from Manor House Agricultural Centre)
- Embedding soil health in government policy and action.

### 8.3 Long-Term Vision

Widespread adoption of pH testing, lime microdosing, and integrated nutrient strategies has the potential to:

- Reduce national synthetic fertiliser use by thousands of tonnes annually.
- Increase food security through higher yields and more resilient soils.
- Lower greenhouse gas emissions by improving soil carbon sequestration.
- Create new business opportunities for youth, agrodealers, and VBAs involved in input distribution and extension services.

By continuing to expand and refine these practices, Kenya can cultivate a new generation of smallholder agriculture that is productive, sustainable, and climate-resilient.

## 9. Conclusion

The FIPS' soil health initiative offers compelling evidence of the transformative potential of context-appropriate innovations in improving agricultural productivity, sustainability, and resilience among smallholder farmers in Western Kenya. Through a combination of microdosing lime, farmer-led soil testing, organic soil amendments, and market systems facilitation, the project has demonstrated scalable pathways for tackling persistent challenges of soil acidity, nutrient deficiency, and input inefficiency.

Crucially, the initiative has succeeded in aligning scientific research with practical farmer realities - delivering results that are both agronomically sound and economically viable. The integration of low-cost technologies such as handheld pH meters and microdose lime application has enabled farmers to make informed decisions, increase yields, and reduce reliance on expensive synthetic fertilisers. Interventions such as WonderGro and Bokashi have added further value by enhancing soil structure, microbial activity, and long-term fertility.

The economic implications are equally significant. As demonstrated in the trials, practices like Bokashi-DAP integration and WonderGro supplementation delivered high returns on investment, in some cases up to 160 times the input cost.

Widespread adoption of microdosing lime techniques and pH testing could substantially reduce fertilizer requirements by improving nutrient efficiency, with trials showing potential savings of 20-50% per farmer on acidic soils (Kisinyo et al., 2015)

Beyond the agronomic and environmental benefits, the initiative has generated new livelihood opportunities. Village-based Advisors (VBAs), agrodealers, and youth are increasingly playing roles as pH testing service providers, input distributors, and trainers - embedding innovation within local economies.

Perhaps most importantly, this work underscores the necessity of systemic support for long-term impact. Partnerships with research institutions like KALRO, supply chain actors such as Homa Lime, and public extension systems have laid the groundwork for sustained adoption and institutionalisation of soil health practices.

As input prices rise and environmental pressures mount, now is an opportune moment to shift from chemically intensive practices to more resilient, knowledge-driven farming systems. The FIPS model provides a tested, adaptable blueprint for policymakers, donors, and development actors seeking to promote sustainable agriculture across similar contexts in sub-Saharan Africa and beyond.



*Michael Tesot, a farmer and Village-based Advisor (VBA) Kuresoi North in Nakuru County*

## 10. Glossary of Terms

Term	Definition	Relevance
<b>Acidic Soil</b>	Soil with a pH level below 5.5; commonly found in high-rainfall regions with intensive cultivation.	Acidic soils can fix key nutrients like phosphorus, reducing their availability and hindering crop growth.
<b>Agricultural Lime</b>	A soil amendment (e.g., Calcium Carbonate or Calcium Oxide) used to raise soil pH.	Corrects soil acidity and enhances nutrient availability.
<b>Agrodealer</b>	A business that supplies agricultural inputs such as seeds, fertilisers, and tools.	Critical for ensuring farmers can access necessary soil health inputs.
<b>Bokashi</b>	A rapid, anaerobic composting method producing nutrient-rich organic fertiliser within 14 days.	Enhances soil health and reduces dependency on synthetic fertilisers.
<b>Carbon Sink</b>	A natural or managed system that stores atmospheric carbon.	Healthy soils act as carbon sinks, contributing to climate mitigation.
<b>DAP (Di-Ammonium Phosphate)</b>	A nitrogen-phosphorus fertiliser containing 18% nitrogen and 46% phosphorus.	Widely used but prone to phosphorus fixation in acidic soils.
<b>Ecosystem Services</b>	The benefits provided by ecosystems, including clean air, water, and fertile soils.	Healthy soils are essential for maintaining biodiversity and regulating climate.
<b>Fertiliser Subsidy</b>	Financial support provided to reduce the cost of fertilisers.	When targeted, can promote the adoption of lime and other soil amendments.

<b>Microdosing</b>	The application of small, precise quantities of an input, such as lime, directly into planting holes.	Offers a low-cost, targeted approach to combat soil acidity among smallholders.
<b>Nutrient Fixation</b>	A chemical process whereby nutrients - particularly phosphorus - become bound in the soil and unavailable for plant uptake.	Common in acidic soils; reduces fertiliser efficiency and crop performance.
<b>Organic Matter</b>	Decomposed plant and animal material in the soil.	Improves soil structure, moisture retention, and nutrient cycling.
<b>pH Level</b>	A measure of soil acidity or alkalinity, ranging from 0 (highly acidic) to 14 (highly alkaline), with 7 being neutral.	Soil pH affects microbial activity, nutrient availability, and overall soil fertility.
<b>pH Testing</b>	Measuring soil pH using laboratory methods or handheld meters.	Informs lime application and nutrient management decisions.
<b>Resilience</b>	The capacity to withstand and recover from stressors or shocks.	Soil health enhances the resilience of farming systems to climate and economic changes.
<b>Soil Health</b>	The continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans.	It underpins productivity, influences input efficiency, and supports ecosystem services such as carbon sequestration.
<b>Value Chain</b>	The sequence of activities involved in bringing a product from input to market.	Agricultural value chains influence input access, production efficiency, and income.
<b>Village-based Advisor (VBA)</b>	A trained local farmer who provides agricultural support and services to peers.	Facilitates knowledge dissemination and adoption of new practices.

# 11. Appendices

## Appendix A: Intervention Highlights

- **Microdosing Lime:** Applied at 5g per planting hole. Increased maize yields from 1,606 kg/acre (control) to 1,739 kg/acre (CaCO<sub>3</sub>).
- **pH Testing:** 87,976 tests conducted since 2019; 445 handheld meters distributed.
- **Bokashi Compost:**
  - 2,428 tonnes produced by 8,993 farmers.
  - Used on 2,248 acres.
  - KSh 6.7 million in estimated fertiliser cost savings.
- **WonderGro Trials:**
  - Yield increase in potatoes up to 16 tonnes/acre.
  - ROI of up to 160 x per acre.
  - Effective against nematodes in tomatoes and coffee.

## Appendix B: List of Counties Covered

- Bungoma
- Busia
- Homa Bay
- Kakamega
- Siaya

## Appendix C: Partner Institutions

- AgRevive Africa Ltd
- Homa Lime Company Ltd
- Kenya Agricultural and Livestock Research Organization (KALRO)
- Kenya Crops and Dairy Market Systems
- Manor House Agricultural Centre
- McKnight Foundation
- Seeds of Change
- The Conservation, Food & Health Foundation (linked to Manor House Agricultural Centre)

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