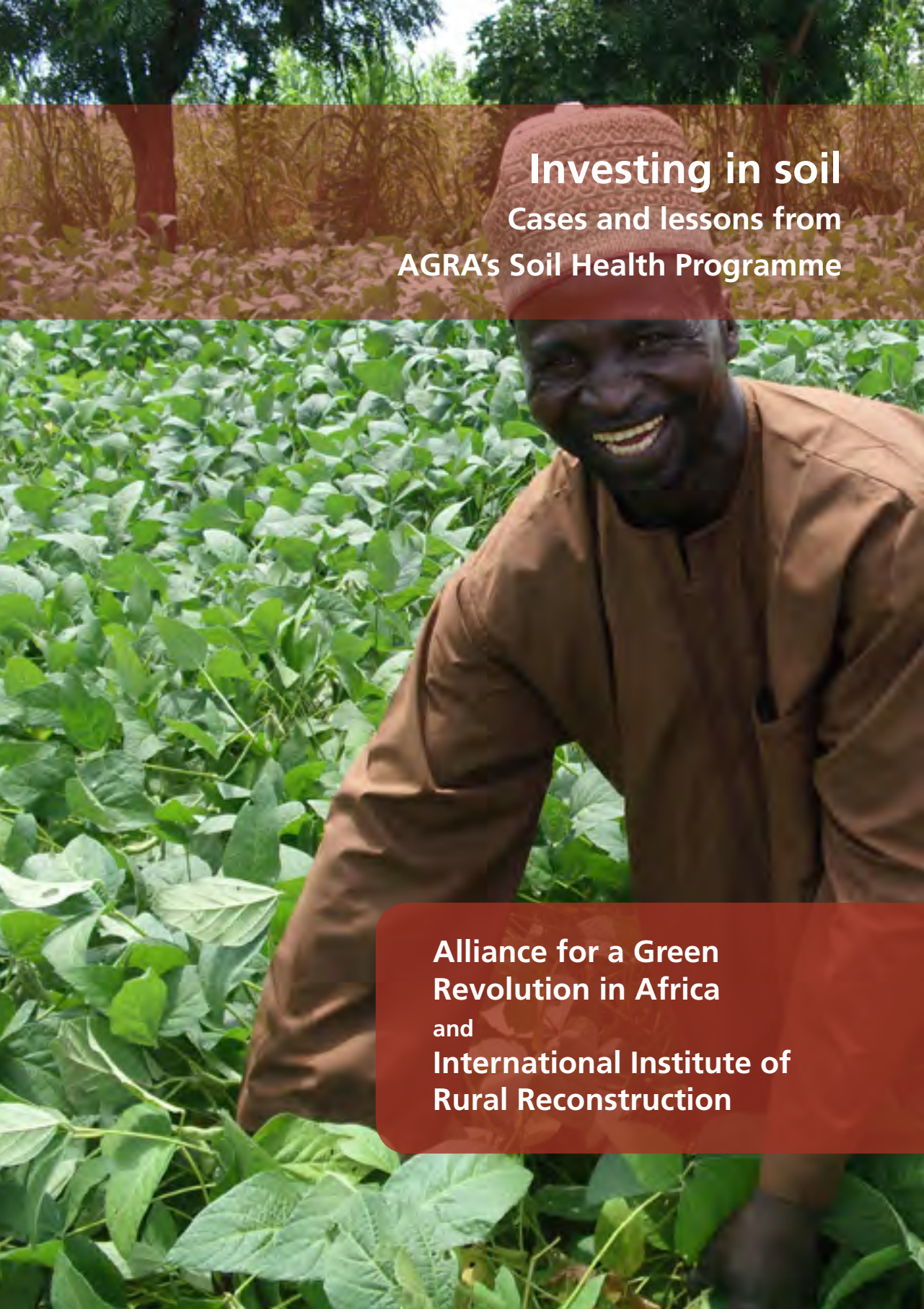

Investing in soil

Cases and lessons from AGRA's Soil Health Programme

Alliance for a Green Revolution in Africa

and

International Institute of Rural Reconstruction

Investing in soil

Cases and lessons from AGRA's Soil Health Programme

AGRA
Growing Africa's Agriculture

IIRR

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A farmer inspecting his soybean crop in Nigeria

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Investing in soil

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Foreword

Soil is one of the most overlooked ingredients in farming and yet it exists right beneath farmers' feet. Healthy, fertile soils are an imperative starting point for agro-based development. But Africa's soils are among the most degraded in the world. And this degradation continues as a result of deforestation, overgrazing of grasslands, continuous deep ploughing and inappropriate use that leads to the "mining" and depletion of soil nutrients.

Yet agriculture does not have to degrade soils. Good agriculture can, and should, restore nutrients, conserve water and prevent soil erosion.

In this book, AGRA demonstrates its commitment to improving soil health by managing the nexus between soil and agriculture, creating solutions and moving beyond demonstrations to showcase success stories that can be scaled up. This book will deepen the debate on alleviating hunger and poverty across Africa. The focus is on the ground below our feet – which, after all, is the most important ingredient in agriculture.

The book draws lessons from the investments made by AGRA's Soil Health Programme. These investments have focused on scaling out of integrated soil fertility management practices by taking a value chain approach. They have facilitated farmers' access to knowledge, financing for inputs (fertilizer, improved seed, etc.) and access to output markets. This approach, termed "going beyond demonstrations", is a distinct departure from the road well-trodden by many research and development programmes, and has yielded innovative solutions that bring public and private institutions in different areas and value chains as service providers. By going "beyond demonstrations", AGRA has championed the uptake of integrated soil fertility management by thousands of farmers in many countries. The last chapter offers a critical analysis of the approach with respect to partnerships, equity and targeting, sustainability, replicability, and impact and value for money.

Investing in soil is an example of how a programme that is informed by research has benefited the livelihoods of millions of poor and disadvantaged farmers, including women and young people. It has done this in part through training and capacity building of farmers and agro-service providers, and by engaging non-traditional private-sector players and policymakers. A unique feature of the book is its presentation of practical, real-life examples of how science can be integrated into the realm of local community lifestyles, and can change lives. African farmers lack resilience: to bounce back from disasters and shocks that are worsened by climate change, they need more "open doors" to knowledge, technologies and market incentives. This is a challenge that calls for evidence-based policy development. The case studies in this book provide good insights towards this goal.

Soils are a finite, non-renewable natural resource. Increased awareness of its life-supporting functions is called for to enable the levels of food production necessary to meet the demands of an African population that is predicted to be one billion by 2050.

The publication of the case studies presented in this book is timely as the world enters 2015, the United Nations' International Year of Soils. ***Investing in soil*** brings a credible voice and face to Africa's experiences and solutions towards healthy soils for a healthy life.

I would like to commend AGRA and its partners, including the farmers, researchers, the private sector, NGOs and participating governments who enabled the Soil Health Programme to generate this unique piece of knowledge. All this is of course a true demonstration of the visionary leadership and philanthropy of many development partners, particularly the Bill and Melinda Gates Foundation: a life-changing gift to many worldwide.

With fertile soils Africa can feed the world.

Lindiwe Majele Sibanda

Chief Executive Officer and Head of Mission

Food Agriculture and Natural Resources Policy Network (FANRPAN)

Preface

Improving soil fertility is fundamental to enhancing the productivity of smallholder agriculture in Africa. It is the starting point. Without it, investments in other yield-enhancing technologies are not likely to bear much fruit. Technically, there is agreement among the experts in soils and agronomy that the best approach is one that integrates organic and inorganic sources of nutrients – so-called integrated soil fertility management. The challenge, though, has been how to get farmers to adopt it on a wide scale. And it is this daunting task that AGRA's Soil Health Programme undertook in 2008, thanks to generous funding from two foundations: Bill and Melinda Gates, and Rockefeller.

To do this, we had to conduct business differently. And that was "going beyond demonstrations". What this meant was that while it was important to create awareness of the technologies through demonstrations on farms and roadsides, we had to do more. We had to find innovative solutions to the systemic challenges that are in the way of smallholder farmers adopting soil health technologies. And that is access to financing to buy the inputs (both improved seed and fertilizer, more so for the latter), access to remunerative markets, and access to good extension and advisory services. These are not interventions that soils projects typically do.

And so the discovery journey of "going beyond demonstrations" forced us to take unfamiliar paths for soil scientists and agronomists. We had to forge partnerships: we had to find out what private-sector buyers wanted; we had to understand the terms and conditions that financial institutions use when lending to smallholder famers. We had to learn new skills to facilitate and broker business deals between farmers (and their associations) and the private sector.

The results have been rewarding. This is what most of the 24 case studies assembled in this book highlight; and they are only a small fraction of the over 120-plus projects the programme has supported in 5 years across 13 countries in sub-Saharan Africa. Our grantees and partners in these countries were the source of the innovations. They demonstrated the benefits of integrated soil fertility management to the farmers in enhancing yields of staple food crops. But they went beyond that, and linked farmers to remunerative markets through value chains. Key to this was strengthening farmers' organizations, and enhancing their governance and ability to take, invest and repay loans.

"Going beyond demonstrations" requires continuous efforts to improve soil fertility, and to understand the environmental benefits of these technologies. This includes their potential to enhance the resilience of the production system to climate change and variability within and across seasons. This requires strengthening national capacity for research and innovation. This was done through an investment to train 170 soil scientists and agronomists in 11 universities across 10 countries. The outcome has been rewarding, as the case studies on the training component highlight. Half of those trained have been women.

This book documents lessons generated by AGRA and its grantees in implementing innovative projects over the last 5 years. It offers a windfall of lessons for development agencies, governments, policymakers, researchers and other specialists working to improve African agriculture. The lessons drawn from these 24 case studies show incontrovertible evidence of impact at various levels, most

importantly for individual households, from the rolling hills of Rwanda to the central highlands of Kenya, and from the semi-arid steppes of Burkina Faso to the southern highlands of Tanzania. The farmers profiled by our grantees are living testimony to the rising incomes and productivity of the farmers touched by a yield-enhancing suite of technologies and practices. This book will be a valuable resource material to various intermediary organizations and institutions that aim to scale up integrated soil fertility management technologies in Africa through a value chain approach. The case studies provide rich insights on the "how". They also serve as a call to action.

This work would not have been possible without our partners and grantees in each country. They were the source of innovations and inspirations, and take credit for it. Kudos also to the staff of the Soil Health Programme, who took the risks in their investments in new and unfamiliar grounds, and provided lots of technical support to the partners in the countries. Great thanks too to the many other institutions (both public and private) that partnered with us in this journey. The great input from AGRA's other programmes (seeds, markets, policy, farmers' organizations, monitoring and evaluation, programme support) cannot go unmentioned. We are also very grateful to our donors for the funding and trust to invest and break new ground. The outcome of the investments will certainly be a game changer in approaches used to scale up smallholder-oriented soil fertility management programmes. Finally, we are grateful to IIRR for their professional work, through a writeshop and field visits, to pull together the story reflected in this in book.

I would like to express my gratitude to the many people who saw the Soil Health Programme through with this book; to all those who provided support, talked things over, read, wrote, offered comments, allowed us to benchmark their work and assisted in the editing, proofreading and design. My special gratitude to Rebbie Harawa, senior programme officer at the Soil Health Programme, who midwifed the development and delivery of this book.

Together, we did it.

Bashir Jama

Director, Soil Health Programme, AGRA

Acknowledgements

THE JOURNEY began in July 2013 when AGRA approached IIRR to help document the progress, successes and challenges in its Soil Health Programme projects in 13 countries in sub-Saharan Africa. Since then, many people have worked tirelessly to produce this book.

We sincerely thank the 17 project managers and coordinators who came to Elementaita, Kenya, to write, critique and revise the manuscripts. We are also greatly indebted to the many farmers, organization staff and researchers whose knowledge and experiences are reflected in this book.

This would be a very different book if it was not for the commitment and openness of the project managers, AGRA staff and their leadership. Thank you all for challenging each other every step of the way. We sincerely thank Isaac Bekalo of IIRR for facilitating the writeshop, and Paul Mundy, our chief editor and designer, who was instrumental in this process. We are greatly indebted to Rebbie Harawa and Marie Rarieya, both of AGRA, whose leadership, critique and guidance helped chart the way. Special thanks to Abednego Kiwia and Noordin Qureish, who provided the much-needed link and network with the AGRA grantees and case holders during the field visits.

We thank the staff of IIRR's Africa Regional Office, who provided an excellent facilitation of the writeshop. Special thanks to Caroline Chirimi, for her efficient secretarial support during the writeshop.

Finally, we would like to acknowledge the Bill and Melinda Gates Foundation and Rockefeller Foundation for their support to AGRA in general, and the Soil Health Programme in particular.

AGRA and IIRR

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1 Introduction

Previous page:

Demonstration with input dealers and farmers in Burkina Faso

You are in a maize field, somewhere in Africa. It is the end of the rainy season, and the crop should be full-grown by now. Instead, it is only shoulder-high and patchy: parts of the field are almost bare. Some plants are tall; others are short and spindly. The leaves are yellow – a sign of nitrogen deficiency – and many show the tell-tale signs of disease. Pink flowers spring up here and there in the field. They look pretty, but you know they are *Striga*, a parasitic weed that thrives in infertile soils. You scoop up a handful of earth. It is dry and sandy. A crust on the soil surface show that the last rain was heavy: the raindrops hit the ground hard. You can see how the water washed away quite a lot of soil: there is a layer of silt at the bottom of the slope.

You look at the small cobs and ask the farmer how much grain she expects to harvest this year. "Four or five bags", she says. That's not enough to support a family, let alone have a surplus to sell. Small wonder that her husband has gone off to town in search of work, leaving her to look after the children and harvest what she can from the plot.

* * *

The same field, a few years later. The tops of the maize plants are well above your head. The cobs are swelling with new grain. The soil is still sandy, but it's darker and moister: signs that it contains more organic matter. And it is covered with a layer of mulch that stopped the rainwater in the last storm from hitting the ground directly. No more silt at the bottom of the slope: all the rainwater sank straight into the soil.

Through the dense, dark-green foliage, you can see the neighbouring plot of beans. The farmer says she grew soybean on this field last year; it enriched the soil, and she expects at least 20 bags of maize from this year's harvest. From the money they earned from last year's crop, she and her husband have invested in a small business. This year they want to renovate their house, she says.

* * *

Africa's soils are among the most degraded in the world. Many are inherently low in fertility, so crop yields are low. Farmers cannot afford the improved seeds and fertilizer they need to raise their productivity. Desperate to grow enough to feed their families, they plant the same crop – maize or sorghum – year after year, further impoverishing the soil. Yields fall further, completing a vicious circle of low soil fertility, low yields, low income and low investment.

A further set of constraints makes these problems even more intractable:

- **Input supplies** Farmers in many areas cannot buy the improved seeds and fertilizers they need. There are few input dealers, they do not stock the right products, and they know little about what they sell, so cannot give good advice to farmers.
- **Credit** Farmers cannot get affordable loans to buy inputs at the beginning of the season. There are few banks or microfinance institutions, and private moneylenders charge sky-high interest rates.
- **Markets** Even if they do grow a surplus for sale, farmers find that market prices for grain are low. They thus have little incentive to grow more.
- **Extension** Farmers cannot get advice on how to manage their soils or on the types and amounts of organic and inorganic fertilizers they should apply.

AGRA's Soil Health Programme

The Alliance for a Green Revolution in Africa (AGRA, Box 1) was established in 2006 with a mission to trigger a uniquely African Green Revolution that transforms agriculture into a highly productive, efficient, competitive and sustainable system to assure food security and lift millions out of poverty. AGRA aims to attain three main goals by 2020:

- Reduce food insecurity by 50% in at least 20 countries.
- Double the income of 20 million smallholder farmers.
- Put at least 15 nations on track to attain and sustain a Green Revolution.

AGRA aims to do this by helping small-scale farmers, who produce most of the continent's food, become more productive and profitable. Low soil fertility and soils exhausted by continuous cultivation of the same crops are a big reason that yields are low. So improving the health and fertility of Africa's soils is vital to combat rural poverty and increase food production and farmers' incomes.

The Soil Health Programme is one of AGRA's core programmes. Launched in 2008, this programme's mission is to increase income, improve food security and reduce household poverty among African smallholder farmers. It aims to:

- Create physical and financial access to appropriate **soil nutrients and fertilizers** for about 4.1 m smallholder farmers by 2014, in an efficient, equitable and sustainable manner.
- Improve these farmers' access to locally appropriate **knowledge, agronomic practices and technology** packages on integrated soil fertility management.
- Influence a **national policy environment** for investment in fertilizer and integrated soil fertility management.

Figure 1 AGRA's Soil Health Programme serves 13 countries

Box 1 AGRA: Alliance for a Green Revolution in Africa

- **Founded** in 2006.
- **Funded** by the **Bill & Melinda Gates Foundation** and the **Rockefeller Foundation.**

Overall goal

- To increase food security and reduce poverty through rapid and sustainable agricultural growth for smallholder farmers in Africa.

Core programmes

- Seed systems
- Soil health
- Market access
- Agricultural policies
- Agricultural financing

Integrated soil fertility management is central to the programme's activities. It includes a range of agricultural practices that aim to improve the use of nutrients and water and to boost crop yields. These practices include:

- The combined use of mineral fertilizers, soil amendments (such as lime and rock phosphate) and organic matter (crop residues, compost and green manure).
- Agroforestry (the combination of crops and trees).
- Crop rotation and intercropping with legumes.
- Conservation agriculture (no-till farming that uses a combination of mulch, direct planting and crop rotation to maintain fertility, prevent erosion and suppress weeds).

The Soil Health Programme's theory of change

To increase their soil productivity and achieve sustainable yield increases, smallholder farmers need to adopt and use integrated soil fertility management practices in an economically viable way. The Soil Health Programme aims to remove constraints that prevent farmers from doing this. That means addressing inefficiencies in the value chain. It does this in various ways:

- Ensuring that farmers have physical access to the **inputs and services** (such as finance) they need.
- Providing them with the right **knowledge** and skills, in the right way.
- Making sure they have the **incentives** to invest in new seed, fertilizer, land and labour (Figure 2).

Access to inputs and services

Farmers who want to use integrated soil fertility management can find some of the **inputs** they need on their own farms. They can store and spread manure, apply mulch, make compost, and plant tree seedlings. But they also need to be able to buy seed of improved crop varieties, fertilizer, equipment and other inputs. That requires a chain of input suppliers: wholesalers in the bigger towns, and retailers in the smaller towns and villages. Products such as fertilizers must be the right type and sold in the right amounts: a farmer who walks 20 km to fetch some fertilizer probably cannot afford a 50-kg sack, and cannot carry it home anyway.

Farmers need appropriate **financial services**: affordable loans to buy inputs at the beginning of the season, a safe place to save their money, and a way to store their crop after the harvest

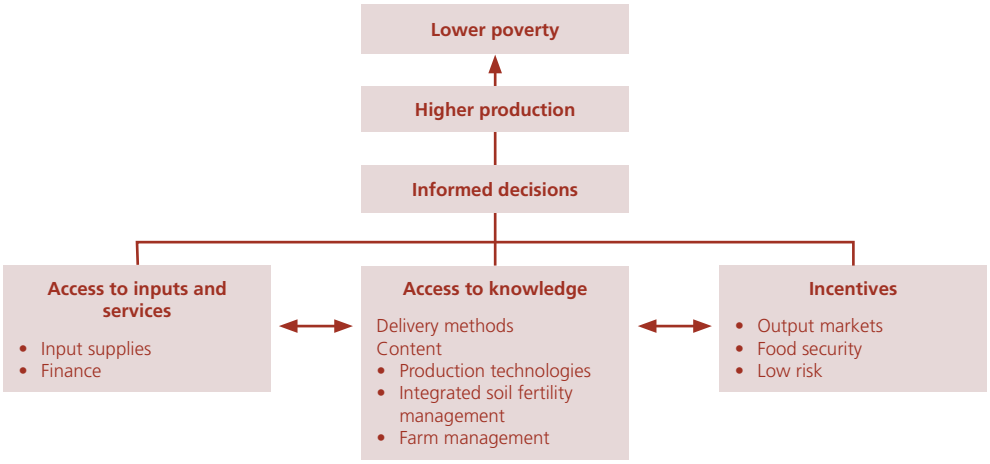


Figure 2 The Soil Health Programme's theory of change

so they can sell it when the price is right. But such services are few and far between in much of Africa, and many financial institutions regard lending to smallholders as too risky. Farmers are more likely to be able to obtain a loan if they get into groups: a bank that balks at lending to an individual may consider lending to a well-organized group. Groups can also run their own savings-and-credit schemes.

Access to knowledge

Farmers will also need the right set of **knowledge and skills** if they are to boost their output. The "right set" will vary from place to place: one soil may require lime, while another may be deficient in phosphorus. It will also depend on the household: a better-off farmer may want information on cash crops, while a poorer farmer may be more interested in food crops. Women may want to learn different things from men. And the information will change over time: as farmers learn and earn more, their interests will change. So the range of information must be adapted to suit the current local conditions. Each farmer and each community will need to make their own decisions about what is right for them.

Technical topics include the use of inputs (seeds, fertilizer, crop protection products); appropriate crop management techniques, practices to manage the soil, water and land, information on farming systems, and postharvest practices. Farmers also need skills such as how to organize and run groups, how to add value to their crop, and how to manage a business and deal with marketing.

Other stakeholders (input suppliers, processors, traders and service providers) also need specific types of information. Take input suppliers: they need to know the technical aspects of the products they sell so they can advise farmers what to buy and how to use it. They also need to learn how to run their businesses more efficiently, whether to offer credit (and how to make sure they get repaid), and where to get cheap supplies.

The **information delivery methods** are also important. They include efforts to raise the awareness of many people about a subject (radio is good for this), or help smaller groups learn

more complex information (as in farmer field schools). A whole range of possibilities lie in between: extension advice, training courses, farmer visits, demonstrations, posters, printed materials, among others. Some methods are "proactive" (the development organization delivers the information to the farmers); others are "reactive" (the information source responds to farmers' queries – as through a mobile phone hotline or question-and-answer session). To meet the needs of farmers and other stakeholders, a combination of methods is needed.

Incentives

The right inputs, the money to buy them, and the skills to apply them: they are still not enough to persuade farmers to adopt the new techniques. Farmers must also be able to see clear benefits from going to the expense and trouble of investing in their soil. One incentive is higher yields, of course – which translate into more food to eat and more money to spend, e.g., on their children's schooling. Another is the relatively low cost and risk of using the new techniques. A third is the availability of a reliable market: one that offers attractive prices and a reasonable profit. Farmers' organizations can enable their members to produce and deliver the quantities and quality that buyers demand.

Many other factors can prevent farmers from adopting integrated soil fertility management. Investing in soil fertility is typically a medium- to long-term venture: the expenses must be made up front, but the gains may be visible only after a year or more. That may be a problem especially if land tenure is an issue: farmers who rent land (or who have insecure tenure) may be reluctant to invest in their soil if they are not confident they will be able to enjoy the benefits in coming seasons. Paradoxically, though, it may also work the other way round: a famer who sees the benefits of soil fertility management may be able to rent extra land to expand production quickly in the next season.

Interventions

Many pieces of the puzzle have to be brought together at the same time if large numbers of farmers are to start using integrated soil fertility management. AGRA's Soil Health Programme is attempting to do just this. It has three sub-programmes:

- Integrated soil fertility management scale-out
- Fertilizer supply and policy
- Education and training.

Integrated soil fertility management scale-out

This sub-programme aims to promote integrated soil fertility management practices to 4.1 million farming households. It does this in various ways.

- It supports **adaptive research** to identify technologies that enhance productivity.
- It uses large **demonstration plots** to create awareness among farmers of these technologies.

Because demonstrations alone are unlikely to stimulate farmers to adopt the improved techniques, the AGRA Soil Health Programme developed an initiative known as "**Going beyond**

demonstrations". This addresses several of the other constraints that restrict the supply of inputs and the marketing of outputs:

- It facilitates **out-grower** contractual arrangements with commercial farms that help farmers to access input and output markets.
- It arranges schemes through which buyers or input dealers provide farmers with production **inputs on credit**.
- It helps set up **input support funds**, managed by farmers' associations or microfinance institutions, to provide production inputs.
- It offers **credit guarantees** through banks.
- It promotes the use of modern **communication techniques**, especially mobile phones, radio, video and community information centres to support extension advisory services.
- It promotes the use of **community extension workers**, especially young people and women, to provide advisory and extension services to fellow community members.
- It networks soil scientists, agronomists and the private sector through **soil health consortia** in each country and across Africa.

"Going beyond demonstrations" is implemented in close collaboration with AGRA's other programmes: market access, seed systems and policy. It incorporates other important elements, such as finance, gender and farmers' organizations.

Fertilizer supply and policy

Fertilizers in Africa are scarce and, at $800–1000 per ton, expensive. This sub-programme aims to increase both the supply of quality fertilizer to farmers, and the demand for fertilizer.

- It supports local companies that quarry rock phosphate and produce **blended fertilizers**. It facilitates access to credit for fertilizer importers and producers. It aims to support the delivery of an additional 187,000 tons of fertilizers across the 13 countries served by AGRA, and to reduce the farm-gate price of fertilizers by 15%.
- It helps countries develop and implement fertilizer **quality-control systems**.
- It aims to train 6,500 **input dealers**, and help them set up and improve their businesses. That should reduce the distance that farmers have to travel in order to buy inputs. It also helps the dealers organize regional and national associations to improve fertilizer supplies.
- It creates **awareness** about the benefits of fertilizers among farmers.

Education and training

Soil science has been woefully neglected at universities and training institutes throughout Africa. Curricula are out of date, facilities are deteriorating, professors are ageing, and few new professionals are being trained in the field. Students cannot get support to study soil science, and they cannot see attractive career prospects. A lack of trained specialists is eroding Africa's long-term prospects for solving its soil fertility problem.

This sub-programme aims to reverse this decline by building the capacity of universities and training institutions in soil science.

- It helps these institutions revise their soil science **curricula**.

- It assists them to upgrade their laboratory and other research and teaching **facilities**.
- It supports the in-service training of 200 **laboratory technicians** who work at universities and research institutes.
- It sponsors 130 MSc and 40 PhD students to pursue their **graduate degrees** at selected African universities.
- It mentors and provides incentives for **women students** to enrol and grow in the profession.

How the Soil Health Programme works

The Soil Health Programme works with partners in each of the 13 countries it serves. The process of designing and selecting initiatives is a competitive one. It works like this.

1. AGRA invites interested organizations to submit a brief concept note describing what they hope to do.
2. It reviews these ideas, selects the most promising ones, and invites the organizations to submit more detailed proposals.
3. It reviews the proposals and approves the best ones for grant funding.
4. It provides technical backstopping and mentoring to the grantees throughout the project life.
5. It works with the grantees to document and share lessons.

Since 2008, the Soil Health Programme has approved 126 grants to national and international NGOs, universities, research institutes, government agencies and farmers' organizations. This book draws lessons from 24 of these projects, shown in Table 1 and Figure 4.

Once AGRA decides to support an initiative, it maintains close links with the grantee, providing technical advice and support where needed. It aims for a true, long-term partnership rather than a typical donor–recipient relationship. This is advantageous for both AGRA and the grantee: AGRA gains a reliable implementing partner, while the grantee gains a supportive long-term donor.

About this book

In July 2013, AGRA contracted the International Institute of Rural Reconstruction (IIRR) to document the experiences of its Soil Health Programme. The documentation aimed to cover 30 projects in the 13 countries served by the programme. It resulted in the following publications:

- Case descriptions of selected projects reflecting the programme's various interventions, along with lessons from three thematic areas: going beyond demonstrations, fertilizer supply and policy, and training and education (this book).
- Three policy briefs, one for each thematic area.

These materials were prepared through a three-step process (Figure 3).

Preparing drafts

IIRR invited the 30 selected AGRA grantees to submit a draft manuscript about their project, following guidelines it had prepared. For those grantees who responded, IIRR staff members visited the projects, interviewed farmers, project managers and staff, and helped some of the grantees to write an initial draft of their case. Each case typically consisted of one or more human-interest

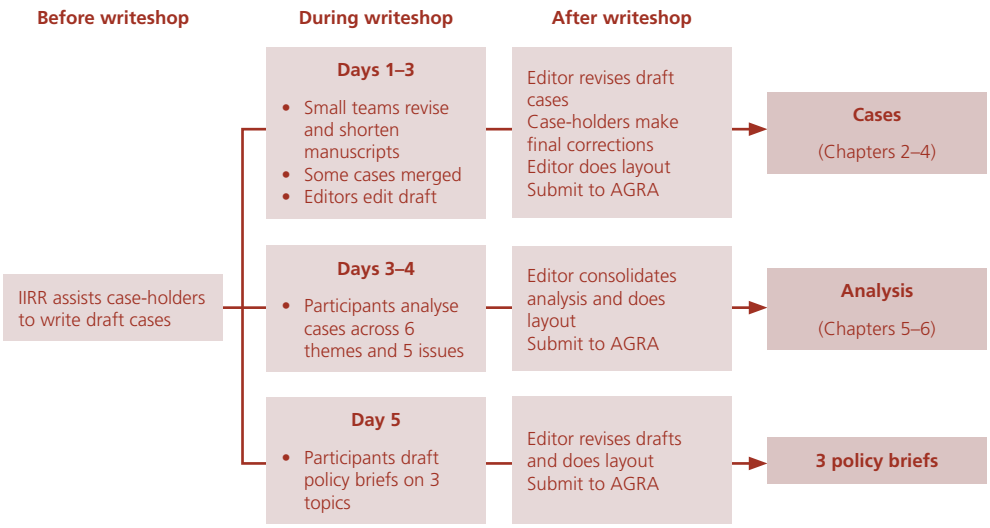


Figure 3 How this book was prepared

stories about a farmer who had adopted the improved soil management techniques, along with a description of the project and some supporting data.

Writeshop

The project managers (the "case-holders") were invited to a 5-day writeshop at the Lake Elementaita Country Club, near Nakuru, Kenya, from 28 April to 2 May 2014. The 30 participants included 17 case-holders, along with facilitators, editors, resource persons from AGRA and IIRR, and logistics staff.

Days 1–3: Writing cases The first 2½ days were dedicated to discussing and revising the cases. To fit all the cases into the limited number of pages in this book, it was necessary to do two things: shorten each draft case to a maximum of 1,200 words (some drafts were as long as 6,500 words), and merge the cases of similar projects. Teams of participants, each consisting of one or more case-holders and an editor or resource person, took on this task, following guidelines provided by IIRR. An AGRA statistician provided additional data to illustrate each case. For those cases where no case-holder was present at the writeshop, one of the AGRA team took responsibility for rewriting the text. In this way, the 24 cases originally submitted were consolidated into the 17 descriptions in this book. When they had completed their drafts, the participants handed them to an editor, who reworked them into a near-final form.

Days 3–4: Analysis After the bulk of the work on the cases had been completed, the participants switched to analysis mode. The participants were divided into three groups, with each group tackling two themes, making six themes in all: extension approaches, access to inputs, access to finance, output markets, policy and institutions, and education and training.

Groups of participants also analysed the cases in terms of five cross-cutting issues: partnerships, replicability, sustainability, equity and targeting, and impact and value for money.

Each small group summarized their discussions on these topics in a document.

Day 5: Policy briefs The final day was dedicated to developing policy briefs on three topics: fertilizer supply, going beyond demonstrations, and education and training. Teams of participants brainstormed ideas relevant for policymakers, then drafted text reflecting these ideas.

After the writeshop

The chief editor took all these draft materials and reworked them into their current form. The draft cases were submitted to the case-holders for final corrections. The other materials were sent to AGRA for review and approval.

How the book is organized

This book presents 17 cases drawing on 24 projects supported by the Soil Health Programme (Table 1). The cases are grouped into three categories:

- **Beyond demonstrations** contains 10 cases summarizing 14 projects under the integrated soil fertility management scale-out sub-programme.
- **Input supplies** presents three cases summarizing four projects under the fertilizer supply and policy sub-programme.
- **Training and education** presents four cases reflecting six projects in the training and education sub-programme.

These categories are chosen for convenience only. There is a large degree of overlap and considerable mutual support among the various sub-programmes in the Soil Health Programme, and indeed with other AGRA programmes. A single project may include elements of all three categories. Because of space limitations it has been necessary to choose only certain aspects of each project. The descriptions here should not be taken as a complete summary of all activities in the 24 projects.

Table 1 AGRA Soil Health projects referred to in this book

Code	Case title	Project name	Principal grantee organization	Contributor
Beyond demonstrations				
01	Soybean is sweeter than sugar in **Kenya**	Enhancing smallholder incomes, food security and nutrition in western Kenya	**Rural Outreach** Africa ropafrica.org	Ruth Oniang'o
02	Increasing agricultural production through lime application in **Rwanda**	Improving crop yields through wide scale promotion of lime and other integrated soil fertility management technologies in the acidic soils of Rwanda	Rwanda Agriculture Board, Institut des Sciences Agronomiques du Rwanda, **ISAR** www.rab.gov.rw	Vicky Ruganzu* (Abdi Zeila, Qureish Noordin)
03	The gold that grows: Promoting soybean in **Uganda** and **Zambia**	Improving smallholder productivity and controlling striga (*Striga hermonthica*) in eastern Uganda through scaling up integrated soil fertility management interventions	**Africa 2000** Network www.a2n.org.ug	Christopher Kyeswa
04		Improving soils and human nutrition using soybean in western Uganda	**Millennium Villages** Project millenniumvillages.org	Johnson Nkuuhe
05		Increasing food legume crop production for improvement of soil fertility, food security, nutrition and income by smallholder farmers in Zambia	Zambia Agriculture Research Institute, **ZARI** www.zari.gov.zm	Laston Milambo
06	Small dose, big results in **Burkina Faso** and **Mali**	Achieving pro-poor green revolution in drylands of Africa: Linking fertilizer micro dosing with input-output markets to boost smallholder farmers' livelihoods	Institut de l'Environnement et de Recherches Agricoles, Burkina Faso, **INERA** www.cnrst.bf, www.inera.bf	Sibiri Jean-Baptiste Taonda* (Marie Rarieya)
07			Institute of Rural Economy, Mali, **IER** www.ier.gouv.ml	Diakalia Sogodogo* (Marie Rarieya)
08	An "anchor farm" in **Malawi**	Improving the productivity of maize and soya beans through integrated soil fertility management and better access to markets	Clinton Development Initiative, **CDI** www.clintonfoundation.org	Austin Ngwira* (Rebbie Harawa)

Code	Case title	Project name	Principal grantee organization	Contributor
09	Producing more with less in northern **Nigeria**	Improving productivity of smallholder millet and sorghum based production systems in the semi-arid region of northern Nigeria through increased use of integrated soil fertility management options and better access to markets	Kano State Agricultural and Rural Development Authority, **KNARDA** www.moanr.kano.gov.ng	Abdullahi Isyaku Raba
10	Introducing soybean rotation in northern **Ghana**	Increasing maize-legume cropping system productivity through scaling out of integrated soil fertility	Savanna Agriculture Research Institute, **SARI** csirsavannah.blogspot.de	Mathias Fosu* (Rebbie Harawa)
11	Phosphate fertilizer for maize and rice in Tanzania	Scaling up Minjingu phosphate utilization in balanced fertilization programme of crops in Tanzania	Sokoine University of Agriculture, **SUA** www.suanet.ac.tz	Johnson MR Semoka* (Rebbie Harawa)
12	Climbing up with climbing beans in **Rwanda** and **Kenya**	Increasing soil fertility benefits of climbing beans and associated agroforestry interventions under smallholder production systems in the Northern and Eastern regions of Rwanda	Rwanda Agricultural Board, **RAB** www.rab.gov.rw	Ngoga Tenge Gislain
13		Enhancing productivity and market development of soybeans and climbing beans in the central highlands of Kenya	**Kenyatta University** www.ku.ac.ke	Jayne Mugwe
14	Promoting fertilizer and pigeonpea in the Beira Corridor of **Mozambique**	Improving smallholder productivity and livelihoods of small-scale farmers in the Beira Corridor of Mozambique through increased fertilizer use and integration of grain legumes	Mozambique Institute of Agricultural Research, **IIAM** www.iiam.gov.mz	Magalhaes Miguel

Code	Case title	Project name	Principal grantee organization	Contributor
Input supplies				
15	Professionalizing input businesses in **Burkina Faso**	Professionalization of agro-input dealers in Burkina Faso	Association des Grossistes et Détaillants d'Intrants Agricoles du Burkina Faso, **AGRODIA**/International Fertilizer Development Center www.agrodia.org	Dominique Bassole* Saidou Kabre
16	Training agricultural input dealers in **Rwanda**	Rwanda agro-dealer development project	International Fertilizer Development Center, **IFDC** www.ifdc.org	Jean Bosco Safari
17	Controlling fertilizer quality in Ghana and Tanzania	Ghana fertilizer regulatory capacity building productivity project	Plant Protection and Regulatory Services Directorate, **PPRSD** / International Fertilizer Development Center mofa.gov.gh	Lawrence Kwasi Alato Felicia Ansah-Amprofi*
18		Strengthening institutions and capacity in fertilizer quality control in Tanzania	Ministry of Agriculture, Food Security and Cooperatives, **MOAFSC** www.agriculture.go.tz	Matilda Kalumuna
Education and training				
19	Building capacity in integrated soil fertility management in Kenya, Zambia and Burkina Faso	MSc integrated soil fertility management training programme	**Kenyatta University** www.ku.ac.ke	Maina Mwangi
20		Capacity building through post graduate training in integrated soil fertility management	**University of Zambia** www.unza.zm	Elijah Phiri
21		Masters training programme in soil science	**University of Bobo-Dioulasso**, Rural Development Institute www.univ-bobo.bf	Bernard Bacye*

Code	Case title	Project name	Principal grantee organization	Contributor
22	Graduate training in soil science in Ghana	AGRA PhD training in soil science in West Africa	Kwame Nkrumah University of Science and Technology, **KNUST** www.knust.edu.gh	Robert C. Abaidoo
23	Putting soil fertility back into Ghana's extension system	Improving food security of small holder producers through middle level manpower capacity building in soil health	University for Development Studies, **UDS** www.uds.edu.gh	Francis K Obeng
24	Training farmers as village extension agents in Nigeria	Promoting the wide scale uptake of integrated soil fertility management practices by smallholder farmers in the moist savannah ecologies of Nigeria	**Ahmadu Bello** University www.abu.edu.ng	Ishaku Y Amapu

* Did not attend writeshop

( ) Prepared draft during writeshop

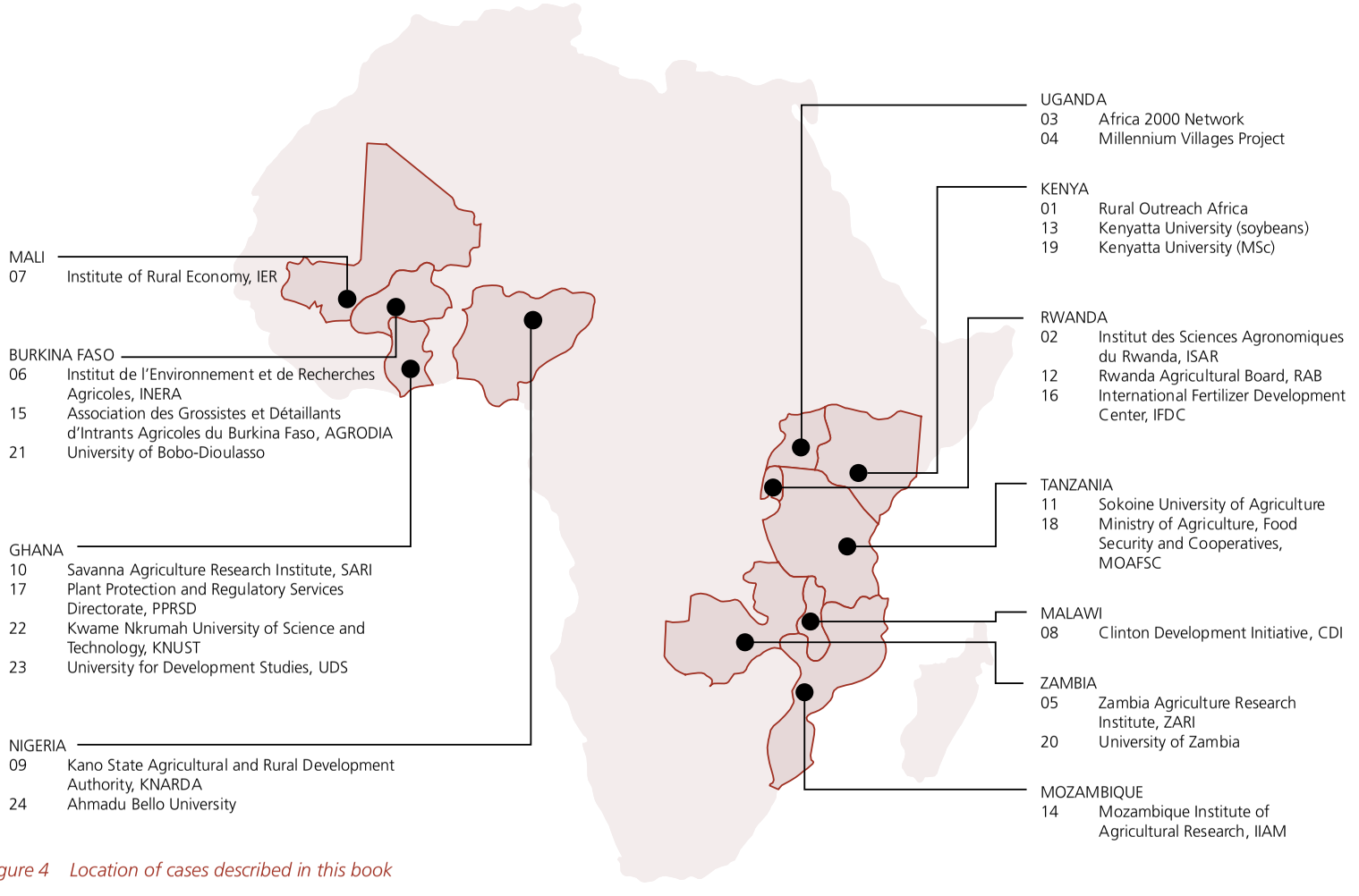


Figure 4 Location of cases described in this book

2 Beyond demonstrations

Previous page:

Training farmer trainers in a "classroom" session – under a tree in Nigeria.

SOYBEAN IS SWEETER THAN SUGAR IN KENYA

EDNA OMWAKO uprooted all the sugarcane on her 0.2 ha of land, and replaced it with soybeans. The 36-year-old mother was tired of trying to support her five children from the cane: the sugar mill paid late, and sometimes she did not make enough to cover her costs. She was confident that she could make more out of soybeans.

But erratic rains in the 2012 growing season meant she harvested only 72 kg of soybeans, bringing in only KSh 3,240. She was disappointed, but not discouraged. She had been attending farmer-to-farmer training sessions organized by Rural Outreach Africa as part of an AGRA-funded project, and she had learned about how soybeans would improve her soil.

The next season, she planted maize on the same land, and was delighted to harvest eight 90-kg bags of maize – four times as much as she had ever got before. They fetched KSh 22,400. Even though the soybean had yielded poorly, it had still improved the nitrogen level in her soil, boosting her maize yield.

"I hope to replace the thatched roof of my house with metal sheets", she beams. "I've spent KSh 5,000 on some metal sheets. I've rented a room for a nursery school, and I want to feed my family better."

Edna now rotates and intercrops soybeans and climbing beans with cereals. She gets better yields, uses less fertilizer and can use the crop residue to make compost.

You cannot eat cane

Edna is just one of the many women farmers in Africa who struggle to feed their families. They include many widows and women whose spouses are away looking for work.

Soils in this part of western Kenya are poor, and yields are low. Edna and her neighbours cannot get technical advice, market information or loans to invest in production. Growing sugarcane brings in money, but people cannot eat cane, so many go hungry for up to 9 months a year.

Edna with the roofing sheets she bought from her maize yield.

Case	01
Project name	Enhancing smallholder incomes, food security and nutrition in western Kenya
Key actors	Rural Outreach Africa Farmers' groups Kenya Agricultural Research Institute Private sector
Target beneficiaries	30,000 farmers
Location	Kakamega and Vihiga counties, western **Kenya**
Years	2011–14
Project budget	$400,000
Contact	Ruth Oniang'o, Rural Outreach Africa, oniango@iconnect.co.ke, ropafrica.org

Poverty levels in the region are high: in 2005/6, 54% of the population in Kakamega county, and 41% in neighbouring Vihiga, were below the poverty line. Farmers in the area are net buyers of maize, their staple food.

Building on 20 years of work

Rural Outreach Africa has been working in this area since 1992. During this time it has helped create 539 farmers' groups and got them registered with the authorities. It built on this network in the AGRA-funded soil health project. It also relied on about 40 young people whom it had already trained in extension practices. They lived in the community and were ready to work with the organization once again. The project also trained 310 farmers as trainers.

The project aimed to improve the low soil fertility by introducing soybeans and training farmers to grow them. A core activity was to set up 155 large demonstration plots in six clusters in Kakamega and Vihiga counties, on land donated by farmers. The project organized field days at these sites so farmers could compare various combinations of crops and fertilizers. Staff also used these plots to train farmers in integrated soil fertility management techniques such as preparing the soil properly, using the right seeds, using rhizobium inoculant, and applying fertilizer.

The project helped the farmers buy inputs in bulk and on time. Apart from soybeans, it targeted various other crops: climbing beans (a new crop in this area), bush beans, maize, improved varieties of bananas, and indigenous vegetables (which Rural Outreach has promoted in the area for more than 20 years).

As a result, the soils have improved, and the farmers have increased their yields of various crops. They have seen their yields of legumes (soybeans, climbing beans and bush beans) rise from 0.65 to 0.95 t/ha, and their maize yields go up from less that 2 to nearly 5 t/ha. They can now earn more, save more, and invest in quality inputs. The groups are more cohesive, and they purchase inputs collectively.

The project introduced the new techniques to 34,678 farmers: more than its target of 30,000. Of these, 11,760 (34%) have fully adopted the recommended technologies (Figure 5). Over 2,400 farmers have adopted the technology even though they are not members of a group organized by Rural Outreach.

Inputs and credit

To ensure that farmers could get the right inputs, the project trained agricultural input dealers on stocking the seed and fertilizers that farmers who practise integrated soil fertility management need. The farmers have started ordering these inputs and paying for them in advance. That is a big change from the previous practice, where they would ask for the inputs on credit. This change is due to a revolving fund set up by the project using KSh 1 million in seed money from AGRA. About 90% of the users of this scheme were women. It has now evolved into an upgraded table-banking facility known as "Umbrella". This was slow to start, but has grown fast in 2014. The revolving fund is held at no charge by First Community Bank in the name of Rural Outreach. Each farmer group manages its own credit and repayments. Over 2,000 farmers have joined such groups, nearly 80% of them women.

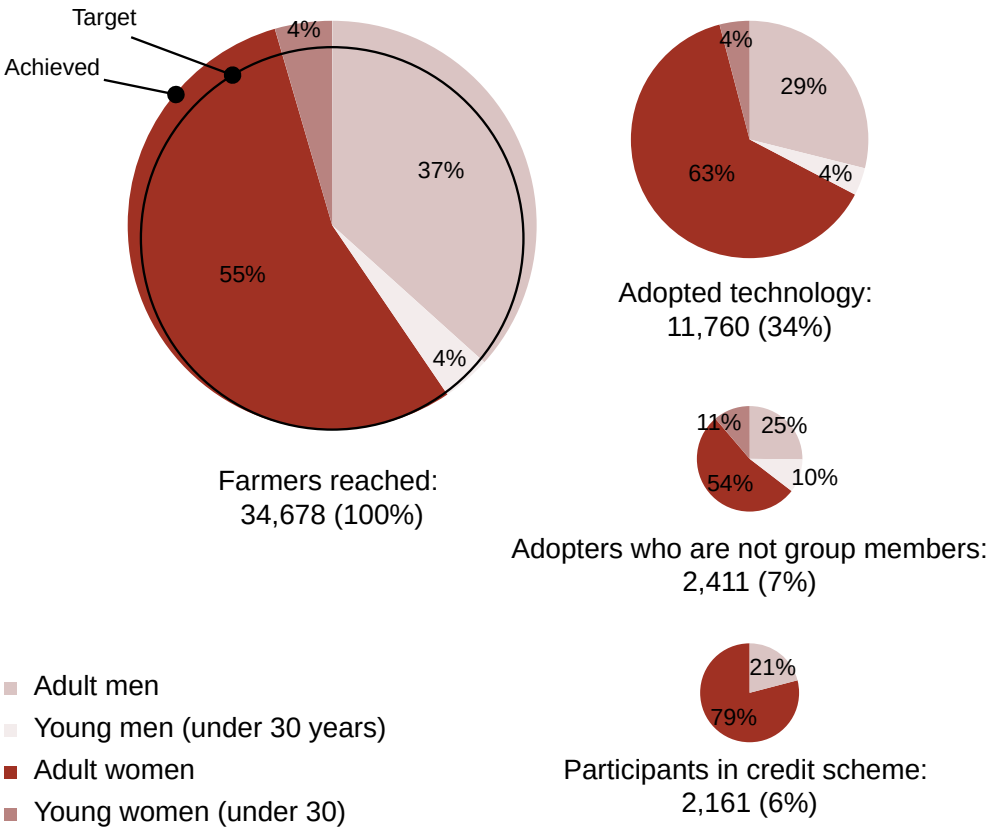


Figure 5 Farmers reached by the project and who have adopted the fertility management technology

We've grown it... now what do we do with it?

Marketing the soybeans grown has proved a problem. The project has tried to link farmers with potential buyers, but many have shown little interest in buying at a price that farmers want. As a stop-gap measure, Rural Outreach has bought three soy processing machines using a KSh 1.2 million (about $13,900) grant from the Kenya Commercial Bank Foundation. Farmers bring their soy to be milled for a fee. The flour is used for food; the by-products go into animal feed. Rural Outreach is encouraging young entrepreneurs to invest in this promising venture. The project has obtained bags for storage and sold them to farmers at an affordable price. These will be introduced to the input dealers to sell once demand picks up.

Soybean is not a traditional crop in the area, and it takes a long time to cook. Rural Outreach arranges demonstrations of soy recipes so people can learn how to cook the beans for their families.

Spreading the word

Soil testing was a popular aspect of the project: farmers were eager to know the results. The soils turned out to be more acidic than is optimal for most crops. The project had to coin a word

for "acidic" in Luhya, the local language. The word chosen, "*obwanya*", describes the taste of a near-ripe banana.

Rural Outreach made sure the project was well known: it informed leaders of all the farmers' groups associated with Rural Outreach, Ministry of Agriculture staff in Vihiga and Kakamega counties, and journalists and other stakeholders. It also arranged for programmes to be broadcast on Luhya-language FM radio stations: Mulembe, West, Vuuka, Ingo and Radio Jambo.

Rural Outreach's partners played an important role in the project: Bukura Agricultural College provided soybean seeds, postharvest management skills and grain storage facilities. The Kenya Agricultural Research Institute offered seed, agronomy expertise and global positioning support. MEA Fertilizer Company supplied Biofix (a rhizobium inoculant) and training on how to use it. Various banks offered assistance with financial literacy. The Ministry of Agriculture advised on relevant policies and related projects. AGRA helped with data management and backstopping support.

Because of Rural Outreach's long involvement and close relationships with local people, it is a valuable partner for other organizations wishing to work in the area. The Ministry of Agriculture, for example, uses Rural Outreach's forums in its own work. It pays farmers associated with Rural Outreach to teach other farmers how to use rhizobium. Based on the success of this project, the ministry is now promoting soybean planting in other areas of western Kenya.

INCREASING AGRICULTURAL PRODUCTION THROUGH LIME APPLICATION IN RWANDA

A WIDOW WITH five children, Xaverine Murebwayire used to struggle to put food on the table. Without land of her own, she toiled in her neighbours' fields to earn a living. Despite her hard work, yields were low. Erosion and low soil fertility are severe problems in her home district of Nyaruguru, a hilly district in Rwanda's Southern province dominated by acidic soils. Discouraged farmers would abandon unproductive land. "We were always blamed by extension workers for neglecting our land to erosion," she says.

But erosion and infertility are not the only problems, Xaverine learned when she started working with an AGRA-sponsored soil health programme run by ISAR, the national agricultural research institute. About one-third of Rwanda's soils are highly acidic – with a pH ranging from 4.5 to 5.5. That is too acidic for most crops to grow well: it can almost halve cereal yields, and makes fertilizer less effective.

The solution is to apply 2–3 tonnes of lime per hectare once every 3 years. This reduces the level of soil acidity, raising the pH to between 5 and 6, which is fine for most crops. It also improves fertilizer uptake and boosts yields. Combine it with measures to control soil erosion, and the results can be dramatic.

The ISAR project helped Xaverine and her neighbours form a group and consolidate their land holdings. Xaverine was elected chair of the 25-member Twisungane Women Group. The project trained them how to improve their yields by applying lime, fertilizer and manure. It encouraged landless farmers, like Xaverine, to "borrow" land that had been abandoned. Xaverine chose 2 acres (0.8 ha) of unproductive land, and sowed 70 kg of seed potatoes loaned by the project.

Xaverine in front of the brick-and-mortar house she built using proceeds from her farm

Case	02
Project name	Improving crop yields through wide scale promotion of lime and other integrated soil fertility management technologies in the acidic soils of Rwanda
Key actors	Rwanda Agriculture Board, Institut des Sciences Agronomiques du Rwanda (ISAR)
Beneficiaries	20,000 smallholder farmers
Location	Nyamagabe, Nyaruguru and Gisagara districts, Southern province, **Rwanda**
Years	2009–12
Project budget	$401,139
Contact person	Vicky Ruganzu, rugavicky@gmail.com, www.rab.gov.rw

At the end of the season, she was delighted to harvest 1 tonne of potatoes. She repaid the loan of seed, saved 400 kg of tubers for her family, and sold the rest. That brought in about $110, which she spent on rebuilding her house. The next season she earned about $90, which went to pay school fees and further house repairs.

Promoting lime

Even though acid soils are common in Rwanda, most farmers and input dealers are not aware of the problem and do not know what to do about it. The AGRA-sponsored project promoted liming and other integrated soil fertility management techniques in Nyaruguru, Nyamagabe and Gisagara districts in southern Rwanda. The project had four key interventions:

Soil testing Should farmers apply lime? Only if their soil is acidic. The project tested and mapped soils on 8,100 ha of farmland, informed the farmers of the results, and helped those with acid soils get some lime. As a result, the farmers bought and applied 2,855 tonnes of lime and 105 kg of rhizobium inoculant.

Teaching farmers about liming The project set up 170 soil-fertility demonstration sites to show farmers the benefits of lime application. It developed training and extension materials for farmers and front-line extension staff, and trained 44 farmers' organizations and 113 extension agents how to apply lime.

Ensuring lime supplies Reliable supplies of lime are needed for the scheme to work. Private companies quarry the lime in the north of Rwanda. Input dealers need capital to buy and transport lime to the south of the country. The project linked the lime producers and dealers with financial institutions, which lent them money to do this. It also trained and supported input dealers in the use of lime.

Adaptive research Students from the National University of Rwanda at Huye did research on soil chemistry and agronomy. That resulted in site-specific recommendations for fertilizer and lime use. A combination of lime with nitrogen fertilizer and farmyard manure generally gives the highest yields.

Lime is not enough

Like Xaverine, 16,000 other farmers have seen their yields of various crops rise as a result of applying lime and fertilizer. The average yield of climbing beans has risen from 1.5 t/ha (without lime) to 3.75 t/ha (with lime, farmyard manure and DAP fertilizer). Soybean yields have gone up from 1.0 to 2.1 t/ha. For cereals such as wheat, the yields have risen from 2.8 t/ha to 4.9 t/ha.

Tests show that just adding lime and fertilizer is not enough. The best combination in most locations and for most crops is lime, fertilizer and farmyard manure.

Lessons

- **Quarry lime locally** Lime is bulky and expensive to transport, but it can be quarried locally. That means more income for farmers on whose land it can be quarried. If no commercial lime is available, kitchen ash can be used instead.
- **Local groups and leaders** Using farmers' groups was an effective way to speed take-up of the liming and fertilization techniques.

- **Soil testing** Soil acidity and fertility differ from place to place, so the recommended liming levels will vary considerably. Soil testing is crucial so farmers can apply the right amounts.
- **Financial needs** It is still necessary to improve business links between lime producers and input dealers. A guaranteed line of credit is needed to ensure a reliable supply of lime to dealers and farmers. Farmers' cooperatives are also needed to promote savings and credit and improve the marketing of the higher crop outputs.

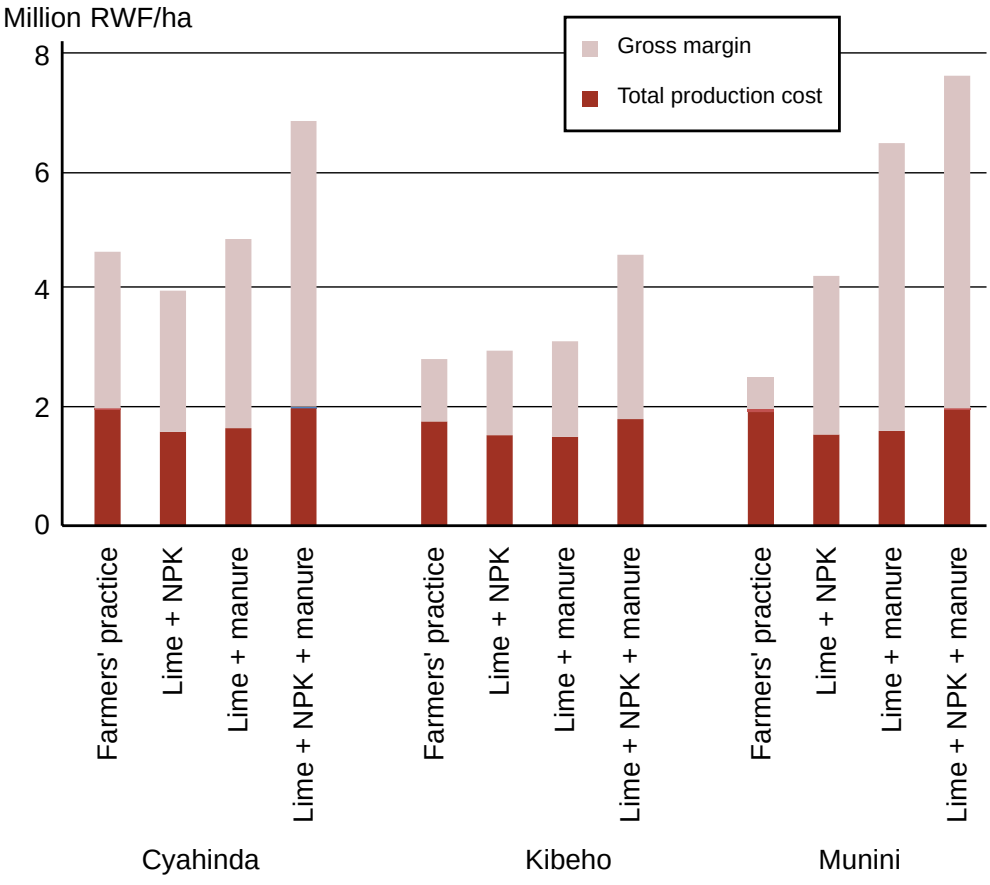


Figure 6 A combination of lime, farmyard manure and NPK fertilizer gave the highest potato yields at three test sites

THE GOLD THAT GROWS: PROMOTING SOYBEAN IN UGANDA AND ZAMBIA

ROBERT AND Jacinta Nkunda had no land of their own, but they needed to support their five children. In 2009, they decided to try growing soybeans. They rented a 0.8 ha plot in Rwembwera, their home village in Isingiro district in Uganda, near the border with Tanzania and Rwanda. They bought 20 kg of seed and broadcast it on the field. At the end of the season, they were disappointed to harvest only 200 kg of beans, which they sold at a loss. The soil was infertile, they realized, and they had not applied any fertilizer or other inputs.

But the next year was better – a lot better. They enrolled in a soil-health improvement project run by the Millennium Villages Project, which supplied them with half-price soybean seed, along with fertilizer and advice on how to cultivate the crops. At the end of the season, they harvested 1.5 tonnes of soybean and made a net profit of USh 900,000 ($350). The next season, they sowed maize on the same plot, and harvested 2 tonnes, which brought in USh 2 million ($780) in profit.

In March 2012 the Nkundas diversified into potatoes. They sold 80 bags over the border in Rwanda, earning USh 6.4 million ($2,500). They have used the money to make their lives a little more comfortable: they now have new beds and a television, and have started building a new house. But they have also invested in their future: they can pay school fees for their children, have bought some land so they no longer have to rent, and have expanded a retail business they run in the town of Kabuyanda.

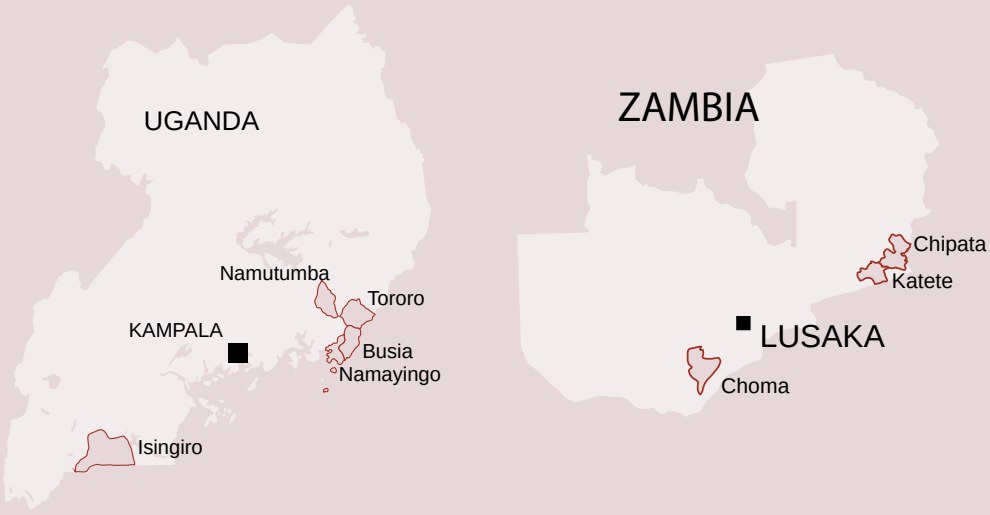
They have not stopped there. They have got 30 families in the neighbourhood to form the Rwembwera Farmers Association and a savings and credit cooperative. They have sworn to continue to buy quality inputs and use the improved technologies when the project ends. Not bad for a couple who have each attended only three years of school.

Infertile soils = low yields = poverty

The problems faced by Robert and Jacinta Nkunda are common across Africa. Millions of farmers have to grow maize to feed their families. But growing maize in the same field year after year further impoverishes soils that were poor to start with. Low yields leave them hungry, and force them into planting yet more maize in the next season. They lack the knowhow and wherewithal to break the cycle of poverty.

Jacinta and Robert Nkunda now run a modern small-scale commercial farm

Case	03	04	05
Project name	Improving smallholder productivity and controlling striga (*Striga hermonthica*) in eastern Uganda through scaling up integrated soil fertility management interventions	Improving soils and human nutrition using soybean in western Uganda	Increasing food legume crop production for improvement of soil fertility, food security, nutrition and income by smallholder farmers in Zambia
Key actors	Africa 2000 Network Uganda	Millennium Villages Project, Uganda	Zambia Agriculture Research Institute
Beneficiaries	25,000 smallholder farmers (13,000 men, 12,000 women)	20,000 smallholder farmers	30,000 smallholder farmers
Location	Busia, Tororo, Namutumba and Namayingo districts, **Uganda**	Isingiro district, **Uganda**	Katete, Chipata, and Choma districts, **Zambia**
Years	2010–14	2010–12	2009–13/14
Project budget	$512,000	$305,839	$1,081,269
Contact	Christopher Kyeswa, ckyeswa@a2n.org.ug, christopher_kyeswa@yahoo.co.uk, www.a2n.org.ug	Johnson Nkuuhe, jnkuuhe@yahoo.com, johnson.nkuuhe@gmail.com, millenniumvillages.org	Laston Milambo, lastonmilambo@yahoo.com, www.zari.gov.zm



Growing soybean can help. This legume fixes nitrogen in the soil, especially if rhizobium inoculant is applied, so can boost the yield of maize grown in the same field in the following season. And given the right markets, it can be a valuable crop in its own right. By alternating maize and soybean in their fields, by sowing improved varieties and applying judicious amounts of fertilizer, farmers can boost the yields of both crops. Higher yields mean higher income, meaning that farmers can afford to buy the inputs they need.

Technically, overcoming the problem of soil fertility is quite easy. Just sow good seed and use the right combination of nitrogen fertilizer and rhizobium inoculant (so the soybean plants fix more nitrogen in the soil). If your soil is acidic, add lime, and if it is deficient in phosphorus, use a fertilizer that contains phosphate. Get it right, and your yields rise like magic if the rains are good.

But reality is more complicated. Farmers have to see the new technologies, be convinced they work, and learn how to use them. The inputs they need have to be in the shops at the right time, and the farmers have to be able to buy them – so they may need credit to do so. After harvest, they need to be able to dry and store their yield, find a buyer, and negotiate a good price. So farmers need a range of skills and services if they are to take advantage of the improved technology.

Three projects, one goal

This chapter describes two projects in Uganda and one in Zambia that used similar approaches to help farmers gain these skills and services, and so grow more. The projects were run by the Africa 2000 Network and the Millennium Villages Project in Uganda, and the Zambia Agriculture Research Institute in Zambia. Between them, they aimed to help 75,000 farmers adopt new production techniques.

The three projects consisted of several components, each dealing with the key constraints. The three components they had in common focused on improving input supplies, helping farmers understand and adopt the recommended production techniques, and marketing output.

Promoting production techniques The central component of all three projects was to introduce the improved production technologies to farmers. They trained community facilitators or farmer leaders in integrated soil fertility management, cultivation practices and farming as a business. These facilitators then passed on their knowledge to members of their groups. The projects set up demonstration plots so the local farmers could see for themselves the benefits of the improved techniques. These plots were also excellent venues for farmer field schools, field days and other types of training. The projects in Uganda also used local radio stations to disseminate messages to a wider audience.

Input supplies It is no good convincing farmers to sow a new variety of seed or apply a fertilizer if they cannot get the inputs they need. This project component aimed to make sure the right items were in the input dealers' shops at the right time, and that the dealers could advise the farmers about the products they were selling. The projects also made affordable credit available to farmers so they could buy the inputs.

Marketing The farmers have grown lots of soybean: now what should they do with it? They need to get organized so they can bulk their output, grade and bag it, identify and negotiate with a buyer. They may also process the soybean and turn it into cakes and other products to sell. Or they may cook and eat some of their beans themselves. This project component dealt with these issues.

Box 2 Project highlights

Africa 2000 Network, Uganda	Millennium Villages Project, Uganda	Zambia Agricultural Research Institute
Promoting production techniques		
625 community facilitators trained (436 men, 189 women), who trained 25,000 other farmers 899 demonstration farms Radio programmes reached 4 million listeners	Training for 20,000 farmers (52% women), 50 schools, 17 extension staff, 10 agro-input dealers 76 demonstrations on community or individual farms 21 demonstrations in schools Field days with 13,292 farmers (7,122 women, 6,170 men) Five radio talk shows Ten testing kits used to test soils and train farmers	21 "agriculture camps" trained 1,176 lead farmers Each lead farmer in turn trained 15 other farmers on soil fertility 80 permanent demonstration sites
Markets		
28 collective marketing associations established and facilitated to sign sales agreements Selected farmers and extension staff trained in processing 5 farmer associations make and sell confectionery products	4 cooperatives established Improved storage promoted 3 communities trained on processing	Buyers found: Zambeef, Mt Meru, FeedTech, ETG and NWK
Input supplies		
61 village stockists trained and linked to reliable suppliers 3,000 farmers facilitated to get loans of up to USh 2 million ($780)	10 input dealers trained and linked to farmers' cooperatives and dealers' association 4,000 farmers trained on how to get bank loans Links created between farmers and Stanbic Bank	Improved soybean and maize seed supplied by ZAMSEED company Fertilizer suited to soybean supplied by Zambian Fertilizer Company Rhizobium inoculant supplied by ZARI; ZARI's rhizobium production capacity improved Outgrower scheme run by NWK

Box 3 Dealing and training in Uganda

Akello Magdalene already ran a small farm input dealership in Namutere when she learned about Africa 2000's project. She attended training on the use of improved seeds and fertilizers, and learned how to become a village stockist. She set up two more shops: one in Busia, and another in Busitema. "There used to be no input dealers in the area and farmers would travel 60–70 km to buy supplies", she says. She employs two assistants to serve customers in her shops.

She also learned how to become a community trainer. She started with 40 groups, and now serves over 60. She provides the training for free, but the participants buy the products she recommends from her shop. Africa 2000 supplies maize and soybean seeds and fertilizer so she can set up demonstrations. She also offers 2-day training courses on processing, for which she charges a fee.

It's been a profitable venture. As well as paying her own children's school fees she also covers the costs of school supplies for 20 needy children from the neighbourhood.

Mining the gold

These efforts have borne fruit. The farmers have at least doubled their yields of soybean and maize. In Uganda, yields of soybean have risen from 0.75 to 1.6 t/ha on average, while maize productivity has shot up from 0.7 to 1.2 t/ha. In Zambia, yields have increased from less than 1 t/ha to more than 2 t/ha for soybean, and from less than 2 t/ha to more than 4 t/ha for maize. Farmers have been getting interested in growing soybean; some individuals now grow up to 5 hectares.

Input supply channels have been streamlined, and access to inputs has improved. In the Africa 2000 project in Uganda, the 61 village stockists have become convenient distribution points for town-based input dealers, and serve as handy locations for local farmers to get their supplies. These stockists can provide inputs at affordable credit. Twenty of them have become registered members of the Uganda National Agro Dealers Association, and have learned how to run their businesses efficiently. Easier access to inputs means that more than 12,500 farmers in the area have started to use fertilizers. The same project has helped establish 165 savings and loans associations; the 1,384 members of these groups use their own savings and loans guaranteed by the project to buy farm inputs.

Better access to markets has led to higher farm-gate prices and income, and has stimulated production of maize and soybean. In Zambia the farmers signed contracts with soybean buyers, while in the Africa 2000 Uganda project, 26 farmer-led bulking centres have been set up to serve over 8,000 farmers.

Spread effects

The projects have also had impacts outside their immediate areas. In Zambia, for example, a fertilizer blend has been designed specifically for soybean: the composition was changed from 10:15:18 NPK to a blend with less nitrogen and more phosphorus (7:20:13). Furthermore, the project has been replicated by the government using a $30 million World Bank loan.

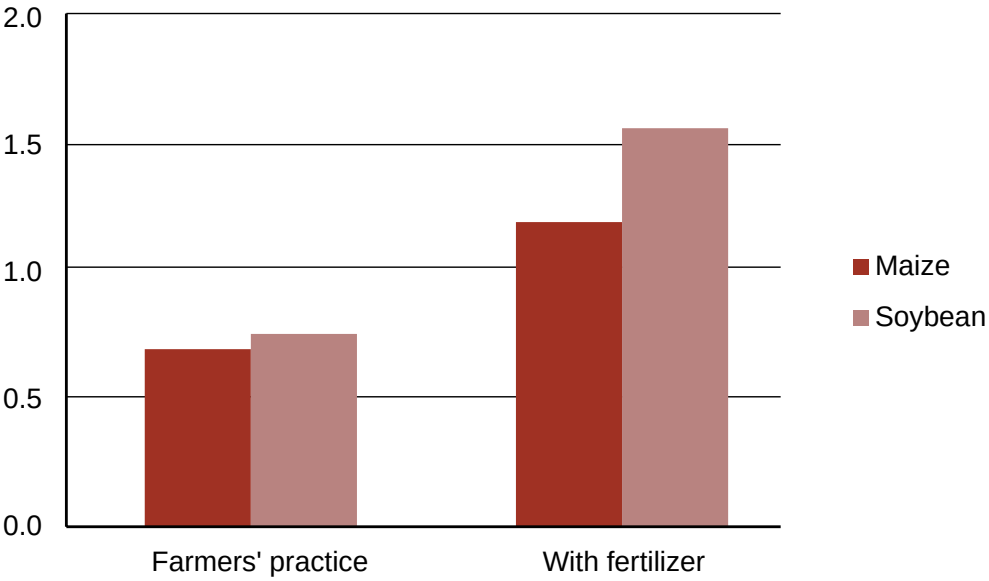


Figure 7 Maize yields in two seasons in Busia, Tororo and Namutumba districts, Uganda

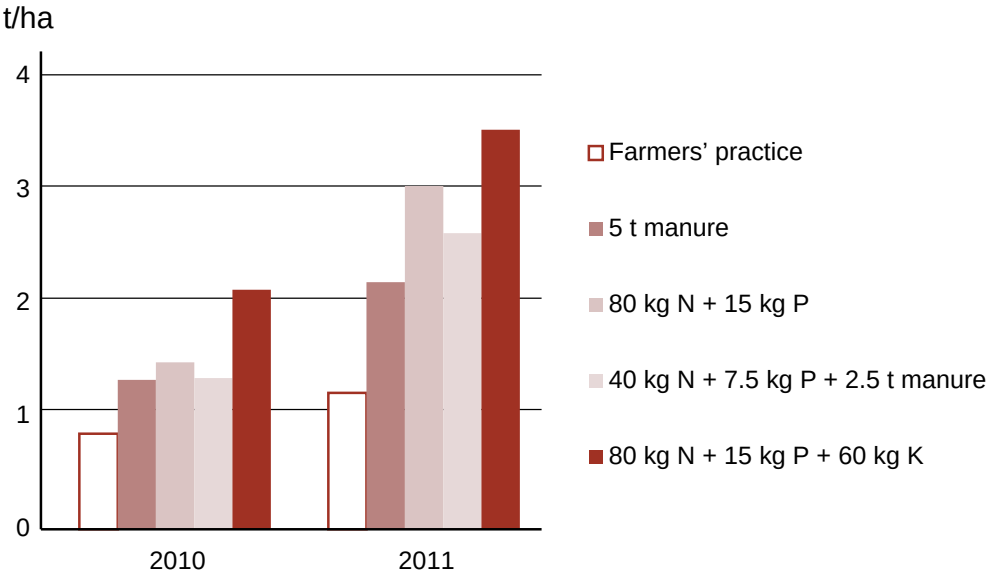


Figure 8 Crop yields in Isingiro district, Uganda (average for several areas)

Box 4 The perils of maize, maize, maize

When he retired from the army in 1998, Phineas Muyabi decided to settle in Mwachisompola, a village in Chibombo district in Zambia's Central Province. He started growing maize on his hectare of land. With seven children, he and his wife needed cash, so they grew one crop of maize after another, and watched their yields fall, from 3 tonnes to begin with down to 1.7 tonnes. The couple ended up on government food relief.

When the Zambia Agricultural Research Institute's food legume project started in the area, Phineas was chosen to be a lead farmer in his group. He hosted demonstrations plots on his land, and applied what he learned. His yields went up to 4 t/ha.

That has made a big difference. The couple has been able to pay for one of their sons to go to university, and they have expanded their farm and are planning to buy three cattle with the next season's profits. "It is like discovering a gold mine", says Phineas. "My life will no longer be the same again and I will be counted as those not amongst the desperate poor in society".

Phineas Muyabi with his wife and grandson in their soybean and maize field

In Uganda, the Millennium Villages Project has led to farmers also using fertilizers to grow potatoes, sorghum and vegetables, as well as planting trees to reduce the effects of climate change, following sensitization by the project.

Challenges

- **Credit** Access to credit has proved a problem. The projects guaranteed farmers' loans with lenders, but the borrowers still had to pay high interest rates that farmers could not afford.
- **Equipment** Land preparation and conservation agriculture techniques require certain types of equipment. The Zambian government has launched a pilot programme in a few districts to lend money to farmers to buy small tractors and no-till planters. This should be scaled up to more districts. But it is available only to farmers with valid land titles – which most farmers do not have.

SMALL DOSE, BIG RESULTS IN BURKINA FASO AND MALI

"I PLANTED TWO fields with millet, sorghum and cowpea", says Mahamoudou Sinare, who farms in Nagreongo, a village in central Burkina Faso. "In the first field, I used the microdose technology and in the second one I used the traditional method – broadcasting fertilizer at sowing time."

The result of Mahamoudou's experiment was clear: the sorghum in his microdose plot yielded three times more than the traditional plot: 1,500–1,600 kg/ha compared to only 500–600 kg/ha. "Ever since I learnt the microdose technology, we have been getting good yields", he says. "We have been practising it for 3 years now."

A three-finger pinch

If they use fertilizer at all, most farmers in Burkina Faso and Mali broadcast it: they throw handfuls of fertilizer across a newly sown field. That is quick and easy to do, but much of the fertilizer ends up being wasted. The fertilizer granules may end up nowhere near one of the newly sown seeds. Most soils in the region are sandy, so the nutrients in the fertilizer are quickly washed away, before the crops can use them. Dosing is also difficult: parts of the field may get no fertilizer at all. And fertilizer is expensive: in Mali it costs $1.65 per kilogram of nutrients, more than four times the world price. Most farmers can afford to buy only small amounts. Fertilizer consumption in Mali is only 5 kg/ha; yields are correspondingly low.

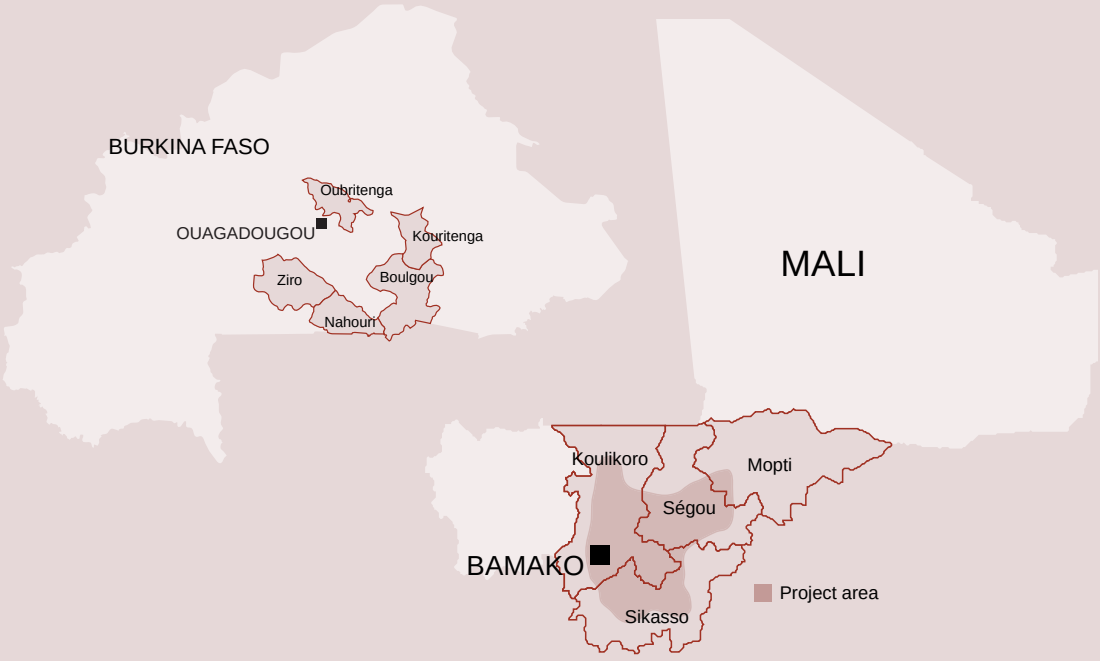
Microdosing overcomes these disadvantages by putting fertilizer where it is needed: next to each plant. It takes two people. The first digs shallow planting holes with a hoe. The second person drops 2–6 grams (a bottle-capful or a three-finger pinch) of fertilizer in each hole, followed by the seed, then uses his or her foot to cover them with soil. When the seeds germinate, the young roots can quickly find and absorb the nutrients. Microdosing can also be used to top-dress the crop 3–4 weeks after the seedlings have emerged: the farmer puts a pinch of fertilizer in a hole next to each plant.

Promoting microdosing

Mahamoudou learned the microdose technique from an AGRA-funded project run by INERA, the national agricultural research institute in Burkina Faso, together with the International Crops Research Institute for the Semi-Arid Tropics and two NGOs (The Hunger Project and Réseau MARP). A similar project, run by the Institute of Rural Economy, focused on neighbouring Mali. This built on a previous USAID project in the area that also focused on microdosing.

Promoting microdosing was the central component of these projects. Project staff facilitated farmer field schools where farmers could learn the technique and monitor their crops throughout a whole growing season. The farmers learned to wait until the soil was moist before using microdosing in order to keep the fertilizer from "scorching" their crop. They also learned how to identify nitrogen and phosphate deficiency in their crops, rotate cereals with cowpea (a nitrogen-fixing legume) and build ridges in their fields to prevent erosion and capture scarce rainwater.

Project name	Achieving pro-poor green revolution in drylands of Africa: Linking fertilizer micro dosing with input-output markets to boost smallholder farmers' livelihoods	
Case	06	07
Key actors	Institut de l'Environnement et de Recherches Agricoles (INERA) ICRISAT-Niger The Hunger Project Réseau MARP	Institute of Rural Economy (IER) ICRISAT-Niger Association for the Development of Agricultural Production and Training (ADAF Gallé) KILABO Sasakawa Global 2000 European Cooperative for Rural Development
Target beneficiaries	130,000 farm households	130,000 farmers, 236 villages
Location	Boulgou, Boulkiemde, Gourma Kouritenga, Nahouri, Oubritenga, Sanguie and Ziro provinces, **Burkina Faso**	Koulikoro, Sikasso, Ségou and Mopti, **Mali**
Years	2009–12	2009–13
Project budget	$2,771,094	$2,843,973
Contact	Sibiri Jean-Baptiste Taonda, staonda2@yahoo.fr, inera.direction@fasonet.bf, www.cnrst.bf, www.inera.bf	Diakalia Sogodogo*, diakalia_sogodogo@yahoo.com, www.ier.gouv.ml



Box 5 Project highlights

Burkina Faso	Mali
Microdosing	
22,413 field demonstrations 440 farmer schools 57,338 farmers benefited 45,000 farmers adopted technology 20,500 farmers trained in microdosing 393 field days with 57,338 farmers Broadcasts reached 366,000 farmers	2819 demonstration plots 11,210 farmers trained on fertilizer microdosing 72 farmers' organizations holding farmer field schools 25,860 farmers trained on integrated soil fertility management Yield increases of 33–47% compared to no fertilizer 206 farmer field days with 9,642 farmers (34% women) 133 broadcasts on regional radio and 6 FM stations
Inventory credit	
58 warrantage warehouses set up 158 committee members trained FCFA 135 million ($280,000) lent to 3,470 farmers (51% women).	1,150 t of grain stored in 43 stores FCFA 72 million ($144,000) lent to 1,077 farmers
input supplies	
36 fertilizer dealerships set up 584 tonnes of NPK and urea fertilizers used in field demonstrations 3,470 farmers (51% women) benefited	43 dealerships set up 76,897 farmers (30% women) bought 94,850 mini-packets and 34,255 50-kg bags of fertilizer

Staff held demonstrations on farmers' fields, and organized exchange visits so farmers from one area could see how others were using the technique. For the demonstration plots, the projects supplied the necessary fertilizer and seeds, while the local farmers prepared the plots and tended the crops. The project team provided technical advice.

The projects also promoted the method on local FM radio stations (a particularly valuable medium in an area where many farmers are illiterate), on television, through theatre performances and on T-shirts and calendars. To reduce the labour required, the research institutes developed and tested simple tools to sow seed and apply fertilizer.

In Mali, the farmers found that microdosing is a lot more efficient than broadcasting fertilizer. In a low-rainfall area, just 32 kg/ha of DAP microdosed fertilizer produced higher millet yields than broadcasting three times that amount of DAP plus 50 kg/ha of urea (Figure 9). Similar results were found in areas with higher rainfall, for sorghum, and for traditional varieties of both crops.

Microdosing is profitable, too: a review in Mali found that it had a marginal rate of return of 2.1 (investing an additional $1 in microdosing yields an extra $2.10 in extra income) (Table 2).

As Mahamoudou Sinare found, the microdosing technique produces higher yields: in most years up to double the amount compared to broadcasting the same amount of fertilizer. In Burkina Faso, 45,000 farmers adopted the microdose technologies. In Mali, the area under millet,

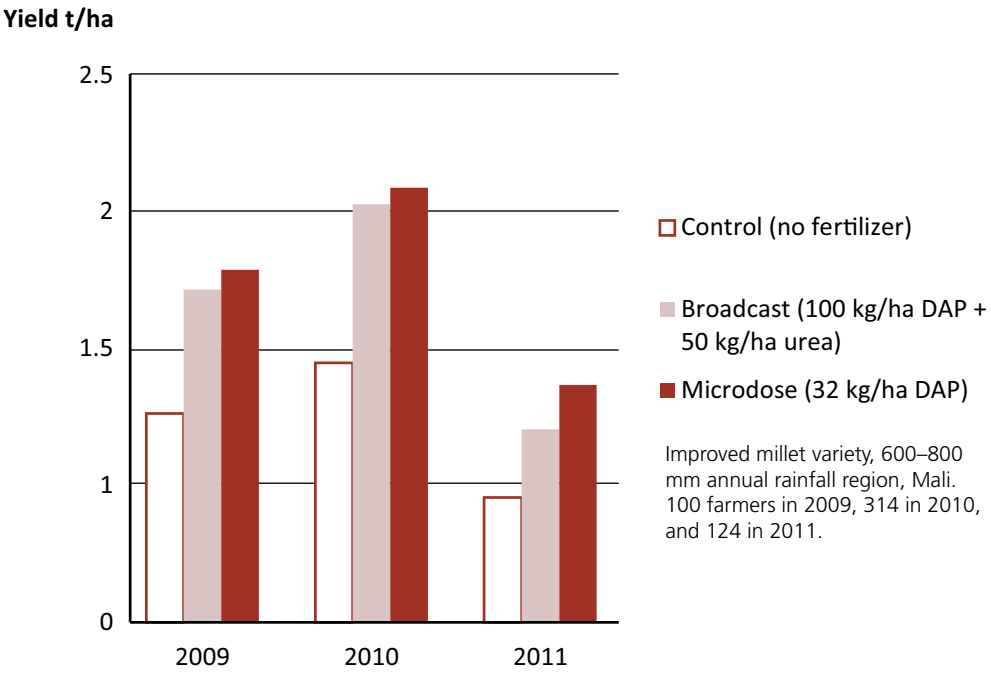


Figure 9 Small amounts of microdosed fertilizer are more effective than larger amounts of broadcast fertilizer

sorghum and cowpea rose by 48.5%, and the percentage of households rotating a cereal (millet or sorghum) with peanut or cowpea went from 24% in 2009 to 41% in 2011. The number of households in the target villages using microdosing rose from 36% (60,642 households) in 2010, to 72% (119,918 households) in 2012.

Ensuring input supplies

A second project component was establishing small input dealerships to enable farmers who wanted to use the microdosing technique to get the seeds and fertilizer they needed. The project helped farmers set up dealerships in convenient locations.

Table 2 Costs, income and marginal rate of return for microdosing fertilizer on millet, Mali

	Costs ($/ha)			Income ($/ha)		Marginal rate of return*
	Labour	inputs	Total costs	From crop	Net	
No fertilizer	180.9	3.5	184.4	216.5	32.1	–
Microdose	208.5	32.4	240.9	392.7	151.8	2.1

*Marginal return = marginal benefit divided by marginal cost.

Box 6 Three tonnes of maize

Moumini Ouedraogo harvested 3 tonnes of maize per hectare from the plot where he had used microdosing. The traditional broadcast method yielded only 2 t/ha, while a control plot without fertilizer produced a miserable 800 kg/ha.

"We are so happy with the microdose technology because with less investment we get much yield", says Moumini. "We take home the harvest, and part of it is used for sustenance and the remainder is warranted. With the money from warrantage we can engage in other activities such as animal breeding or diversification in the production of other crops."

Inventory credit

A third pillar of the projects was to establish inventory credit or "warrantage" schemes to help farmers earn more from their crop. Such a scheme works like this. After the harvest, the farmers put their grain in a local storehouse. The grain is weighed, and a bank or microfinance institution issues a loan using the grain as collateral. The farmers can use this money to cover their expenses, invest in the next season's crop, or run small enterprises such as trading, poultry raising, vegetable growing and garment making. Freed from the need to sell immediately to get money, they can wait until the grain price rises before selling it. The projects promoted such schemes through field schools, radio, etc. – the same methods as they had used to promote microdosing.

Institutionalizing microdosing

- **Extension methods** The project used multiple methods to help farmers get familiar with the technique and see how they could benefit. These included demonstrations, farmer field schools, field days, radio and other media. Using the local languages was important.
- **Extension uptake** As a result of these successes, the Burkina Faso government has trained agricultural extension officers on this technology to scale out the technology throughout the country. It is expanding the microdose technology to 12 of the country's 45 provinces using a $14 million loan from the Islamic Development Bank. The microdosing idea is also gaining ground in Mali and Niger, and it is being included in the national agricultural extension programme.
- **Partnerships** Such successes are possible only through partnerships between scientists, extension agencies, input dealers, seed producers and financial institutions, all working together to inform and serve farmers. Building such partnerships is a challenge, even within the research institute itself.
- **Credit** Providing credit meant farmers could buy the new seeds and fertilizer they needed. The warrantage system was vital: it meant that farmers' groups could offer tangible collateral to banks and microfinance institutions in return for a loan. The projects backed this up with a sizeable deposit with a bank to use as security. Despite this, conventional banks still view lending to farmers as too risky, and charge them high interest rates.
- **Long-term effects** While microdosing is promising, its long-term effects are still poorly understood. Further research is needed to determine its effect on the soil and ways to reduce its labour requirements.

AN "ANCHOR FARM" IN MALAWI

MALAWI IS a big tobacco producer, but the crop is declining: demand and prices are falling, and farmers are looking for alternatives. Lucy Banda used to be one of these farmers. This 46-year-old single mother-of-six cultivates 5.2 ha of land in Mlonyeni, a village in Mchinji district, central Malawi. Along with tobacco, she also grew soybean, but using traditional cultivation methods and no inputs. Yields were poor: in 2011 she harvested only 10 bags (500 kg) of the beans from 0.8 ha.

Then Lucy learned how to improve her soybean crop from the Clinton Development Initiative (CDI), which runs a large commercial farm nearby. She learned about improved seed, rhizobium inoculants and better cultivation practices. In the 2012/13 season, she sowed a hectare of land, and was delighted by the yield: 1,850 kg of soybeans. For the first time in her life, she earned K320,000 ($800) – a huge rise in her normal income. She used some of the money to renovate her house and to pay medical expenses, but invested the rest in her farm – for example in fertilizer for her maize field. She is planning to buy an oxcart with the proceeds of the 2014 season.

How did Lucy get in touch with CDI? She is a member of one of the farmer "clubs" organized by CDI as part of the organization's outreach mandate (CDI is associated with the Clinton Foundation, an international development NGO). The club members learn new techniques from CDI, then inform their neighbours in turn. "We go around the village as a club to teach others about soybean agronomy as we were taught by CDI", says Lucy. "We also share our success stories with our friends and show them how we have benefited from soybean farming business."

Soybeans are the answer

Continuous cultivation of maize and tobacco has impoverished the soil in many areas of Malawi, resulting in low yields and poor incomes. Soybeans are part of the answer: they improve the soil fertility by fixing nitrogen, so boosting the yield of the next crop in the field. They are also a valuable crop in their own right: demand from local processing industries is high.

But traditional soybean cultivation methods produce low yields: an average of only 1 t/ha. With the right inputs – improved varieties, fertilizer and rhizobium inoculant – and cultivation methods, the potential is 4 t/ha or more.

The anchor farm approach

CDI's commercial farms (currently five in number and covering over 2,000 ha) grow maize, groundnut and soybean. The organization uses them as "anchor farms" to promote improved soybean cultivation among farmers in the surrounding areas. AGRA supported this work. The anchor farms provide a range of services: training government extension workers and lead farmers (who in turn train other farmers), market linkages (input supply, financial services such as input loans, farm produce supply contracts), and farmer organization development.

Training and farmer organization CDI encourages the surrounding farmers to work in "clubs" of 10–20 people each. Each club elects a leader as the contact person for the anchor farm's ser-

Case	08
Project name	Improving the productivity of maize and soya beans through integrated soil fertility management and better access to markets
Key actors	Clinton Development Initiative (CDI) Chitedze Agricultural Research Station Department of Agricultural Extension Services Senwes Grainlink
Target beneficiaries	21,000 smallholder farmers
Location	Mchinji district, **Malawi**
Years	2010–13
Budget	$719,638
Contact	Austin Ngwira, Director for Agriculture, CDI, Lilongwe, angwira@clintonfoundation.org, www.clintonfoundation.org

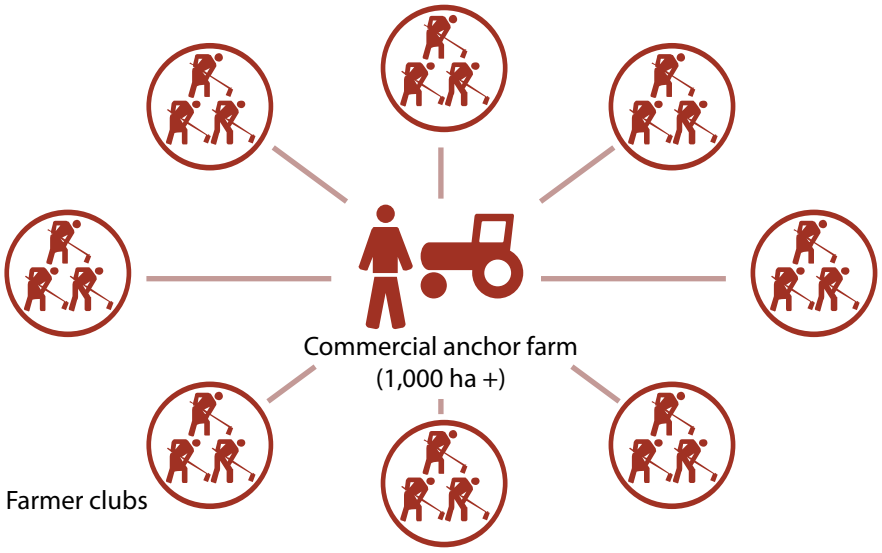


Figure 10 Anchor farm model for reaching smallholder farmers

vices. CDI staff train these lead farmers, who in turn train their fellow club members. They use demonstration plots and field days to show the effect of crop rotation, good cultivation practices, the use of fertilizers, and improved varieties of soybean and maize.

Loans for inputs To help farmers buy inputs, CDI acts as a broker between them and a bank. The club members have to raise a 15% deposit in order to qualify for a loan to pay for the inputs. CDI works with two local banks, whose local agents collect loan deposits and repayments. Farmers do not get cash; instead, the loans come from dealers in the form of fertilizers, seeds and other inputs. These dealers in turn obtain their supplies from seed and fertilizer companies.

Marketing the output CDI's farms have contracts to supply soybean to four big buyers: Maldeco Fisheries, Farmers World, Transglobe, and Senwes-Bunge. CDI arranges for these buyers also to purchase beans from the smallholders. After harvesting their beans, the club members bring them to designated bulking centres to be weighed and picked up. The final price is determined at the time of sale. This is also when the bank agents come to collect the loan repayments. CDI trains the farmers on postharvest handling, grading and calculating their profit levels.

Boosting yields

Using the new techniques, the club members have more than doubled their yields: from 1.3 to 3.5 t/ha of maize, and from 0.8 to 1.8 t/ha of soybeans. That represents an extra $356/ha from maize and $462 from soybean. Over 25,000 farmers have received training either directly from CDI or indirectly through their clubs. Nearly half of them are women. A total of 8,644 ha of land is now under integrated soil fertility management.

In the 2012/13 season alone, the project helped 3,216 farmers to get loans from NBS Bank. All the farmers who got a loan applied rhizobium to their soybean crop.

A total of 76 agricultural extension workers and 14 supervisors have been trained on integrated soil fertility management and good agronomic practices. The lead farmers in clubs who act as "para-extension" agents helps overcome the shortage of extension workers: Malawi has only one

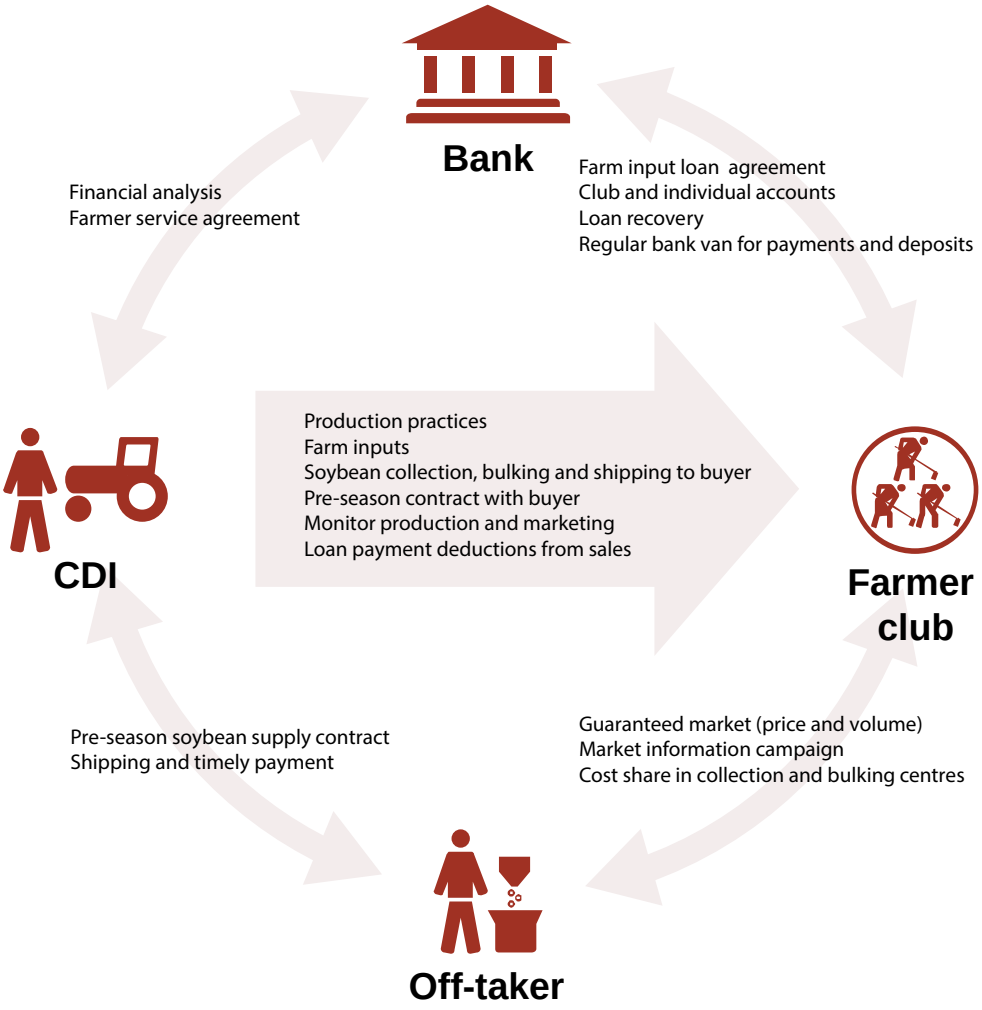


Figure 11 Framework of interventions in the anchor farm model

such agent for over 2,000 farmers. These extra people are vital if the farmers are to continue to use the technology after the end of the project.

The results generated by the CDI anchor farm project have catalysed further support. For example, in 2013 the Dutch government approved $3 million in funding for 3 years to enable CDI to replicate the anchor farm business model in Iringa, Tanzania. Recently, CDI secured funding from the Rothschild Foundation to support the design and implementation of a community warehouse receipt system, starting with a pilot 500-t community warehouse at Nabulenje in Mchinji district. In September 2012, the Malawian government named CDI as its lead technical partner on soybean promotion.

Replacing tobacco

Driving through Mchinji district, one gets a sense of the spread of the soybean–maize rotation. The area used to be dominated by tobacco and maize; now large areas of soybeans grow next to the maize fields. This is good news for smallholder farmers who thought that their livelihood was going downhill following the collapse of the tobacco market.

A number of smallholder farmers in the area have expressed interest in bank loans so they can start growing soybean and maize in rotation. But interest rates of 45% a year are prohibitive. Other sources of loans at lower interest rates are needed. One possibility is to establish savings and credit cooperatives.

The availability of improved soybean seed remains a problem. Few companies produce legume seeds because farmers tend to recycle the seed they grow for several seasons before they want to buy new seed. Seed companies prefer to sell hybrid varieties of crops (such as maize) that farmers have to buy every year. A way to overcome this problem is to set up informal seed systems, where individual farmers or groups are contracted to produce seed, and get the technical support they need to do so. Seed inspectors can certify this seed as "quality declared seed".

The anchor farm approach of grouping farmers in clubs and linking them to demonstrations, input and output markets enabled CDI to reach more farmers than it had targeted. The lead farmers have quickly helped to spread knowledge on integrated soil fertility management. The anchor farm model has a potential for scaling up because it brings the different actors of the value chain.

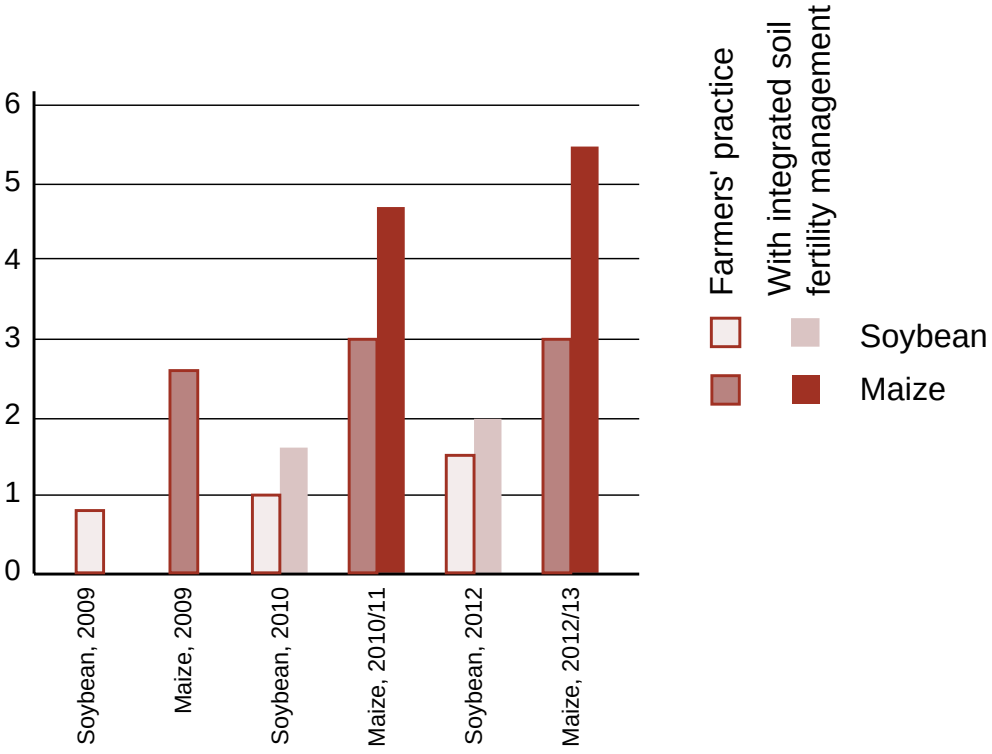


Figure 12 Soybean and maize yields in demonstration plots in Mchinji district, Malawi

"I USED TO cultivate four farms, or about 6 ha", says Adamu Baffa. "But I realized I was just wasting resources. Now I concentrate my efforts on two farms – about 3 ha – and I am harvesting more than twice what I used to get from the four farms."

The change for Adamu came in 2010 when he started attending training on soil health offered by an AGRA-funded project run by the Kano State Agricultural and Rural Development Authority and Bayero University. He was already an experienced farmer, but the training taught him about how to grow cereals and legumes in alternating strips. It also covered things like crop rotation, the use of improved seed, applying the right type and amount of fertilizer, and the best planting densities.

"With the right amount of fertilizer and labour, I now cultivate enough food to feed my family all year round and have surplus to sell. With the surplus, I can buy fertilizer for my farm production", Adamu explains.

Adamu used to struggle to feed his family. And he was by no means alone: with over 10 million people, Kano is the most populous state in Nigeria, and about 70% of its inhabitants are small-scale subsistence farmers. The rising population pressure has led to continuous cropping and soil nutrient mining, land degradation, and the spread of cropping to marginal lands. Annual nutrients lost have been reported to exceed 57 kg NPK per ha. That has led to severe declines in crop yields and a rise in soil degradation. Add to that problems such as erratic rainfall, overgrazing, poor access to inputs and markets, a lack of affordable credit and scarce extension services, and you have a recipe for poverty.

Five steps to attack a complex problem

The solution to this interlocking set of problems must address each of the main bottlenecks in the production and marketing system: soil fertility, farmers' skills, and access to inputs, credit and markets. That is what the AGRA project aimed to do in 30 communities across six local government areas in Kano State: Tofa, Kabo and Gwarzo in the sorghum belt, and Gezawa, Gabasawa and Ajingi in the millet belt. The project began with 210 farmers' groups in 2010, expanding to 480 in 2011 and 780 in 2012. Each group had around 25 members, so the project directly reached about 20,000 farming families.

The project had five main components:

- **Training on crop production and soil fertility** The project trained extension agents and lead farmers on integrated soil fertility management, including fertilizer use, composting, cereal-legume strip-cropping and rotations, use of improved seed, and reduced tillage. It focused on two cereal crops (sorghum and pearl millet) and three legumes (groundnut, cowpea and soybean).
- **On-farm demonstrations** These covered improved seeds, strip intercropping, the use of recommended rates of fertilizer on both crops, relay cropping (sowing the next crop before the standing crop has been harvested), and rotating the cereals and legumes in the following season.

Case	09
Project name	Improving productivity of smallholder millet and sorghum based production systems in the semi-arid region of northern Nigeria through increased use of integrated soil fertility management options and better access to markets
Key actors	Kano State Agricultural and Rural Development Authority (KNARDA) Bayero University, Kano (BUK) International Institute for Tropical Agriculture (IITA)
Beneficiaries	20,000 farmers
Location	Tofa, Kabo, Gwarzo, Gezawa, Gabasawa and Ajingi, Kano State, **Nigeria**
Years	2010–13
Project budget	$600,178
Contact	JM Jibrin, jibrin@gmail.com Abdullahi I Raba, raba_abdullahi@yahoo.com MI Daneji, midaneji@gmail.com AB Mohammed, ibabamohd@yahoo.co.uk A Zayyad, zyd014@yahoo.com www.moanr.kano.gov.ng

Figure 13 The Kano project's five main components

- **Access to inputs** Improved seeds were sourced from private companies and the Kano State Agricultural and Rural Development Authority. The project assisted the farmers to set up community seed-multiplication schemes to improve the supply of good-quality seed, and linked them to input suppliers. It trained one farmer from each of 30 communities how to set up a small input shop, and put them in touch with reputable fertilizer dealers. These shops sold 1-kg packs of urea fertilizer to local farmers.
- **Postharvest** Farmers were trained on postharvest processing and storage. Women farmers were prioritized to receive training on value addition.
- **Linkage to credit sources and markets** The project linked farmers to Citibank (for affordable credit), and buyers of their crops. It trained 120 farmers on business development and credit management. Some of the farmers were able to secure loans worth $300–800 each at a very low interest rate of 6%.

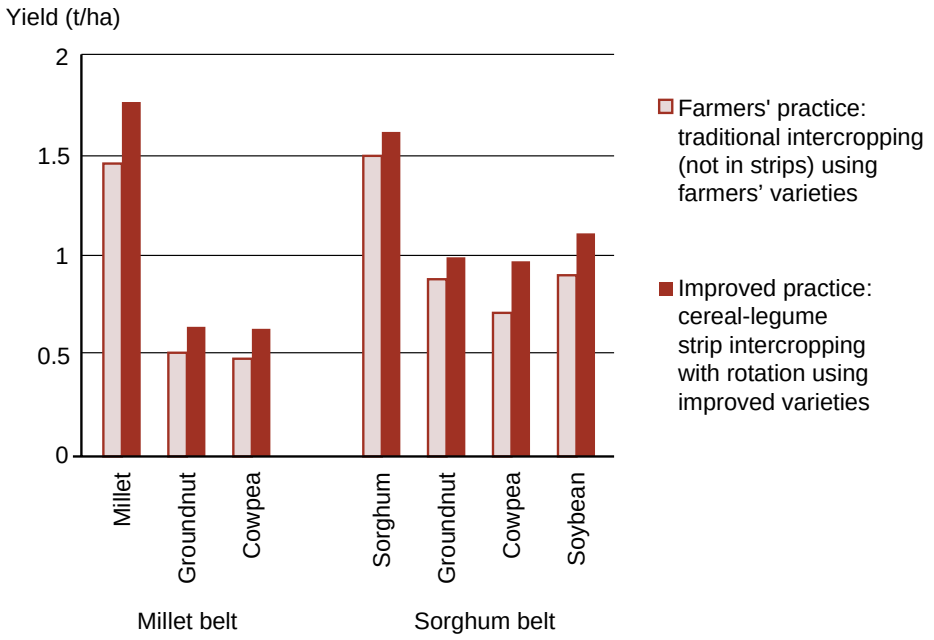
A boost in yields

The project recommended that farmers sow improved varieties of cereals and legumes cereals in alternating strips: four rows of the cereal, then four rows of the legume, then four rows of cereal, and so on. In the second year, the farmers were to switch the rows, sowing the cereals where the legumes had been in the previous season to take advantage of the improvement in soil fertility made by the legumes. Adamu Baffa and his fellow farmers found that indeed boosted yields: by as much as 20% for millet and 36% for cowpea (Figure 14).

The improved practices actually cost a little less than the traditional practice, but gave 34% more profit (Figure 15).

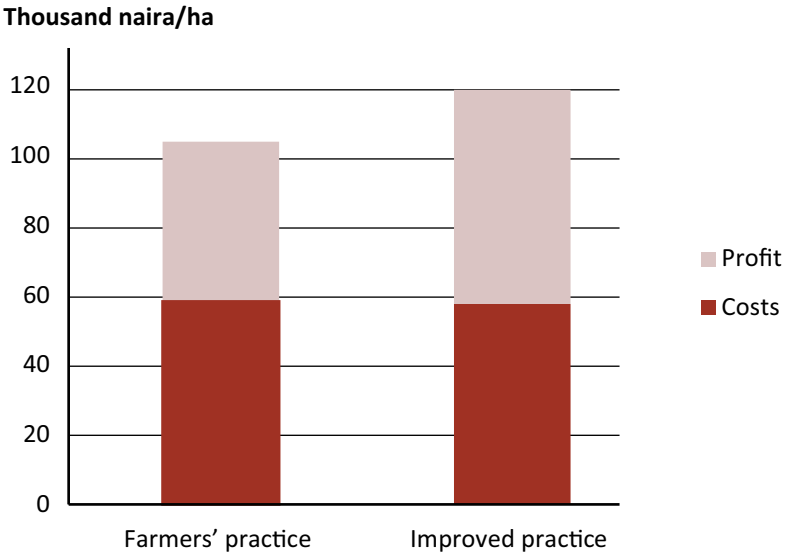
Factors for success

- **Partnership is imperative** The close collaboration and understanding between the three implementing organizations was a key factor leading to success. These organizations have been working in the project area for many years and have the confidence and goodwill of most stakeholders in the local agricultural value chain. In addition, the partners worked together with several other projects with similar goals: N2Africa, Tropical Legumes II, and the Purdue Improved Cowpea Storage Project.
- **Farmers' organizations and value chain approach** The project used a value chain approach to link farmers' groups with sources of credit and inputs and with potential buyers of their output. Because the groups are empowered to work on their own, the gains made by the project are more likely to be sustained over time.
- **More time needed** Nevertheless, 3 years is too short a time to improve soil health. Future projects should be designed to last at least 6 years for improvements in the soil properties to be seen.



Data from 75 demonstration plots in millet belt and 75 plots in sorghum belt, 2011

Figure 14 The improved practices led to higher yields of both cereals and legumes



Data from 150 lead farmers in millet belt and 150 in sorghum belt, 2012.
Farmers' and improved practices as in Figure 14.

Figure 15 Cost-benefit analysis of using improved practices introduced by the soil heath project

INTRODUCING SOYBEAN ROTATION IN NORTHERN GHANA

"IT WAS beyond my wildest dreams!" Ibrahima Shaibu beams when he thinks of his latest maize harvest. "I looked at the lush green maize field with a lot of expectations as I anxiously waited for it to mature. From the onset, I knew I was going to have a great harvest, and my family members were excited when the harvest finally arrived: a bounty 12 bags of maize."

The 37-year-old smallholder sits on the veranda of his new, tin-roofed, cement-plastered house in Cheshegu, a village in Kumbungu district, in Ghana's Northern Region. Why was the maize yield so good? "I just added soybean to my stable of crops", he says. He has learned to rotate the legume with maize and other crops. Because it fixes nitrogen from the air, it enriches the soil, boosting yields of the next crop grown in the field. He says that after he has grown soybean in a field, his maize yields more than double: from 4½ bags to 12 bags in one field, and from 7 to 16 bags in another.

Shaibu learned the new technique, and got his first pack of soybean seeds, from the Savanna Agricultural Research Institute as part of an AGRA-funded project. After the soybean harvest he divides the beans into three parts: he saves some as seed for the next season; some go to make soup, soy milk and *tubani* (soybean pastry) for his family; and he sells the rest. A 100-kg bag of beans fetches GHS 70–75 ($25), but Shaibu has found that he can get GHS 90 ($30) per bag if he sells later in the year. A factory in nearby Tamale buys soybean to make cooking oil.

Breaking the vicious circle

The soils in northern Ghana have naturally low fertility, but the problem is made worse by continuous cropping of cereals such as maize. Farmers know about fertilizers and improved seeds, but few can afford them. Plus, they do not know how to use commercial fertilizers in combination with manure and compost. To feed their families, they feel forced to grow as much maize as possible, which further impoverishes the soils.

SARI's soil health project aimed to help them break out of this vicious circle. It promoted a range of integrated soil fertility management techniques, including improved seeds, appropriate amounts of inorganic fertilizer, cereal-legume rotations, and intercropping. The project had four main components.

Building the capacity of farmers' organizations The project helped farmers form groups to make it easier for them to buy inputs, sell their output, learn from one another, and get new ideas. It trained the group leaders in group formation and management, constitution-building, financial management, and farming as a business. It established farmer field schools to train 2,000 farmers a year in practical aspects of soil fertility management, and trained 265 government and NGO extension staff how to form and guide these field schools.

Technical capacity building The project trained extension personnel and farmers in various ways. A total of 120 demonstration plots a year showcased maize-soybean cropping systems, the use of improved seeds, fertilizers and rhizobium inoculants, sowing methods and early sowing. The project introduced Fertisoil (a factory-produced organic fertilizer), compost-making, and the

Case	10
Project name	Increasing maize-legume cropping system productivity through scaling out of integrated soil fertility
Key actors	Savanna Agricultural Research Institute (SARI) Council for Scientific and Industrial Research Centre for Agriculture and Rural Development (CARD) International Fertilizer Development Center (IFDC)
Beneficiaries	120,000 smallholder farmers
Location	Tamale, Northern Region, **Ghana**
Years	2010–13
Project budget	$1,542,607
Contact	Mathias Fosu, mathiasfosu@yahoo.co.uk, csirsavannah.blogspot.de

use of manure (which many farmers used to spread too thinly on their fields, or even throw away). It also trained farmers on aspects such as postharvest handling and storage. It used field days, videos and call-in radio programmes with 42 listening clubs to further disseminate information. The project reached 90,000 smallholder farmers through these means.

Access to finance and farm inputs To help farmers get the inputs they needed, the project supported a cashless credit facility in partnership with the Center for Agriculture and Rural Development, a local NGO that works on microcredit. This made it possible for 3,466 farmers to get loans worth $300,000 to buy fertilizer and improved seeds at an interest rate of 12% per year.

To make fertilizer more widely available, the project linked with an agro-dealer network organized by the International Fertilizer Development Centre so the dealers could stock the types of products promoted by the project. The project trained the dealers on fertilizer types and use, pesticide handling, the characteristics of improved seed, store organization, the safe handling of chemicals, and extending knowledge to farmers. It created 28 dealer/farmer's organization networks in eight districts; some of the dealers delivered fertilizer directly to the farmers' groups.

Output markets In collaboration with IFDC and local FM radio stations, the project broadcast market information such as crop prices through radio, mobile phones and leaflets. It put the farmer groups in touch with aggregators who buy produce in bulk from the groups. The aggregators agreed to buy directly from the farmers' groups if they could meet volume and quality targets. That assurance stimulated the farmers to adopt the improved production techniques and strengthen their marketing groups.

Double yields, cut poverty

The project has shown that a few relatively simple and affordable techniques can double yields and significantly reduce poverty in northern Ghana.

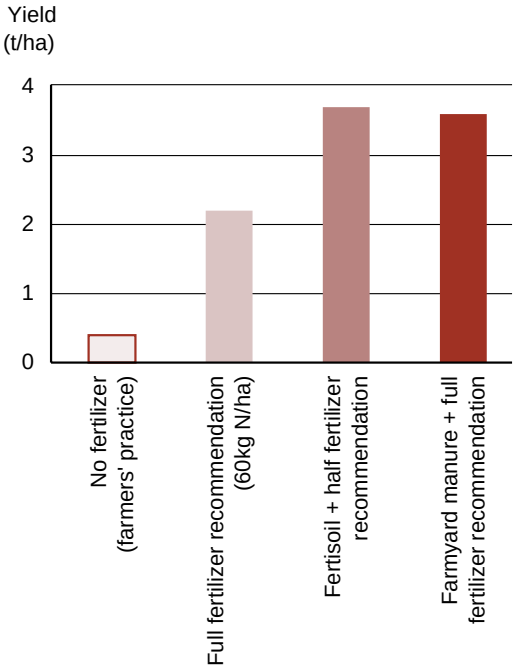
The integrated soil fertility management techniques championed by the project bore fruit. Data from the demonstration plots show this clearly: For maize, a combination of organic and inorganic fertilizer produced the best yields. Using the commercially prepared Fertisoil product, it was possible to halve the fertilizer dose and still get a top yield (Figure 16). Farmers who keep animals can combine manure with the recommended dose of mineral fertilizer to get a similar yield. The organic matter improves the soil structure and soil health.

For soybean, the demonstrations showed that a combination of rhizobium and the recommended P and K fertilizer dose doubled yields (Figure 17). When farmers saw this, they wanted to buy the inoculant locally. To meet this demand, SARI has partnered with EMBRAPA, the Brazilian national agricultural research institute, to produce rhizobium inoculants.

By harvesting more, the famers could easily repay their loans: the credit scheme achieved a 100% repayment rate. The Center for Agriculture and Rural Development, which ran the scheme, has a strong track record in loan recovery and works closely with farmers to monitor the loans. It is important that loans are disbursed at the right time so farmers can get the inputs they need when they need them.

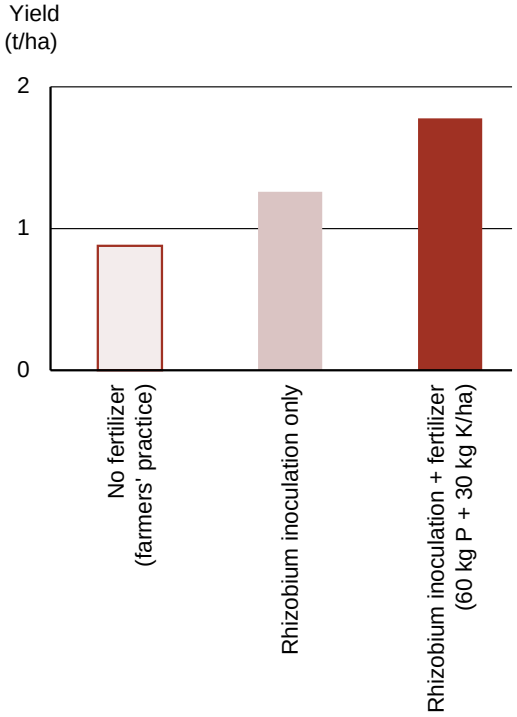
Although the project trained extension staff from the Ministry of Food and Agriculture, they have many other responsibilities, so not all were available to support the project. That meant that the project fell short of its target to reach 120,000 smallholders (it in fact reached only 90,000). On the other hand, the radio broadcasts had wide coverage and may have reached more farmers

than thought. Using multiple extension approaches such as radio and video can help overcome the shortage of extension staff faced by many countries in Africa.



Maize yields from 33 demonstration plots, 2010

Figure 16 A combination of mineral and organic fertilizer gave the best yields



Soybean yields from 11 demonstration plots, 2010

Figure 17 Inoculating soybean seed with rhizobium raised yields by 43%; applying fertilizer as well more than doubled yields

PHOSPHATE FERTILIZER FOR MAIZE AND RICE IN TANZANIA

Build a brick house? Perhaps buy a motorbike? These are no longer mere dreams for Safiana Mwelondo. She has more to spend because she has doubled or even trebled the yields from her small rice farm.

Safiana has half a hectare of land in the Mombo Rice Irrigation Scheme, a 200-hectare scheme in Tanzania's Tanga region. She has been able to boost her output thanks to two things. First was training she received from Sokoine University of Agriculture as part of the AGRA-funded rock phosphate project. And second, she now applies phosphate fertilizer to her crop.

In common with many – but not all – parts of Africa, the soil on Safiana's farm is deficient in phosphorus, one of the three major nutrients that plants need (the others are nitrogen and potassium). Without enough phosphorus, rice plants are stunted and spindly. The younger leaves seem healthy, but older leaves turn brown and die. The leaves in some varieties turn purple. Despite this, moderate phosphorus deficiency is hard to recognize in the field.

Phosphorus deficiency is not as common as nitrogen deficiency, so many farmers and extension workers do not think of applying phosphorus fertilizer.

Tanzania is fortunate to have large deposits of high-grade rock phosphate east of Lake Manyara. This deposit is mined by Minjigu Mines & Fertiliser Ltd., a private company that crushes the rock into powder, granulates and blends it to two different formulations: known as Minjingu Hyperphosphate and Minjingu Mazao (*mazao* means "reap results" in Swahili). The company sells these fertilizers in Tanzania, South Africa, Zambia, Kenya, Uganda, and Rwanda.

Compared with diammonium phosphate (DAP, a more concentrated but purely artificial chemical fertilizer), the Minjingu fertilizers have various advantages: they are produced locally; they contain substantial amounts of calcium along with some magnesium and potassium, plus traces of micronutrients such as boron, zinc and copper, which plants need in small amounts. Minjingu Mazao fertilizer is also supplemented with nitrogen (10%), sulphur (5%) and zinc (0.5%). Both types release phosphate slowly into the soil, so have an effect over several seasons. But this slow release is also a disadvantage, as farmers may see the benefits only in the next season. The Minjingu Mazao formulation aims to overcome this: it is a blend of Minjingu Hyperphosphate with urea, which dissolves quickly so has an immediate effect on the crop. A bag of Minjingu Mazao contains about half the nutrients as a bag of DAP, but costs only half the price (Table 3).

Minjingu Mazao is part of a package offered by government through the National Agricultural Input Voucher Scheme. Under this scheme, farmers get three vouchers that they can exchange for inputs: one voucher for 10 kg of improved seed, one voucher for a bag of DAP or two bags of Minjingu Mazao, and one voucher of a bag of urea.

So the supply of fertilizer is there. But how about the demand? And how about the chain of extension staff who advise farmers, and the agro-supply dealers who sell bags of the fertilizer? And which farmers should apply this type of fertilizer?

Case	11
Project name	Scaling up Minjingu phosphate utilization in balanced fertilization programme of crops in Tanzania
Key actors	Sokoine University of Agriculture Minjingu Phosphate Company, Tanzania Fertilizer Company Extension Directorate of the Ministry of Agriculture African Soil Health Consortium Research institutes in eastern and northern Tanzania
Beneficiaries	100 extension workers 10,000 smallholder farmers Agro-input dealers
Location	Siha and Same (Kilimanjaro region), Kilombero, Morogoro and Mvomero (Morogoro region), Korogwe, Mkinga, Muheza and Handeni (Tanga region), **Tanzania**
Years	2009–14
Project budget	$424,416
Contact	Johnson MR Semoka, Soikone University of Agriculture, semoka@yahoo.com, www.suanet.ac.tz Based on an original manuscript by JMR Semoka, ST Ikerra, N Amuri, C Msuya-Bengesi and I Kullaya

Table 3 Prices of various types of fertilizer in Morogoro, eastern Tanzania

Fertilizer type	Formulation ($N:P_2O_5:K_2O$)	Price (TSh per 50-kg bag)	Price (TSh/kg P)
Urea	46:0:0	65,000	2,826
DAP	18:46:0	65,000	6,500
Minjingu Mazao	10:20:0	32,500	7,386
Minjingu Hyperphosphate	0:28:0	26,000	4,000

Prices of Minjingu fertilizers from Minjingu Mines and Fertiliser Ltd; others from agro-dealers in Morogoro

TSh 1,700 = $1

Apply phosphate only if your soils need it

Finding answers to these questions was the aim of the Sokoine University phosphate rock project. The project complemented a larger government effort to promote the use of phosphate fertilizer. It trained about 100 extension staff and over 10,000 farmers in eight districts in eastern and northern parts of Tanzania. It focused on maize and rice: two major food staples in the country.

During the 2010/11 cropping season, the project worked with farmers' groups to conduct 45 demonstration trials in seven districts: Siha in Kilimanjaro region; Kilombero, Morogoro and Mvomero in Morogoro region; and Korogwe, Mkinga and Muheza in Tanga region. The demonstrations compared urea (60 kg/ha N/ha) and phosphorus fertilizer from different sources, namely diammonium phosphate (DAP), Minjingu Hyperphosphate and Minjingu Mazao (20 kg P/ha) with the farmers' usual practice, which is applying no fertilizer at all.

These demonstrations showed that farmers should be careful when choosing whether to apply phosphorus. In some locations, the yield increases were spectacular (Figure 18). In other places, the phosphorus scarcely increased yields at all, and farmers would lose money if they invested in it (Figure 19).

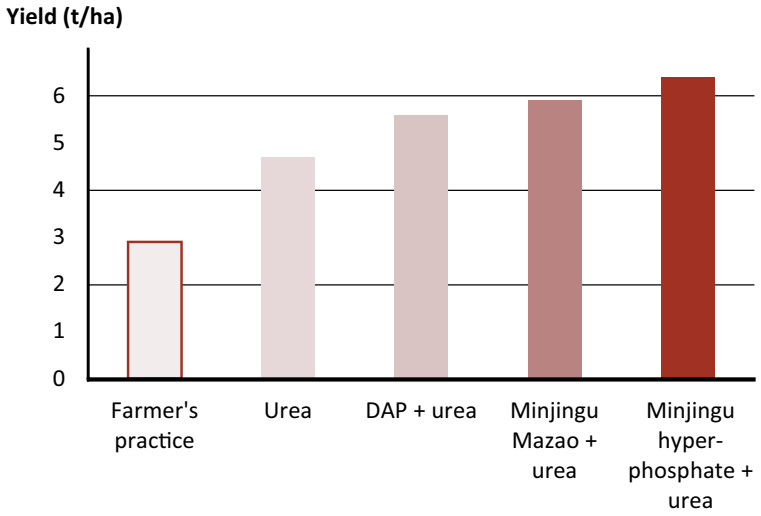
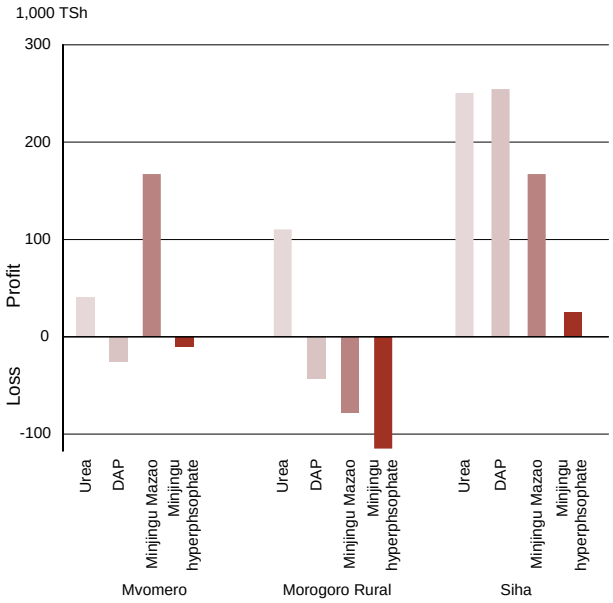


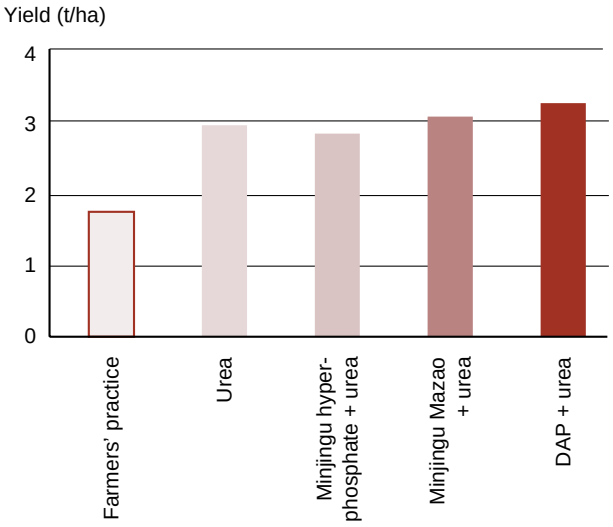
Figure 18 Rice yield in Kilombero, 2010/11 season



Net returns from different fertilizers compared to using no fertilizer, selected districts

Exchange rate: $1 = TSh 1,700

Figure 19 Applying urea is a good idea. For phosphate, it depends



Urea: 60 kg/ha

Minjingu Hyperphosphate, Minjingu Mazao and DAP: 20 kg P_2O_5/ha

Figure 20 Effects of urea and phosphate fertilizer on maize yield over seven districts

Combining results from the seven districts, the most effective and most profitable combination was 60 kg/ha of urea plus 20 kg/ha of either DAP or Minjingu Mazao (Figure 20).

If your soil needs phosphorus, which should you choose: DAP or Minjingu Mazao? Minjingu Mazao, because it has longer-term effects: the phosphate it contains is released slowly into the soil, so it fertilizes the subsequent crops, whereas DAP has to be applied each season. That makes Minjingu Mazao more economical in the long run.

Training on fertilizer

For farmers to make the decision on whether to invest in phosphate fertilizer, they need to know whether their soil needs this nutrient. The project staff trained 100 extension staff and 10,000 farmers how to sample their soils and get them tested. The tests showed that that the soils tended to moderately to strongly acidic. Acid soils bind phosphorus tightly so plant roots cannot absorb this element, so it is necessary to add phosphorus fertilizer to make up the deficiency.

The training did not stop with phosphorus. It also covered the key principles of conservation agriculture (a method of farming that avoids ploughing, keeps the soil covered, and rotates crops from season to season), crop nutrition, and other integrated soil fertility management techniques.

To help the farmers understand these approaches, the project produced two simplified guides on maize and rice production, along with leaflets and posters.

Successful agro-dealer training, but slow uptake

The project helped improve the supply of fertilizers in various ways. It trained input dealers on topics such as record keeping, seed selection, use of pesticides and fertilizer storage. "We were also taught how to advise farmers on fertilizer use to realize good yields," says Doto Selemani, a dealer in Ifakara, a village in Kilombero district.

The project also ran a voucher scheme to help farmers buy the fertilizer on credit. It identified creditworthy farmers' associations and gave farmers loans to cover half the cost of the seed and fertilizer they needed. The loan was recovered after harvest through the farmers' association. Fifty tonnes of fertilizer were supplied in this way. For the two associations that qualified for the scheme, recovery of the loan was 100%.

Unfortunately this scheme did not work for most of the farmers' groups established during the project period because they had not evolved to the level that they could meet the criteria set for loans. The cooperative units in the district councils were advised to continue mentoring the farmers' groups to strengthen them.

Counting the benefits

In all, over 10,000 smallholder farmers and other stakeholders have received information from the project. Around 5,000 of these now use Minjingu fertilizers, mainly Minjingu Mazao, on a total of 8,500 ha. Some 1,300 farmers neighbouring the demonstration farms applied the recommended package of one bag of DAP at planting and two bags of urea for topdressing. This resulted in a rice yield increase from an average of 3.5 t/ha to 5–6 t/ha.

The project found that farmers should be encouraged to apply nitrogen fertilizer, as this raised yields and profits in all areas. They should apply phosphorus only if their soils require it: according

to research, that is if the soil is deficient in phosphorus and acidic (with a pH of less than 5.5). To find out if this is so, they should get their soils tested. Soil tests are needed in each village, and ideally in each farm.

The Minjingu Mazao formulation is a good option for farmers who need to apply phosphate.

Credit facilities are a good way of getting fertilizer out to farmers, but farmers' associations have to be strengthened so that they can use the facilities.

CLIMBING UP WITH CLIMBING BEANS IN RWANDA AND KENYA

"Climbing beans are so sweet whichever cooking method you use and for this reason I can never fail to plant them for my own use", Eliphas says. He and his wife Idah Muthoni Kaburu farm a 0.4 ha plot in Chogoria division, Maara district, in the central highlands of Kenya.

The beans are good for the soil too, as Eliphas and Idah have found. Rotating the beans with a cereal crop not only produces beans for home consumption or sale; it also enriches the soil with nitrogen fixed by nodules in the climbing beans' roots.

Instead of staying small, like bush beans, these varieties climb up poles. "The climbing beans have higher yields", says Eliphas. "One kilogram of climbing bean seeds yields about 180 kg, while 1 kg of bush beans yield 50 kg under similar management."

Climbing beans produce a lot more vegetation than bush bean varieties. Incorporating the leaves and stems back into the soil boosts the organic matter and fertility of the soil. That increases the yields of the next cereal crop grown in the field.

Climbing beans are not a traditional crop in the area. Eliphas and Idah found out about them in 2011 through a training course organized by the Kimwe dairy group, which they belong to. "After the training we planted 200 g of climbing beans and harvested 45 kg during the short rains of October 2011", Eliphas explains. He says that a similar quantity of bush beans would yield only 10 kg.

The couple plant the beans at a spacing of 90 cm by 60 cm. They apply manure and commercial fertilizer to the crop. They are pleased with the results, and eager to pass on their knowledge. "I have been able to share these information as well as the seeds with several of my neighbours and friends", says Eliphas.

Projects in Kenya and Rwanda

Eliphas and Idah are among the thousands of farmers in central Kenya who have learned how to grow beans from an AGRA-funded project led by Kenyatta University. This aimed to reach 30,000

Climbing beans produce a large amount of biomass that can be returned to the soil.

Case	12	13
Project name	Increasing soil fertility benefits of climbing beans and associated agroforestry interventions under smallholder production systems in the Northern and Eastern regions of Rwanda	Enhancing productivity and market development of soybeans and climbing beans in the central highlands of Kenya
Key actors	Rwanda Agricultural Board Local government Extension workers Farmers' organizations NGOs	Kenyatta University Ministry of Agriculture Farm Concern International Kenya Agricultural Research Institute Farmers' groups
Beneficiaries	25,000 farmers	30,000 farmers
Location	Musanze (Northern province), Bugesera, Ngoma and Nyagatare (Eastern province), Rwanda	Embu and Meru regions, Kenya
Years	2010–13	2010–13
Project budget	$544,077	$806,629
Contact	Ngoga Tenge Gislain, ngogatenge@gmail.com, ngogaisaac@yahoo.com, www.rab.gov.rw	Jayne Mugwe, jaynemugwe@yahoo.com, www.ku.ac.ke

Box 7 Beans for Bellancille

Bellancille Nyiramiryango recently started growing climbing beans on her 1.2 ha farm in Burera district, in northern Rwanda. A widow with four children, she rotates the beans with potatoes, maize and sorghum. That has raised her sorghum yield from 0.5 to 0.7 t/ha, bringing in an extra $200 per season. She has bought a cow with the money she earned; it gives her milk, as well as manure she uses to make biogas. She spreads the biogas slurry along with fertilizer on the soil. Higher soil fertility means higher bean yields too: they have gone up from 0.8 to 1.4 t/ha.

farmers with information and seed of two types of legume: climbing bean and soybean. A similar project worked in Rwanda, led by the Rwanda Agricultural Board, aimed to serve 25,000 farmers.

Because these were new crops for many farmers, it was necessary to tell them where to get the seed and fertilizer they need, and train them how to grow them. The projects addressed various constraints. We focus here on those relevant to climbing beans.

Supply of improved seed

Persuading farmers to grow climbing beans is of little use if they cannot get seed. Seed firms are typically not interested in producing and distributing legume seed as farmers only need to buy one batch, and can then use it to produce more on their own. That makes seed production an uninteresting commercial proposition.

The projects' solution was first to produce seed of improved climbing bean varieties on research stations, and then distribute them to farmers, who multiplied and distributed it to members of their groups. The multipliers had to return the same amount of seed to the project as they had received; in Kenya, they had to return double the amount. The projects trained them on seed production and postharvest handling. Over 3 years in Rwanda, 722 t of improved seed were produced in this way at more than 20 locations. In Kenya, some 7,035 farmers (51% of them women) received climbing bean seed through this system. Half of them shared seed with at least one neighbour, so more than 10,000 farmers got improved seed in this way.

Training on bean production

This covered aspects such as plant spacing, fertilizer application, staking, weeding, harvesting and storage. In Rwanda, farmers traditionally broadcast the seed of climbing beans. The irregular spacing makes it hard to use stakes, weed the crop, and harvest the beans.

The Rwanda project organized training sessions for 150 farmer representatives, 400 demonstration trials, along with two farmer field days and study tours on good agronomic practices. In this way, 4,825 farmers were trained in the production techniques, including the use of phosphorus fertilizers and farmyard manure. The project also produced promotional and training materials and distributed them to 20,000 extension staff and farmers.

In Kenya, climbing beans are new, so farmers have to learn from scratch how to grow them. Over 150 field days were held across the study area, attended by nearly 29,000 farmers (half of them women). Over 38,000 farmers attended training on production techniques, value addition, utilization and marketing of soybean and climbing beans. The project also trained 134 local en-

Harvesting and weighing climbing beans

trepreneurs in postharvest handling and entrepreneurial skills, and 137 extension personnel in production technologies.

Getting poles

Climbing beans want to climb… and that means farmers need a good supply of poles, each 2–3 m long. One hectare of beans requires about 52,000 poles. In Kenya, farmers generally use the long, straight branches of *Grevillea robusta*, a fast-growing tree. In Rwanda, farmers use Napier grass stems rather than wooden poles; they last for three seasons. A shortage of suitable poles, and the cost of buying them, are major constraints to farmers planting climbing beans on a large scale.

The Rwanda project obtained seeds of various agroforestry species (*Leucaena leucocephala*, *Calliandra calothyrsus*, *Gliricidia sepium* and *Alnus acuminata*) from the agroforestry programme of the Rwanda Agriculture Board. It gave these seeds to five farmer groups, which set up nurseries and produced 30,000 seedlings. Farmers were encouraged to plant them along farm borders, hedges and terraces. That not only produced beanpoles; it also helped control soil erosion and produced leaves and prunings to be fed to animals and enrich the soil.

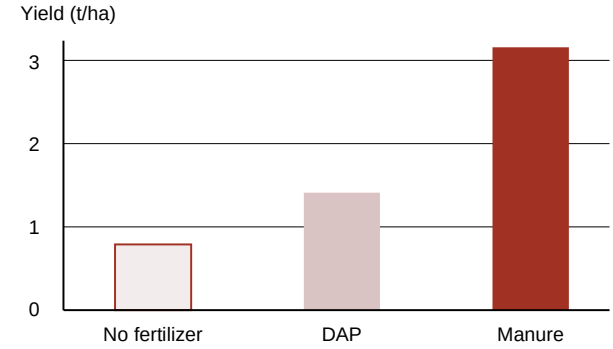
An alternative is to replace most of the poles with string. Alex Kiura Titus, a farmer in Manyatta Divison, Embu, Kenya, sets up strong poles at the ends of each row, suspends a wire between them, then allows strings to dangle from the wire. He then guides the beans to climb up the strings.

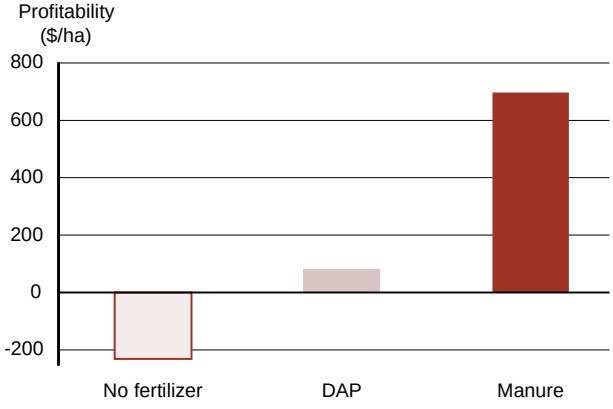
Empowering farmers' groups

Farmers' groups were central to the projects' efforts in both countries. Project staff worked with existing groups, trained them in group dynamics, and helped them agree to bylaws to govern themselves. The farmers' groups played an important role in disseminating seed and information.

Fertilizer applications

Many farmers think they do not need to fertilize beans. That is untrue: they yield a lot more if they are given an appropriate level of fertilizer – preferably farmyard manure. The projects ran a series of tests on village farms to compare various combinations of fertilizer and manure.





Profitability = value of output – cost of seed, poles, fertilizer and labour

Figure 21 Yield and profitability of climbing beans in Rwanda. Remera and Rwaza (Northern Province) and Karembo (Eastern Province)

In Rwanda, tests found that applying 50 kg of DAP fertilizer (18–46–0 NPK) increased bean yields from 0.8 to 1.43 t/ha. Using lots of manure (20 t/ha) boosted yields much more: up to 3.2/t/ha, and was much more profitable (Figure 21).

But fertilizers are expensive and can be hard to find. Both projects helped farmers to get the fertilizer they needed on time. The Kenya project organized dealers to deliver inputs to the farmers at a reduced cost. In Rwanda, the project arranged for farmers to be loaned fertilizer at the beginning of the season, and pay for it after harvest in the form of seed.

Climbing beans are spreading

As a result of the projects, the area of climbing beans has risen and yields have gone up in both countries. In the Kenya project area, the number of farmers growing this type of beans rose from 12% to 53%. The average area planted doubled from 700 m^2 to 1,300 m^2 (about one-eighth of a hectare).

Climbing beans are filling an important niche in diets. Like Eliphas and Idah, many Kenyan farmers like their taste. A survey of 231 farmers found they consumed about 60% of the beans they grew themselves. They sold relatively little of their crop.

Climbing beans take longer to mature than bush beans, and they do not all mature at the same time. The continuous harvest means that farmers can do several pickings throughout the season if they want to sell fresh beans, or pick when they want a vegetable to accompany a meal.

Not yet at the top

Yields of the beans have not yet achieved their potential for several reasons. One is a shortage of stakes: 52,000 stakes per hectare is a lot of poles. And many of the stakes are too short to give the highest yields. Even fast-growing shrubs take at least 9 months to produce poles of the right length. In Kenya, a market has arisen for the stakes: one pole costs KSh 10, and can be used for five seasons.

Climbing beans need a lot of water. Most of Rwanda gets enough rain, but the areas suitable for the crop in Kenya still need to be mapped.

Birds can be a serious threat to climbing beans: they eat the flowers, and no flowers means no beans. Farmers have found inventive ways around this problem. For example, they plant sunflowers as a "catch crop" near the bean field. The birds prefer the sunflowers and leave the beans alone. Other farmers plant the beans near their houses, where they can scare birds away more easily.

PROMOTING FERTILIZER AND PIGEONPEA IN THE BEIRA CORRIDOR OF MOZAMBIQUE

The Beira Corridor is an important chunk of Mozambique. This slice of land links Beira, a port and Mozambique's second city, with Zimbabwe, Malawi, Zambia and the eastern part of the Democratic Republic of Congo – landlocked areas with big growth potential. Despite its strategic importance, the corridor has been relatively neglected until recently.

That is beginning to change. The Mozambican government is investing in rail and road links, and is encouraging investment in the region. It is also investing in farming through the Beira Agricultural Growth Corridor, an initiative launched in 2010 that focuses on commercial agriculture and agribusiness.

An AGRA-funded project implemented by the Mozambique Institute of Agricultural Research (known by its Portuguese initials, IIAM), is part of this broad effort. The project set out to improve soil fertility, productivity and livelihoods of smallholder farmers in the corridor in Mozambique by promoting fertilizer use and by integrating pigeonpea into local farming systems. Most farmers grow maize and sorghum but not legumes. They use very little fertilizer: Mozambique's fertilizer consumption is only 3.5 kg/ha, one of the lowest rates in the world (the world average is 107 kg/ha). Fertilizers are scarce and expensive, and farmers do not know much about how to use them. As a result, crop yields are low – typically less than 1.0 t/ha for maize.

The IIAM project aimed to change this by raising farmers' awareness on the use of fertilizer, developing fertilizer dosage recommendations, persuading farmers to grow legumes (pigeonpea, groundnuts, cowpea and soybeans) in rotation with their maize, and help farmers find markets for their legumes. The project targeted 30,000 farmers in two provinces in the Beira Corridor, Manica and Sofala.

Training and demonstrations

The project trained 25 extension workers in four districts: Gorongosa in Sofala province, and Manica, Vanduzi and Báruè districts in Manica province. These staff learned how to set up demonstration plots and train farmers in integrated soil fertility management techniques. These included fertilizer application rates, correct crop spacing, intercropping and rotation of maize and pigeonpea, incorporation of crop residues, and pest and disease management. A total of 354 demonstrations were established across the four districts over the 3-year project duration. The demonstrations were sited on the land of cooperating farmers. These farmers and locations were selected carefully: the farmers had to be well-respected in the community; their fields had to be close to a road, have the right soil and other conditions, and be able to handle visiting farmers.

More than 4,000 farmers attended a total of 24 field days to showcase the soil fertility techniques.

Case	14
Project name	Improving smallholder productivity and livelihoods of small-scale farmers in the Beira Corridor of Mozambique through increased fertilizer use and integration of grain legumes
Key actors	Mozambique Institute of Agricultural Research (IIAM), Central Zone Research Centre
Beneficiaries	30,000 farmers
Location	Gorongosa (Sofala province), Manica, Vanduzi and Báruè (Manica province), **Mozambique**
Years	2010–13
Project budget	$678,000
Contact	Magalhaes A Miguel, IIAM-CZC, magalhaesamademiguel2013@gmail.com, www.iiam.gov.mz

The project also produced several posters, flipcharts, booklets and leaflets to promote the fertility management practices. It distributed these to extension workers, input dealers and farmers.

Input supplies

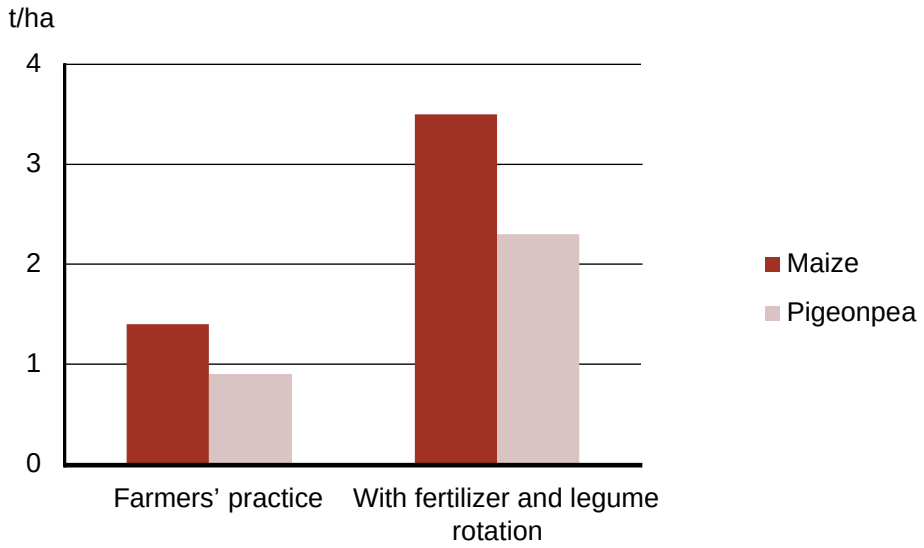
The project helped link farmers with seed and fertilizer suppliers. Some of the farmers – on a first-come, first-served basis – could buy fertilizers on credit: they paid half the price when they received the inputs, and paid the balance after they had harvested their crop.

Strengthening soil services

IIAM's Central Zone Research Centre, which managed the project, conducts analyses of soils and plant tissues. The project improved the centre's laboratory equipment and supplies to strengthen its ability to do so. As a result, soil and plant tissue samples no longer have to be sent to Maputo or to neighbouring Zimbabwe for analysis. More samples can now be analysed, and the results can be obtained faster.

From zero to 15,600

After 3 years of project work, 15,600 farmers are now using integrated soil fertility management techniques in the four districts. That is up from zero before the project began. Another 21,000 farmers know about the technologies. A total of 12,500 ha are now farmed using the improved methods. Among the adopters, maize yields have risen from 1.4 t/ha before to 3.5 t/ha now. Legume yields have gone up from 0.9 to 2.3 t/ha (Figure 22). Farmers now have a new product, pigeonpea, that they can sell on the market. The rising demand for fertilizer has stimulated input dealers to open outlets in all four project districts.



Data from 98 demonstration plots involving 1,770 farmers in Gorongosa, Manica, Vanduzi and Barue districts in 2011.

Figure 22 Yields of maize and pigeonpea with and without soil fertility practices in the Beira Corridor

3 Input supplies

Previous page:

Inspecting a fertilizer warehouse in Kumasi, Ghana

PROFESSIONALIZING INPUT BUSINESSES IN BURKINA FASO

Modern Seed has grown from small beginnings. This chain of four shops sells seeds, fertilizer, pesticides and other inputs around the city of Bobo-Dioulasso. It started in 2000, when Boukaré Sawadogo used his family savings to set up a small shop on a street corner in the city. He found it tough going at first: few farmers came through the door, they knew little about the products he was trying to sell, and they could not afford to buy inputs at the start of the season.

Hoping to boost his business, Boukaré joined AGRODIA (Association des Grossistes et Détaillants d'Intrants Agricoles du Burkina Faso, or the Association of Wholesalers and Retailers of Agricultural Inputs in Burkina Faso). That led to an opportunity to attend training offered by an AGRA-funded project called Professionalization of Agro-Input Dealers of Burkina Faso (PRODIB). The training covered business management, product knowledge, demand creation, distribution management skills, extension advice, record-keeping and client relationships.

His new skills helped Boukaré to run his business better, attract new customers and strike deals with his suppliers. He was able to give farmers advice on how to apply fertilizers, use quality seed and solve farm problems. His business began to grow; he got a loan of FCFA 10 million (about $21,500) from the project credit facility to open three more shops.

Boukaré has trained his staff in the same knowledge and skills as he had learned. "I am determined to encourage more people to do business professionally," he says.

Advising farmers is a good way to win customers, he has found. He helps PRODIB organize field demonstrations and visits by farmers, and the project has selected Modern Seed as one of its four centres for technology transfer.

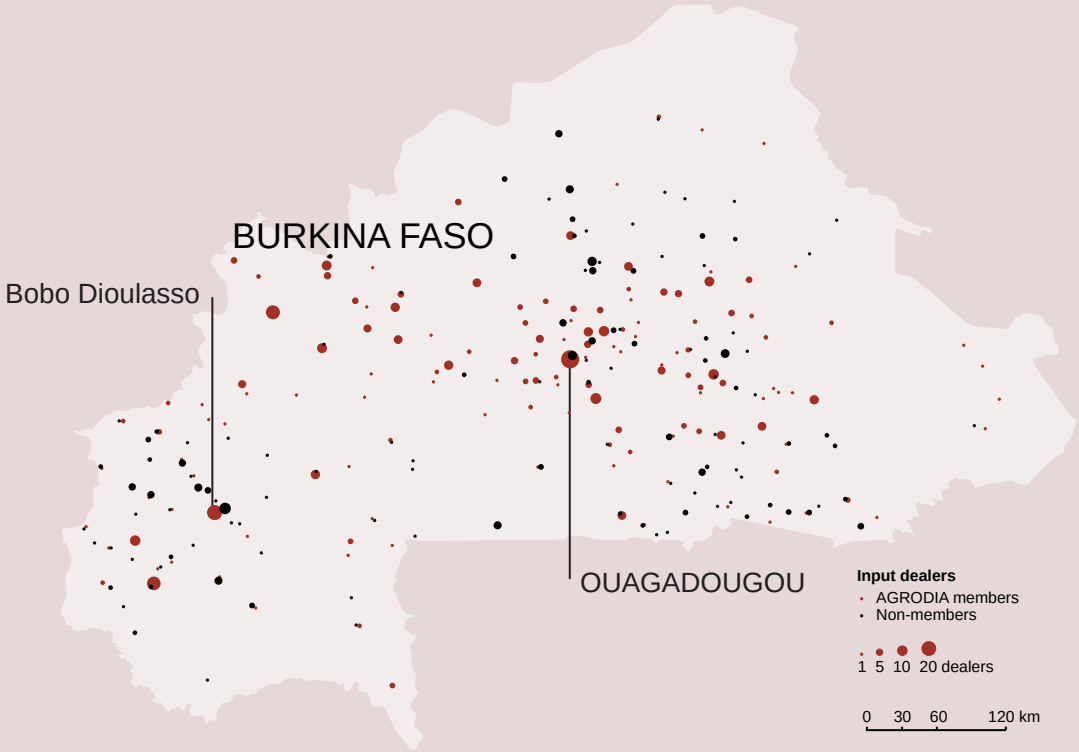
Using loans, Boukaré purchases fertilizer specially formulated to suit maize, and offers it on credit to his customers. He has become a major fertilizer supplier to the farmers' organization in Houet province, delivering more than 200 tonnes of fertilizer a year.

Professionalizing input dealers

A lack of fertilizer is one of the reasons that crop yields in Burkina Faso are low. On average, Burkinabé farmers use only 8.3 kg of fertilizer per hectare – way below the world average of 107 kg/ha, and less than the 50 kg/ha target set by African governments for 2015. Supply is part of the problem: there are few shops selling inputs, meaning farmers have to travel long distances to pick up a bag or two of fertilizer. Those that exist have little capital, so keep only limited stocks. Plus, many dealers have never learned how to manage their business or market their products. Poorly informed themselves, they were not in a position to advise farmers on what products to buy and how best to use them.

PRODIB aimed to change this by helping the input dealers become more professional. The 3-year project was a partnership between AGRODIA and the International Fertilizer Development Center (IFDC), with AGRA funding.

Case	15
Project name	Professionalization of agro-input dealers in Burkina Faso
Key actors	Association des Grossistes et Détaillants d'Intrants Agricoles du Burkina Faso (AGRODIA)
	International Fertilizer Development Center (IFDC)
Beneficiaries	994 agricultural input dealers
	400,000 farmers
Location	Burkina Faso
Years	2011–14
Project budget	$1,753,500
Contacts	Dominique Bassole, dbassole@ifdc.org, kabros2004@yahoo.fr, www.ifdc.org



Four pillars

The project rests on four pillars: training for input dealers, trading licenses, bulk purchases, and credit.

- **Training** PRODIB offered several types of training, covering basic technical skills, business linkages, ways to stimulate farmers' demand for products, sales and marketing, business skills, logistics planning, financial management, legal issues, and credit.
- **Trading licenses** With their improved skills, a total of 528 dealers obtained trading licenses.
- **Bulk purchases** PRODIB arranged for farmers' organizations to make bulk purchases of inputs from the dealers. Such purchases are good for both sides: they cut the cost of inputs for the farmers, at the same time as increasing the sales volumes and profit levels for the dealers. The dealers also offered extension advice to the farmers to further boost their sales.
- **Credit** PRODIB included a $250,000 AGRA grant dedicated to providing loans to dealers and farmers so they could expand their businesses. This money was deposited with the Bank of Africa, which also administered the loans. The loans were made available exclusively to dealers who were AGRODIA members. Regional AGRODIA committees vetted loan applications from association members. If approved, the applications were forwarded to a national committee, which again checked them before forwarding them to the bank to issue a loan. This mechanism has so far handled loans worth a total of FCFA 450 million (about $1 million).

Dealers use their loans to buy stock which they can then sell to farmers on credit at the start of the season. When the farmers repay at the end of the season, the dealer can also repay the bank.

A focus on dealers benefits farmers

While PRODIB focuses on input dealers, its ultimate goal is to benefit farmers. Nearly 400,000 farmers have gained better access to services and inputs. New shops have cut the average distance that farmers have to go to buy inputs by one-third: from 27 to 20 km. Alongside other projects and government initiatives, the project has helped boost average fertilizer use by 20%, from 8.3 kg/ha to 10 kg/ha. Farmers are now more likely to buy fresh seed, rather than save seed from their previous crop. That results in higher yields.

The dealers have benefited too. Over the project's 3-year lifetime, they sold nearly 5,700 t of improved seeds (more than three times the project target), and over 67,000 t of fertilizer, double the target. With their trading licenses, the dealers can get cheap loans and supplies.

AGRODIA has been registered with the authorities, and has grown from 255 dealer-members at the start of the project in 2011, to 994 by December 2013. Now with a nationwide reach, the association offers its members valuable training, information and support. It has a permanent office with four staff, regional and national committees to manage credit applications, and a directory to make it easy for farmers to find trustworthy dealers. The government has given it the task of distributing subsidized inputs throughout the country for the next 2 years (2014–15).

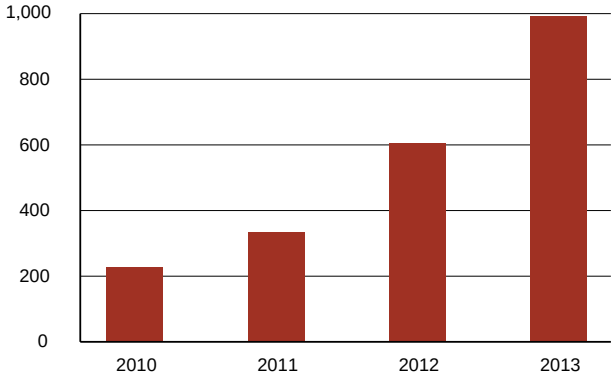


Figure 23 Cumulative number of input dealers trained by the project

Challenges and lessons

AGRODIA now has an excellent reputation, and maintaining it will take skills and initiative. The association needs to strengthen its regional chapters.

Credit remains a problem. Some dealers have been reluctant to sell products to farmers on credit: they fear that farmers will be unable to repay, and that would leave the dealers themselves in debt to the bank. AGRODIA intends to approach the farmers' association to negotiate ways to get cheaper credit for farmers in order to boost demand for the types of products the dealers sell. Future credit facilities should be designed to ensure that farmers as well as dealers can get credit to buy inputs.

While the distance farmers have to travel to the nearest dealer has fallen, 20 km is still too far. More dealerships are needed to cut the distance further.

TRAINING AGRICULTURAL INPUT DEALERS IN RWANDA

After she graduated with a diploma in agronomy in 2010, Gloriose Musanabandi decided to open a farm-input shop in her village in Gasabo district in Rwanda. She invested her savings in the venture. But things were difficult at first, Gloriose remembers. She had "limited capital to expand my business, very high prices of input products and low earnings, high operational costs and limited knowledge on input usage to advise farmers."

In 2011, she joined the Rwanda Agro-dealers Development Project, an AGRA-funded initiative to strengthen and professionalize input dealers throughout the country. The project gave her new knowledge and skills – and lots of ideas. She rented a small piece of land – about one-tenth of a hectare – by the roadside next to her shop. She used it to plant demonstrations to show the effect of fertilizer on crops. That season she sold 5.25 tonnes of fertilizer to 88 farmers.

She has not looked back. She now sells 11 tonnes of fertilizer a year, and she has opened a new shop in nearby Rugende. She earns 2 million Rwandan francs (about $3,000) a year. "Thanks for the project which has seen me move from one level to another", she says.

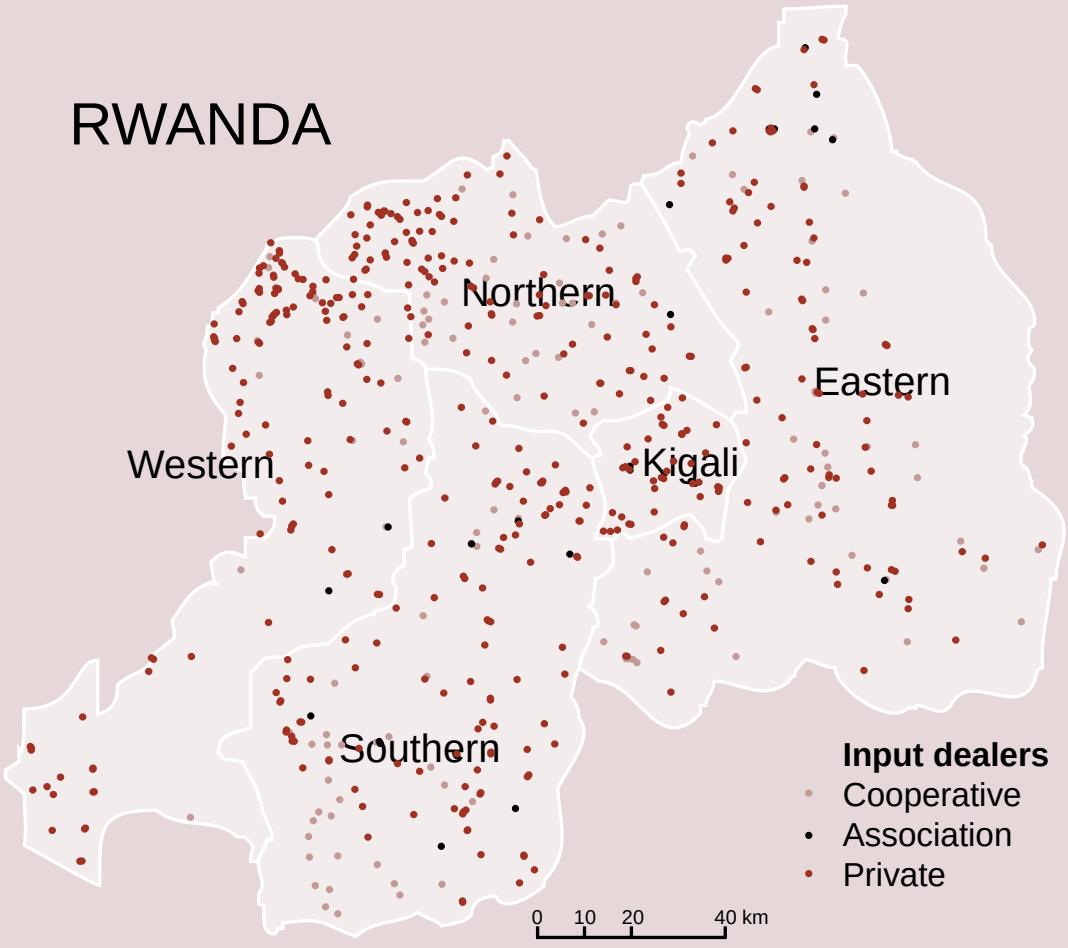
Empowering dealers

Rwandan farmers have to travel a long way – 10–20 km on average – to find inputs such as fertilizer and agrochemicals. The few input dealers know little about the products they stock, so cannot give farmers the correct technical advice. In addition, many farmers have a dim view of the dealers: they often think of them as engaged in smuggling or other types of shady business.

The International Fertilizer Development Center (IFDC) teamed up with AGRA to tackle this problem. The Rwanda Agro-Dealer Development Project aimed to develop a network of at least 400 trained and competitive private-sector input dealers, and boost the accessibility of and demand for inputs. It worked with both private enterprises (like Gloriose's) and cooperatives. The project had three main components.

Gloriose serves a customer at her shop in Rugende

Case	16
Project name	Rwanda agro-dealer development project
Key actors	International Fertilizer Development Center (IFDC)
Beneficiaries	1,062 agro-dealers
Location	Nationwide, **Rwanda**
Years	2010–13
Project budget	$1,550,000
Contact	Jean Bosco Safari, sjboscofr@gmail.com, www.ifdc.org



Agricultural input dealers in Rwanda

- **Human capacity development** This consisted of three parts: building the capacity of existing and potential private-sector agro-dealers and farmers' cooperatives, and to help them form business networks; strengthening input supply linkages; and setting up a trade association and disseminating market information. The project trained a total of 1,062 dealers (28% of them women) and equipped them with the technical skills to advise farmers on fertilizer matters. It also formed 31 district agro-dealers' cooperatives, five provincial unions, and a steering committee with the aim of setting up a national federation. This was followed by an accreditation survey that set up a database of agro-dealers' shops across the country, and two study tours in Kenya and Tanzania for 11 dealers.
- **Improving access to finance** The project trained 18 bank staff on financing input dealers' businesses, and 354 input dealers on business finance, management and credit. The relationships created through the training made it possible for the banks to offer affordable credit to the dealers so they could develop their businesses.
- **Spreading knowledge to farmers** The project used its training courses for the dealers to introduce them to new farming techniques. After the trainings, project staff helped the dealers set up fertilizer demonstration plots and hold field days for farmers. The project also used radio programmes and advertisements to raise awareness of the benefits of using fertilizer appropriately.

Reaching half the farm population

The dealers served by the project currently supply about 800,000 farmers (nearly half of Rwanda's farming population) with inputs. During the project lifetime, they supplied 126,000 tons of fertilizer. Because of the increase in number of dealers in rural areas, farmers now have to travel only 2–10 km to the nearest source of inputs, compared to 10–20 km before. The average maize yield without inputs is 0.9 t/ha; with fertilizer it is 3.5 t/ha.

The dealers have established 446 demonstration plots, and provide valuable training on the fertilizers to local smallholders. It is estimated that about 234,000 farmers cultivating 160,000 ha have benefited from these demonstrations and from the technical advice offered by the dealers. Farmers are now much more aware of where their nearest dealers are and the products they provide.

The database contains 1,158 dealers' shops across the country: it is a useful resource for banks and other organizations. The government uses the dealers' network to implement its "smart input subsidy" programme: the government provides vouchers for subsidized fertilizer to smallholders; they then redeem the vouchers at a dealer's shop. A voucher entitles them to buy fertilizer at half price.

The dealers borrowed nearly $265,000 in affordable credit from financial institutions. That has helped many of them to establish their own businesses or, like Gloriose, become agents of change in their communities.

Dealing with dealers

The Rwandan government recognizes the important role played by the input dealers, who have become key partners in its fertilizer subsidy programme. Nevertheless, the subsidies make it difficult for private-sector input suppliers to flourish. They find it hard to compete with the cheap inputs,

and some official distributors supply fertilizers directly to farmers, bypassing the dealers altogether. All this makes financial institutions reluctant to invest in the sector.

Indeed, banks still consider financing the dealers a big risk. The problem is on both sides: the dealers lack collateral, creditworthiness and financial management skills, while the banks know little about farming. Both sides need to learn more about the other.

The training of dealers ran into a gender problem: many dealerships are owned by couples. The husband would attend the training, even though the wife was the one who managed the shop. Only 28% of the training participants were women. The female shopkeepers might be reached more effectively by arranging shop-to-shop training.

Finally, it took longer than expected to form a national federation of dealers. This had still not been completed by the close of the project.

CONTROLLING FERTILIZER QUALITY IN GHANA AND TANZANIA

A farmer sees the kind of yield increases that fertilizer can bring. So she saves up her money, travels to an input dealer in town, and buys a bag of fertilizer. She takes it home, puts it on her field, and waits for the boost in yield.

She waits in vain. The fertilizer she has bought with her hard-earned cash has been adulterated: it contains only a fraction of the nutrients printed on the label. Somewhere between the port and the dealer, someone has added sand and stones to the bag.

Unfortunately this is by no means a rare problem in Africa. In Tanzania, 28% of the input dealers in the Southern Highlands zone, and 10% in the Northern zone, reported cases of substandard fertilizer from distributors or companies. Both are areas with relatively high consumption of fertilizer. In Ghana, a nationwide quality-control exercise carried out in 2010 by the Pesticide and Fertilizer Regulatory Division found that 51% of samples taken of 15–15–15 blend did not have the correct amounts of nutrient. Also, 12% of the fertilizer bags sampled were underweight. Other problems in Ghana and Tanzania include wrong or misleading labels, and adulteration. Some of these problems are genuine errors; others are clearly the result of fraud. Because fertilizers are both scarce and valuable, it is inevitable that some people in the supply chain succumb to temptation.

Error or fraud: the result is the same. Farmers do not get the yield they expect; they waste their money, and lose faith in the potential of fertilizer to improve their crop. Someone else pockets a quick shilling, cedi or franc.

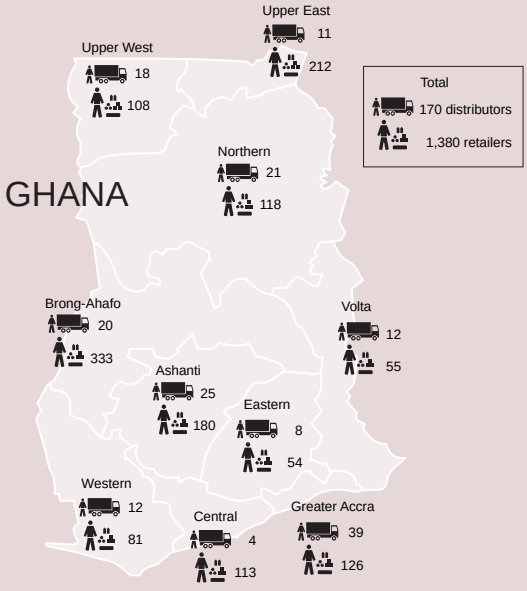
Building controls

Whatever the cause, better controls are needed to make sure that what the fertilizer label says is actually in the bag. That should be the job of fertilizer regulatory agencies in each country – but these are under-staffed and some lack the necessary equipment and skills.

Analysts checking fertilizer quality at the Agricultural Research Institute-Mlingano, Tanzania

Case	17	18
Project name	Strengthening institutions and capacity in fertilizer quality control in Tanzania	Ghana fertilizer regulatory capacity building productivity project
Key actors	Ministry of Agriculture, Food Security and Cooperatives (MOAFSC)	Plant Protection and Regulatory Services Directorate (PPRSD), Ministry of Food and Agriculture Ghana Atomic Energy Commission International Fertilizer Development Center (IFDC)
Beneficiaries	Farmers, fertilizer dealers, policymakers	Farmers, agro-input dealers, fertilizer inspectors, agricultural extension officers, researchers, police service, customs, state attorney
Location	Tanga and nationwide, **Tanzania**	Accra and nationwide, **Ghana**
Years	2010–14	2010–14
Project budget	$396,875	$466,669
Contact	Matilda Kalumuna, kokwijuka@yahoo.co.uk, kokwijuka2@gmail.com Agricultural Research Institute Mlingano, Tanzania. www.agriculture.go.tz	Felicia Ansah-Amprofi, fampronge@yahoo.com Plant Protection and Regulatory Services Directorate, Ministry of Food and Agriculture, Accra, Ghana. mofa.gov.gh

Areas already covered by the project in Tanzania



Registration of fertilizer dealers in Ghana

Take Tanzania as an example. The Tanzania Bureau of Standards used to be responsible for controlling the quality of fertilizer imports. It checked the fertilizer at the port of entry, but with only three fertilizer inspectors, it was in no position to do follow-up checks on wholesalers or retail dealers countrywide after that.

Various African governments have recognized the problem and are beginning to deal with it. The Tanzanian government passed the Fertilizers Act in 2009, which established the Tanzania Fertilizer Regulatory Authority. In Ghana, the Plants and Fertilizer Act of 2010 (Act 803) established the Pesticide and Fertilizer Regulatory Division to regulate the fertilizer industry.

AGRA has supported both Tanzania and Ghana to build the capacity of these institutions to enforce the laws. The projects consisted of three major components.

Awareness creation and advocacy The projects supported the national governments to create awareness about the new laws among input dealers and other carefully selected stakeholders. They held sensitization workshops, produced information brochures for distribution at workshops and agricultural shows, and used local and national radio and TV stations to publicize the new rules.

In Ghana, 630 individuals (350 farmers, 100 agriculture extension workers, 30 fertilizer inspectors, 100 input dealers and 50 others from the police, customs, immigration and the Environmental Protection Agency) attended the project workshops. In Tanzania, participants included 41 district officials, 250 input dealers, eight representatives of farmers' organizations and three media staff.

Building institutional capacity In Tanzania, the project provided the new Tanzania Fertilizer Regulatory Authority with office furniture and equipment. It also supplied additional equipment to a laboratory at the Agricultural Research Institute Mlingano in Tanga. This lab analyses soils, water and plants; the new equipment enables it to analyse fertilizers as well.

The project in Ghana equipped the fertilizer laboratory at the Plant Protection and Regulatory Services Directorate of the Ministry of Food and Agriculture.

Training In Tanzania, the project trained an additional 100 former extension officers as fertilizer inspectors. It trained 15 staff at four laboratories in the techniques needed to analyse fertilizers, and 178 input dealers in fertilizer law and quality management. Tanzania now has six laboratories capable of analysing fertilizers.

The project in Ghana trained 30 fertilizer inspectors, 3 analysts, and 100 other stakeholders.

The projects also developed inspection manuals for inspectors and field extension officers, as well as analytical manuals for laboratory testing of samples.

Table 4 Numbers of fertilizer enterprises registered in Tanzania and Ghana

Chain actor	Tanzania	Ghana
Importers	30	45
Distributors		170
Manufacturers	5	
Input dealers	395	1,380
Distributors	61	
Fertilizer products		123

Registration of dealers and inspection of dealer outlets

The Fertilizer Act in Tanzania requires the new regulatory authority to register and license fertilizer dealers. The authority has so far done this for five manufacturers, 30 importers, 61 distributors and 395 dealers. Inspections have found some with substandard fertilizers; they have been either warned or their businesses have been closed.

In Ghana, a total of 45 importers, 170 distributors, 1,380 retailers and 123 fertilizer products have been registered. The authority found that it was necessary to create awareness of the new fertilizer law before starting inspections: it proved counter-productive to carry out inspections when dealers who did not know that the law existed. Raising awareness first made it possible for various actors in the fertilizer supply chain – importers, distributors and retailers – to register their companies and comply with the laws.

4 Training and education

Previous page:

Learning how to inoculate soybean seed with rhizobium, Ghana

BUILDING CAPACITY IN INTEGRATED SOIL FERTILITY MANAGEMENT IN KENYA, ZAMBIA AND BURKINA FASO

IF FARMING in Africa is to develop, it needs specialists in various fields of agriculture – and especially in soil fertility. The continent's universities have the mandate to train these experts, but lack the capacity to do so. Problems include a shortage of staff, inadequate skills; poorly equipped laboratories, and ill-targeted research. Low government investment in tertiary education and agricultural research (below the NEPAD-recommended level of 2% of agricultural GDP) has undermined the universities further and made it hard to retain qualified research staff. African universities score low on international quality indicators of student supervision, staff composition by discipline, quality of teachers, publication records, membership in professional associations, and curriculum review and development.

Throughout the continent, research institutions, private companies and development agencies cannot get the highly qualified and motivated staff they need. In 2010 in Zambia, for example, less than 10 soil scientists with master's degrees worked for the Zambian Agricultural Research Institute. In Kenya, the government's Vision 2030 strategy recognizes inadequate agricultural research as a key weakness. In countries such as Mozambique and Rwanda, political turmoil led to loss of skilled personnel, who need to be replaced.

Healthy soils need skilled specialists

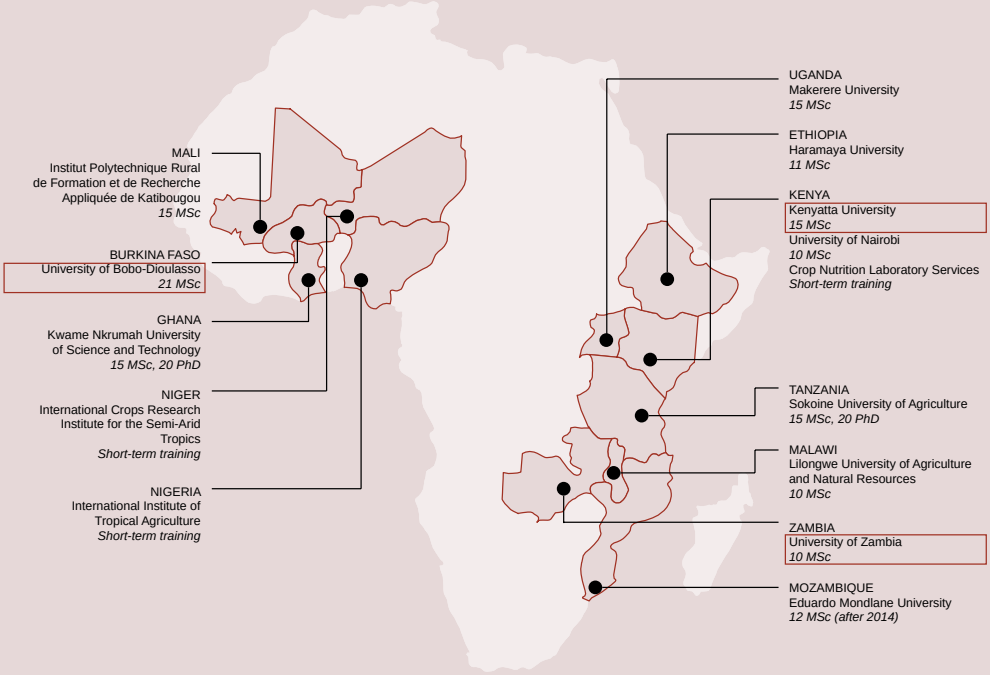
AGRA began tackling this issue in 2009, when it started working with universities and research institutions in various countries throughout Africa. The aim was to build the universities' capacity to train a new generation of young professionals in integrated soil fertility management. It supported three main aspects: postgraduate training of students, short courses for technicians and other staff, and refurbishing and re-equipping soil laboratories.

Postgraduate degrees

AGRA supported ten universities (see map) to train MSc and PhD students in soil science and agronomy. The PhD training was done at two regional hubs: Kwame Nkrumah University of Science and Technology in Kumasi, Ghana, for West Africa (see the next case in this chapter), and Sokoine University of Agriculture in Tanzania for Eastern and Southern Africa. The programme recruited candidates from national agricultural research institutions and universities who were already working in soil fertility management.

As of December 2013, 40 PhD students (one-third of them women) were studying for their doctorates at the two PhD hubs. For the MSc programme, 113 students (54% of them women) had been enrolled at various universities; 42 of them had graduated and returned to their home institutions. Some had been promoted; have continued to pursue studies for their PhDs, either locally or abroad. In addition, Eduardo Mondlane University in Mozambique will train 12 AGRA-supported MSc students in 2014–16.

Case	19	20	21
Project name	MSc integrated soil fertility management training programme	Capacity building through post graduate training in integrated soil fertility management	Masters training programme in soil science
Key actors	Kenyatta University, Kenya	University of Zambia	University of Bobo-Dioulasso, Burkina Faso
Beneficiaries	15 soil fertility management professionals in Kenya, Rwanda and Mozambique Soil fertility management lecturers, researchers and students at Kenyatta University	10 MSc students from Zambia, 6 lab technicians 1 soil science laboratory	21 MSc students from Burkina Faso, Mali and Niger Soil science lecturers, researchers and students of the Institute of Rural Development at University of Bobo-Dioulasso Ministry of Agriculture, Burkina Faso; Institute of Rural Economy, Mali; National Institute of Agronomy Research, Niger
Location	Kenyatta University, **Kenya**	University of Zambia, Lusaka, **Zambia**	University of Bobo-Dioulasso, **Burkina Faso**
Years	2010–14	2011–14	2010–13
Project budget	$716,697	$370,972	$488,881
Contact	Maina Mwangi, maina.mwangi@ku.ac.ke, www.ku.ac.ke	Elijah Phiri, ephiri@unza.zm, www.unza.zm	Bernard Bacyé, bbacye@gmail.com, www.univ-bobo.bf



Box 8 Learning about soil health: Immaculate Nyampinga

"My quest for agricultural knowledge has been driven by the need to help smallholder farmers back home in Rwanda to overcome the perennial food insecurity problem", says Immaculate Nyampinga. The 32-year-old student has wanted to learn more about agriculture since she was in high school. She is among 15 beneficiaries of AGRA scholarships taking an MSc course on integrated soil fertility management at Kenyatta University in Kenya.

Immaculate works with PRICE, an IFAD project in Rwanda. She says she has developed great faith in deep fertilizer placement and integrated fertilizer use. "Back home I advise farmers on deep placement to increase their yields, especially of rice," she adds.

Immaculate Nyampinga practising soil sampling with an auger

Training technicians

The programme enhanced the equipment-handling and analytical skills of 200 laboratory technicians at universities and national agricultural research institutes through in-service training. New staff were recruited where necessary. The training was held at Crop Nutrition Laboratory Services (a private firm in Nairobi), the International Crops Research Institute for the Semi-Arid Tropics (near Niamey, Niger), and the International Institute of Tropical Agriculture (Ibadan, Nigeria). In universities such as Kenyatta University, academic staff and technicians attended short courses in geographical information systems and biometry. To address the severe under-representation of women in agricultural research, at least 50% of training opportunities were reserved for women.

By December 2013, 183 of the targeted 200 lab technicians (41% of them women) had been trained on good laboratory practices and soil and plant analysis. Three-fifths of the technicians came from West Africa, the rest from Eastern and Southern Africa.

Strengthening institutional capacity

Doing training at African institutions has various advantages. It costs only half as much as in the United States or Europe. It also improves the facilities and staff of the institutions, and strengthens their ability to offer high-quality training. The programme allocated about 16% of its total budget ($12.5 million) to upgrade communications, water and electricity supplies, teaching facilities and laboratories in the 10 universities.

Such upgrades have a multiplier effect: they improve both undergraduate and postgraduate training, support multidisciplinary research, and serve public demand for soils, plant and water testing and advisory services. The labs can generate income by offering commercial soil, water and plant analysis services: the University of Zambia, for example, has doubled the number of samples it tests to over 2,000 per year. The income earned covers the lab operations, pays for chemicals used in training, and tops up the technicians' overtime pay. Plus, the university saves money by not having to send samples away for analysis.

Box 9 Personal and professional growth: Brian Gondwe

Brian Gondwe is one of 10 AGRA-sponsored students doing their MSc in integrated soil fertility management at the University of Zambia. The 31-year-old Zambia Agriculture Research Institute employee has submitted his thesis on "Evaluating maize genotype for N use efficiency", as well as a journal article for publication.

"This course is a milestone in my life and I can clearly see the benefits", he says. "I can now analyse soil and plant materials and I can prepare fertilizer recommendations. My seniors at work have developed a lot of confidence in me, and now they assign me projects they could not dare give me before. I immediately got promoted from research officer to senior research officer in recognition of my improved performance at work."

Improving training quality

The programme improved the quality of training in various ways. It promoted partnerships with centres of excellence in Africa and outside, sponsored visiting professors from the United States and the Netherlands, and supported the exchange of expertise among universities and research institutes in Africa.

It also revamped curricula for graduate courses, making them more practical, eliminating repetition, and making them more relevant to national requirements. This revision was based on a thorough needs assessment and various workshops involving faculty, administrators and vice-chancellors from the ten universities. Key aspects of the new curricula include integrated soil fertility management, agribusiness, geographic information systems, remote sensing, writing and communications skills, and climate change.

Student research

Research by the MSc and PhD students supported by the programme was clustered into five thematic areas. These aimed to improve the fertilizer supply and distribution chain, fertilizer use efficiency, nutrient and water interactions, diagnosing and managing soil health, and dissemination and delivery methods. Scientists from national and international research centres collaborated with the university faculty to guide the research. The students did participatory research with communities, preferably in their own countries; many worked with other AGRA-supported projects.

That meant the research was relevant to smallholders and could be applied immediately. In Rwanda, for example, the results of research on lime were used to set standards and guidelines for lime procurement and use. In Kenya, farmers are using findings on optimal intercropping of maize and soybean to increase their crop production.

Building strategic partnerships

Partnerships made it possible to leverage AGRA's investment, further develop institutional capacity and train more students. For example, the Regional Universities Forum for Capacity Building in Agriculture (RUFORUM), a consortium of 32 African universities, sponsored an additional six students at Sokoine University, the University of Nairobi and Kenyatta University, and supports a faculty exchange programme. Wageningen University in the Netherlands provides quality assurance to the two PhD training hubs, as well as the University of Nairobi and Kenyatta University. The

Box 10 Burkinabé graduates in key administrative roles

For soil fertility to take a more prominent role in agricultural development, it is not enough to just educate a few researchers. Administrators must also understand the key role of integrated soil fertility management in improving yields and income.

Apingwendé Rodrigue Ouedraogo and Pascaline Téné Abga épouse Kima are two master's graduates who work in the secretariat of the Ministry of Agriculture and Food Security in Burkina Faso. There they help steer decisions on agricultural policy and support small-scale farmers and input dealers. Soil fertility has high-level backing in Burkina Faso: Rodrigue works on a presidential programme known as "Operation 800,000 manure pits". Pascaline is in charge of studies at the ministry; her work covers aspects such as identification of eroded land, the impact of farming on the environment, and technology packets to improve soil fertility. She also helps recruit new staff and develop curricula for training centres.

training programmes work closely with experts within and outside Africa to support teaching, research and student supervision.

Institutionalization of interventions

The universities have invested their own resources to support the soil fertility training programme: they have recruited new staff; improved facilities; made library resources, laboratory and office space available; and provided housing to PhD students and visiting scientists. In Ethiopia, the government added six more students to the MSc course, enhancing the cost-effectiveness of the AGRA programme investments. In Ghana, the university invested in teaching classes and study cubicles before students arrived.

Overcoming challenges

- **Gender** It was difficult to meet the minimum 50% quota of qualified women students. That led to delays in admission in some universities. Incentives such as family support packages and other affirmative actions are needed to attract women.
- **Staff skills** Bringing in students from different countries and cultures revealed gaps in the capacity of staff to guide and support them effectively. Training on supervisory skills is recommended.
- **Demand exceeding supply** The demand for training in soil fertility management sometimes exceeded the human, physical and financial resources available. To address this demand, the universities found funding and resources from elsewhere, but this was still not enough. Quality management systems are needed to continue the momentum and sustain the programme integrity.
- **From research to dissemination** A lack of funding hampers efforts to disseminate the results of students' research. Funds for this should be a component of future grant budgets.
- **Staff turnover** High turnover of trained staff, particularly those who operate new equipment, may erode the gains from the intervention. Staff-retention measures are needed to avoid this.
- **Commercializing facilities** Ways are needed to transform the upgraded lab and field research facilities into viable commercial entities so as to fully harness their capabilities.

Box 11 A solution for acid soils: Athanase Nduwumuremyi

Acid soils are a big problem in Rwanda – but Athanase Nduwumuremyi knows the solution: apply lime. The results of his research on the topic have been used to set standards and guidelines for lime procurement and utilization in his home country (see the story in Chapter 2).

Athanase is one of 15 MSc students studying at Kenyatta University in neighbouring Kenya. A technician at the Institut des Sciences Agronomiques du Rwanda, he was promoted to assistant research fellow with the Rwanda Agriculture Board after earning his master's degree. He has since won a scholarship to study for his PhD in plant breeding at the African Centre for Crop Improvement, KwaZulu Natal University, South Africa.

Athanase Nduwumuremyi (left) with his supervisors from Kenyatta University: Dr Jayne Mugwe and Prof. Benson Mochoge at his research site in Rwanda.

GRADUATE TRAINING IN SOIL SCIENCE IN GHANA

You are a West African student, and you want to do your master's or PhD in agriculture. What subject do you choose? You could select something that leads to an attractive career – such as agribusiness, agricultural economics and biotechnology. Or you might go for a broad subject to make it easy to find a relevant job, like general agriculture and extension. Sure enough, in the last 10 years, enrolment in these subjects has risen.

Why not soil science? Unfortunately, this vital subject has been left behind. Student numbers have stagnated, and many universities' soil science curricula are seriously out of date. The lack of investment in the field is beginning to show: many soil laboratories have closed or are obsolete, and the few soil scientists have either retired, or are heavily overloaded and close to retirement age. The gender situation is particularly serious: few soil scientists are women.

Box 12 Chinyere's journey

In 2010, Nigerian student Chinyere Okebalama was awarded an AGRA scholarship to do her PhD in soil science at KNUST. That has given her the opportunity to learn a lot more than just soils. Her new skills include proposal writing, communication, statistics and data management.

"Through the capacity building initiative of the AGRA project, I was encouraged to apply for the African Women in Agricultural Research and Development (AWARD) fellowship", she says. With my writing skills, I was selected from among 790 applicants. Today, I am a proud fellow of the prestigious career-development programme."

In 2012, the AGRA project helped her attend a conference on soil health in Nairobi, where she presented her research on limiting major nutrients in two soils in the semi-deciduous forest zone of Ghana. She has also joined several professional associations, including AfNet and the Organization for Women in Science for the Developing World.

"Though it has been more challenging combining my pursuit for PhD with family responsibilities, this project has provided me with a comfortable apartment, health insurance for myself and dependants, and permission to visit my husband back home in Nigeria. I have become confident and more knowledgeable in integrated soil fertility management technologies and in soil science as a discipline", she says.

Chinyere in her research field

Case	22
Project name	AGRA PhD training in soil science in West Africa
Key actors	Kwame Nkrumah University of Science and Technology (KNUST)
Beneficiaries	20 PhD and 15 MSc students from Burkina Faso, Ghana, Mali, Niger and Nigeria
Location	Kumasi, **Ghana**
Years	2010–15
Project budget	$2,194,693 (PhD) and $500,157 (MSc)
Contact	Robert C Abaidoo, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana; abaidoorc@yahoo.com, www.knust.edu.gh

Study soils at KNUST

At Kwame Nkrumah University of Science and Technology (KNUST) in Ghana, AGRA's soil health programme is trying to overcome some of these constraints in two ways: by making soil science more attractive for students, and by upgrading the soil science department's facilities and curriculum. The project consists of five parts.

Scholarships The project gave scholarships to 20 PhD and 15 MSc students to study soil science at the KNUST. Most of these students were staff of national agricultural research institutes and universities in West Africa; they were selected competitively. The PhD candidates had to have a good master's degree in soil science, agronomy or a related field.

The scholarships provide the students with partial support: they include a stipend, accommodation, travel from the student's home country, support for thesis research, a laptop computer, and a book allowance. The four-year programme comprises one year of course work and three years for thesis preparation.

Students from francophone countries take a parallel 6-month refresher course in English to prepare them for the programme. This is one aspect of the programme that should be reconsidered: the students did not yet understand enough English to keep up with their soils-related coursework. Francophone students need to be given 6 months English language training prior to, rather than parallel with, the main course.

Research work in home countries The students go back to their home countries to do research on problems that affect people there. They either work in their original institutions, or KNUST links them to ongoing projects on soil health or related subjects.

Attracting women to soil science Women play a huge role in farming in West Africa, but there are very few female soil scientists. Reasons for this are the conflicting demands of family life and the heavy financial requirements for higher education. Half of the scholarships were earmarked for women candidates. In 2010, KNUST had no female postgraduate students in soil science. Under the AGRA programme, eight of the 20 PhD and eight of the 15 master's students are women. The project also offered special accommodation for women students with families, support for baby care, and visits by their families (Box 12). Such conditions make it easier for women to consider a career in soil science and make it less likely they will drop out for family reasons.

Improving curricula and infrastructure KNUST has collaborated with other West African universities to revise its soil science curriculum and make it more demand-driven. The new curriculum aims to address the many challenges facing smallholder farmers in Africa. It encourages the students to be more farmer-centred in their studies and research. Modules include climate change adaptation and mitigation, communication in agriculture, agribusiness, and qualitative and quantitative research methods.

Infrastructure improvements included the refurbishment of laboratories, purchasing of lab equipment, and training of laboratory technicians.

Quality assurance In fields where KNUST lacked sufficient capacity, the project engaged external academic staff to teach and supervise students. Lecturers came from universities in the Netherlands, Germany, Kenya and West African national research institutes. They have improved the quality of KNUST's coursework, helped the students gain confidence, and helped them publish their research findings.

A centre of excellence

The AGRA support has stimulated investments by KNUST itself in its soils department. It has erected an office block to accommodate the students, and extended the contracts of retired professors so they could mentor younger staff.

KNUST has now become a centre of excellence that attracts top-notch visiting professors from within and outside Africa. Its improved facilities attract students and projects from other countries in West Africa. A World Bank project has supported 39 students from The Gambia, Ghana and Sierra Leone to enrol in various programmes in agriculture. USAID has booked space for 15 students for the 2014/15 academic year. The Liberian government also sponsors students to study in Kumasi.

The volume of research has increased, and KNUST's partnerships with other universities have led to the regionalization of the soil science education programme. KNUST has established linkages with advanced universities in the Netherlands, Germany and Kenya. A total of 27 PhD and MSc students have completed their coursework, and 17 have finished their research.

"*Yɛn deɛ, agoro bi na yedie sɛ yɛreyɛ afuo!*" (we have just been joking and thinking we were farming), exclaimed Afia Ataa. She was impressed by her visit to the Kwadaso Agricultural College in Kumasi. She had seen how big the maize cobs were compared to her own fields. And she had learned how to produce such a good harvest herself: by not burning the stubble before ploughing, and by adding manure as well as the inorganic fertilizer she already applied.

Ms Ataa was one of 120 farmers who attended a field day at the college in July 2013. Demand was so large from the surrounding villages that the college had to hire three buses to bring in all the farmers who wanted to see the plots. Afterwards, farmers started phoning the college principal, asking for more information. The college assigned three extra staff to answer their questions.

Building capacity nationwide

The field day was one of a series organized by agricultural colleges throughout Ghana as part of an AGRA project. This project aimed to overcome one of the bottlenecks in the country's extension service: a lack of staff knowledgeable about integrated soil fertility management. It is the job of four agricultural colleges of the Ministry of Food and Agriculture, in Kwadaso, Ohawu, Ejura and Damongo, to train students in general agriculture. About 200 graduate each year; many of them go on to work in public and private extension organizations. The colleges also offer on-the-job training to practising extension staff. Because soil infertility is such an important problem in Ghana, it is vital that these students learn how to improve the soils.

In addition to the four colleges, the project also works with three farm institutes in Wenchi, Asuansi and Adidome, which also train students and farmers. The project is implemented by two universities: the University for Development Studies in Tamale and the University of Cape Coast, along with the Savanna Agricultural Research Institute of the Council for Scientific and Industrial Research.

Students marking out a plot to sow seed

Case	23
Project name	Improving food security of small holder producers through middle level manpower capacity building in soil health
Key actors	University for Development Studies, Tamale University of Cape Coast Savanna Agricultural Research Institute, Tamale
Beneficiaries	Agricultural colleges and farm institutes 30,000 farmers
Location	Damongo, Kumasi, Ejura, Wenchi, Asuansi, Ohawu and Adidome, **Ghana**
Years	2011–14
Project budget	$495,915
Contact	Francis K Obeng, francisobeng@yahoo.com, www.uds.edu.gh

Revising curricula

The curricula taught by the colleges and farm institutes were outdated: students focused mainly on crop production, and very little on soil health – even though a healthy soil is the basis for high and sustainable yields. A central plank of the project has been to modernize the curricula and incorporate integrated soil fertility management concepts. A joint review by staff of the universities and the colleges produced recommendations for revisions.

Staff from the University of Cape Coast facilitated the accreditation of a new course on integrated soil fertility management for the Kwadaso college's Diploma in Extension programme. This college is now teaching this course. The syllabuses of the other three colleges and farm institutes have been revised to incorporate soil fertility concepts, and are on track for accreditation.

The two universities have also revised their own soil science curricula to incorporate integrated soil fertility management at the bachelor's level.

Training staff and students

Even the best curriculum is of little use if staff cannot teach it. The project aims to train 60 staff of the colleges, farm institutes and practising extension workers in integrated soil fertility management, soil testing, soil sampling techniques, field layout and the use of global positioning systems. It has so far trained 14 academic staff and 25 extension workers.

Demonstrations of integrated soil fertility management are a key part of the teaching process. Staff and students lay out demonstration plots during the growing season following protocols designed by the University of Development Studies. A total of 21 demonstrations have been managed over the 3 years of the project. The demonstrations serve two purposes: they train the students – 824 of them over the last 2 years – about soil fertility and how to set up and run demonstrations. They also serve farmers in the communities around the colleges and farm institutes. Each institution invites farmers (like Afia Ataa) to field days when they can see the results of the demonstrations. Farmers around the Kwadaso college in Kumasi have donated land to two student groups to use for demonstrations, so speeding the adoption of the improved soil management methods by local people.

Equipment

The colleges and farm institutes lacked the basic equipment needed to do soil science, learn about soil properties, and advise farmers. The project provided them with simple soil testing kits, pH meters (to measure soil acidity), soil hydrometers and sieves (to measure particle size), weighing scales and assorted chemical reagents. It also provided global positioning equipment (important for mapping) and camcorders (for recording interviews).

Radio programmes

As part of its outreach work, the project has entered into partnerships with ten radio stations throughout Ghana to disseminate information on soil fertility to farmers. It has trained the radio station presenters and producers on soil fertility and developed programme scripts. In northern Ghana, four radio stations have broadcast 90 discussion programmes involving ministry and university staff, researchers and farmers. In the south, staff and students from the colleges collaborate with six radio stations; they have so far broadcast seven programmes.

Soil testing equipment, reagents and textbooks supplied to colleges

The programmes are in the local languages: Dagbanli, Gonja and Likpakpa in the north, and Akan and Ewe in the south. Farmers call into the programmes to present their views and ask questions. If the resource person cannot speak the local language, the host translates from English.

A few hiccups

Bureaucracy has been a challenge for the project. The curriculum in Kwadaso Agricultural College has been revised, but delays in accreditation have hindered the adoption of the new syllabuses in the other colleges. Current policy restricts the hiring of new government employees, so some of the new graduates may not be able to find the extension jobs they have been trained for. This is despite the shortage of extension workers in Ghana: there is only one such worker for every 3,000 farmers – not nearly enough to serve the country's needs.

The demonstrations have experienced a few hiccups along the way. In the first year some supervisors were not familiar with the correct way to set up demonstrations, so they did not follow the protocols properly. Drought and incorrect spraying against weeds harmed the crops. And some demonstrations used uncertified seeds because there were no certified input dealers nearby. The colleges should be linked to certified dealers to ensure a supply of quality seeds, fertilizers and other inputs.

The future of the radio programmes is in doubt after the end of the project. Currently, the project pays the resource persons an allowance so they can appear on the programmes. One possibility is for the ministry to take over these costs.

TRAINING FARMERS AS VILLAGE EXTENSION AGENTS IN NIGERIA

"YOUR TRAINING has equipped us and our families to improve our agricultural practices and thus improve our livelihoods…" The SMS was sent to one of the trainers at the Institute for Agricultural Research at Ahmadu Bello University. It was from John Kayit, who had been trained as a local agricultural extension agent by the university staff. With his new skills, he now advises 40 of his fellow villagers on how to grow crops and improve the fertility of their soils.

John is one of 336 farmers (including 96 women) that the university has trained as local extension agents. Their neighbours look on these agents with the same kind of respect they give to medical doctors. Many, like John, are literate: they are retired teachers, or are clergymen or traders, who are practising farmers but who lack any formal training in agriculture.

These agents are filling a major gap in the formal extension system in Nigeria. Most farmers rarely, if ever, meet a government extension agent: there is one formal agent for every 1,200 farmers. So there is big demand for advice on various aspects of farming, as well as for help in linking farmers to input suppliers and buyers of their produce. Farmers know their yields are low – less than 1 tonne of maize or soybeans per hectare. They could easily double these yields by applying the right types and amounts of fertilizer and by improving their crop management. But do not know how; they cannot get improved seeds or fertilizers; and they could not afford them even if these inputs are available. Plus, if they do grow a surplus to sell, they are not organized into groups to get a good deal from traders who might buy their produce.

Training farmers to train farmers

The four Rs of fertilizer application: Right source, Right rate, Right place, Right time

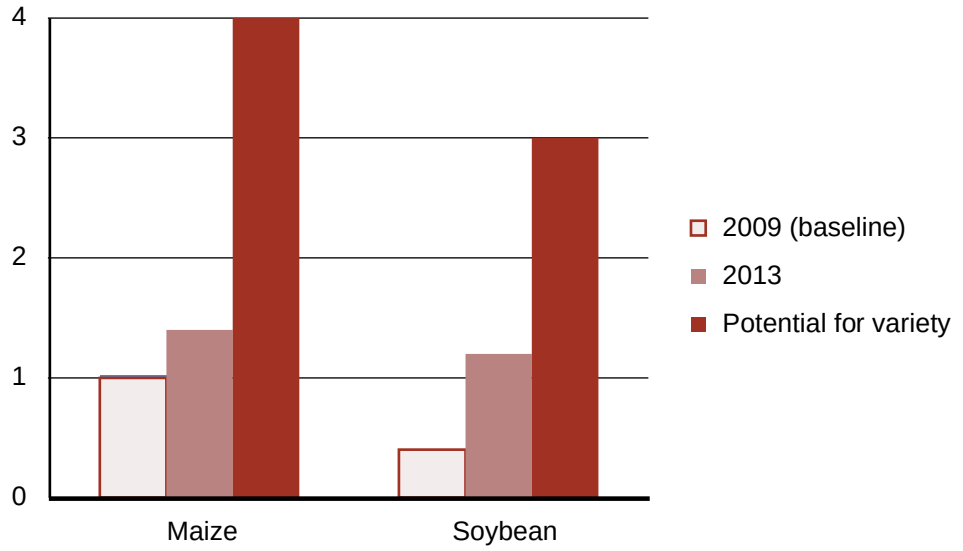
The Ahmadu Bello University project tried to overcome these problems. A key feature of this initiative was to train farmers as local extension agents in 29 pilot villages in nine states in the Guinea savannah zone of Nigeria. The focus was on teaching them about integrated soil fertility management. The project organized workshops with 30 to 50 farmers and government extension personnel. Participants learned improved farming techniques such as ideal crop spacing, crop management, pest control, and the "four Rs" of fertilizer application. They also learned extension methods such as how to organize groups and set up demonstration plots. The training was participatory and hands-on, building on the trainees' own knowledge and experience. It was conducted in both Hausa and English.

Other aspects included training in seed production, and linking groups to fertilizer companies and seed suppliers so they could buy fertilizer and seed directly in bulk.

Reaching out

The idea was for the farmer extension agents to complement the efforts of the government extension workers. In fact, they have ended up providing all the extension services to their fellow farmers. The project gave them a transport allowance of $37.50 per month, but no other payment.

Case	24
Project name	Promoting the wide scale uptake of integrated soil fertility management practices by smallholder farmers in the moist savannah ecologies of Nigeria
Key actors	Institute for Agricultural Research, Ahmadu Bello University (coordinator) National Agricultural Extension Research and Liaison Services Fertilizer Suppliers Association of Nigeria Sasakawa Global 2000 Agricultural development projects (official government extension organization) Seed and agrochemical companies Other AGRA projects in the area
Target beneficiaries	60,000 smallholder farmer households
Location	Pilot villages in Kaduna, Katsina, Kano, Zamfara, Federal Capital Territory, Nasarawa, Benue and Plateau states, **Nigeria**
Years	2009–11 (no-cost extension 2012–13)
Project budget	$803,094
Contact	Ishaku Y Amapu Department of Soil Science, Institute for Agricultural Research, Ahmadu Bello University, Zaria, iyamapu@yahoo.com, www.abu.edu.ng



Maize variety: SAMMAZ 14 open-pollinated; Soybean variety: TGX 1448-2E

Figure 24 Average yield of farmers in 29 pilot villages in the moist savannah of Nigeria

By the third year of the project, John and his fellow farmer agents were together serving a total of nearly 13,000 farmers – or nearly 40 people each. The number of farmers who had access to and used fertilizers rose from 19,000 in the first year to 37,000 in the third year.

Many farmers in northern Nigeria rely on government-subsidized fertilizer. The project started to change attitudes: more are now going to private dealers: they bought an extra 60 tons of fertilizer in total, without waiting for the subsidized product. They are also beginning to use improved production practices, such as sowing their seed at the recommended spacing and using the recommended dose and types of fertilizer. Yields have gone up as a result: maize yields have risen from 1 t/ha before the project, to 1.4 t/ha in 2013, while soybean yields have trebled from

Farmers being trained on the basics of fertilizers and their correct application

0.4 t/ha to 1.2 t/ha in the same period. The farmers have started to manage and sell their output collectively. The project helped them get organized into groups so they could do this.

A new trend is for farmers' groups to grow certified seed. In 2013, 144 farmers grew a total of 72 tons of maize seed and 77.6 tons of soybean seed (up from zero in 2009). They sold these to seed companies at a mark-up of a 27%, giving a gross income of ₦13 million ($80,000).

Problems remain

- **Village extensionists** Training farmers as extension agents is an effective way to help local people learn new techniques. The extensionists are motivated to improve their own farming, and can help their neighbours do the same. This approach should be scaled up.
- **Farming as a business** Farmers need help to see their farming as a business, and to encourage them to invest in and innovate what they do. Farmers' organizations can help in this: they can set up savings-and-credit schemes to help their members buy the inputs they need to improve their yields.
- **A need for trust** While organizing farmers into groups has had many benefits, the lack of trust in some groups limits their effectiveness and their ability to bulk their output and sell it collectively.
- **Incentives for village extensionists** Having farmer extension agents based in their home villages is a big step forward, as they can provide more continuous advice than an outside government agent can. But they still need to move around in order to serve their friends and neighbours. The project covered their transport costs, but this ceased when the project ended. Sustaining this support beyond the project life is a challenge unless the government steps in.
- **Certified seed** Producing certified seed locally is also a good idea. It means the seed is cheaper, and local farmers can get it more easily.
- **Credit** Access to credit at reasonable interest rates was a challenge that still needs to be addressed.

5 Intervention areas

Previous page:

Preparing land for soybean planting

The 24 projects covered a wide range of activities, approaches, agro-ecologies and socioeconomic conditions. To analyse the projects we chose six broad intervention areas: access to inputs, extension approaches, output markets, access to finance, education and training, policy and institutions. We asked the project managers to answer three questions on each:

- **Why is this area of work important?** Why should AGRA and its grantees be involved in it? What problems and opportunities does it address? Why is AGRA supporting it? This question focuses on the **justification** for being involved in this type of work.
- **What are we doing about it?** What approaches do the projects use? What are they doing, and how are they doing it? This question addresses the **types of activities** that the projects implement.
- **What should we be doing differently?** How can we improve what we are doing? What should we do in addition? What did not work, and what should we stop doing? What are implications of focusing narrowly or broadly? These questions aimed to generate suggestions or **recommendations** to AGRA, the grantees and other development agencies for changes and improvements to their work.

All of the 24 projects were involved in at least two of the six intervention areas. Two were engaged in all six areas, while another 11 were involved in four or five (Table 5). This illustrates the breadth and complexity of the projects and the challenges they address. It also reflects a deliberate strategy: AGRA recognizes that smallholder farmers face multiple bottlenecks. It is necessary to address several constraints at the same time if the farmers are to free themselves from a cycle of poverty and significantly improve their production levels and income.

An example: to grow more maize in a sustainable way, a farmer must know how to manage the soil and crop. He or she will need capital, or a loan to buy seed and fertilizer. And he or she must also be able to sell the extra output at a decent price.

In these three sentences, we can discern the need for interventions in four areas:

- Access to finance
- Access to inputs
- Extension services to provide knowledge and skills
- Output markets.

Indeed, precisely such a combination was the recipe used by six of the 19 projects in Table 5.

Table 5 Areas of intervention of selected projects

Code	Principal grantee	Country	Access to inputs	Extension approaches	Output markets	Access to finance	Education, training	Policy, institutions
	Beyond demonstrations							
01	Rural Outreach	Kenya	•	•	•	•	•	•
02	ISAR	Rwanda	•	•	•	•		
03	Africa 2000	Uganda	•	•	•	•		•
04	Millennium Villages	Uganda	•	•	•	•	•	•
05	ZARI	Zambia	•	•	•	•		•
06	INERA	Burkina Faso	•	•		•		
07	IER	Mali	•	•		•		
08	CDI	Malawi	•	•	•	•		
09	KNARDA	Nigeria	•	•	•			
10	SARI	Ghana	•	•	•	•		
11	Sokoine Univ	Tanzania	•	•	•	•		
12	RAB	Rwanda	•	•	•		•	
13	Kenyatta Univ	Kenya	•	•	•		•	
14	IIAM	Mozambique	•	•	•			
	Input supplies							
15	AGRODIA	Burkina Faso	•			•		
16	IFDC	Rwanda	•	•	•	•	•	
17	PPRSD	Ghana	•					•
18	MOAFSC	Tanzania	•				•	•
	Education and training							
19	Kenyatta Univ	Kenya					•	•
20	Univ of Zambia	Zambia	•	•			•	•
21	Univ of Bobo-Dioulasso	Burkina Faso					•	•
22	KNUST	Ghana					•	•
23	UDS	Ghana		•			•	•
24	Ahmadu Bello Univ	Nigeria	•	•	•		•	

ACCESS TO INPUTS

This section discusses the projects' efforts to improve access to fertilizer, seeds, lime, rhizobium, etc. These efforts included training input dealers, linking farmers to the dealers, setting up seed-growing schemes, and improving controls over fertilizer quality.

This was a key area for nearly all the Soil Health Programme's projects: 20 of the 24 projects listed in Table 5 had a component that addressed access to inputs.

Why is this area of work important?

Artificial fertilizers Many soils in sub-Saharan Africa are inherently low in fertility and cannot support a good crop without using external inputs. Other soils are naturally more fertile, but have been depleted of nutrients by continuous cropping of cereals and other staples. Manure and compost can help, especially to raise the amount of organic matter in the soil. Large amounts are needed to replenish nitrogen levels: preparing them, carrying them to the field and applying them takes a lot of labour. Often not enough is available or they are of poor quality. Many organic materials are anyway low in phosphorus and potassium, two of the main plant nutrients. That makes artificial fertilizers important to increase crop yields.

Nevertheless, fertilizers are expensive and hard to find in much of Africa. Most have to be imported, then carried long distances over rutted roads. The network of wholesalers and retail input dealers is thin on the ground: many farmers have to travel a long way to the nearest dealer, then have to carry heavy sacks of chemicals back home. Fertilizer supplies often arrive too late to be useful, and some are the wrong type for a particular crop or have been adulterated, so are ineffective. Many input dealers are poorly informed about what they sell, so cannot advise farmers appropriately. Farmers end up applying the wrong chemicals at the wrong time, and harvest low yields as a consequence. That lowers their trust in the potential of fertilizers and in the people who sell them.

Other soil amendments Nitrogen is the plant nutrient that is most commonly lacking. But some soils are also deficient in other nutrients, especially phosphorus. In addition, many tropical soils are acidic: they bind nutrients so tightly that crop roots cannot extract them. They would benefit from periodic lime applications to reduce the acidity and make more nutrients available to plants.

Seed Most African farmers keep the seed from the last harvest and sow it in the following season. That has advantages: local varieties are hardy and adapted, and farmers do not have to find the money to buy seed. But local varieties tend to produce low yields. With fertilizer, manure, and good agronomic practices, higher-yielding hybrid varieties of cereals can produce a lot more – often double or treble the yields. Farmers have to buy new seed each season, but they can afford to do so because of the higher productivity.

Legumes such as soybean, cowpea and climbing beans are important for crop rotations and intercropping: they fix nitrogen in the soil, reducing the need for expensive nitrogen fertilizer and boosting the yield of the subsequent cereal crop. Unlike maize, the best legume varieties are not hybrids, so farmers can keep the seed from one season to the next. That means that commercial seed producers are generally uninterested in supplying legume seed.

Rhizobia, a type of bacteria that lives in nodules on the roots of legumes, are responsible for fixing nitrogen. In many soils, inoculating the legume seed with rhizobia can substantially increase

the legume yield and the amount of nitrogen it fixes. But there are few commercial rhizobium producers in Africa, and this important input is hard for farmers to find.

What do we do about it?

The Soil Health Programme aimed to support the delivery of an additional 187,000 tons of fertilizers across the 13 countries served by AGRA, and to reduce the farm-gate price of fertilizers by 15%. It increased access to inputs in various ways.

Improving supplies of fertilizer and soil amendments

Several projects supported credit guarantees and matching grants to input dealers they had trained so they could stock up on fertilizers.

Examples: AGRODIA, Burkina Faso [15]; IFDC, Rwanda [16][1]

AGRA also supported local companies that quarry rock phosphate and produce blended fertilizers, and that produce lime, such as the Société de Production d'Aliments des Végétaux in Rwanda.

AGRA has also invested in the African Fertilizer and Agribusiness Partnership, a collaboration between the New Partnership for Africa's Development (NEPAD), the International Fertilizer Development Center (IFDC), the African Development Bank, and the Agricultural Market Development Trust (AGMARK), with the support of African Union. This partnership complements other initiatives by these institutions to promote private-sector-led fertilizer markets in Africa. It aims to establish more competitive and sustainable fertilizer markets that will provide smallholder farmers with the incentive, initiative and capability to source and use fertilizer. The partnership currently works in three priority countries: Ghana, Mozambique, and Tanzania.

Training input dealers and setting up dealer networks

Many of the projects trained input dealers and help them promote their products. The projects both worked with existing input dealers and help train new ones – usually farmers who are interested in setting up their own village input-supply shops and acting as distributors for larger stockists in town.

The rationale behind this is clear. Increasing the number of input dealers means farmers have to travel less far to get supplies – in fact, the stockist may be in the farmer's home village. Trained dealers who are knowledgeable about the products they sell can advise farmers better – and they want repeat custom from their friends and neighbours. Plus, input dealers have a built-in incentive to promote their products, since they can earn more. (The same cannot be said for extension staff, who have no such incentive to do a good job.) Each dealer sells to hundreds of farmers, so if a project trains a few hundred input dealers, it can indirectly reach tens of thousands of farmers.

Examples: Rural Outreach, Kenya [01]; ISAR, Rwanda [02]; Africa 2000, Uganda [03]; Millennium Villages, Uganda [04]; INERA, Burkina Faso [06]; IER, Mali [07]; KNARDA, Nigeria [09]; SARI, Ghana [10]; Sokoine Univ, Tanzania [11]; Kenyatta Univ, Kenya [13]; AGRODIA, Burkina Faso [15]; IFDC, Rwanda [16]

1 Numbers in the [square brackets] refer to the project code numbers given in Tables 1 and 5.

Linking farmers to input suppliers

Various projects linked farmers' organizations to reputable input suppliers so they can buy fertilizers and other inputs. Methods included introducing input dealers to farmers, involving dealers in training courses and demonstrations, and supporting credit schemes where farmers could pay for part of their inputs at the beginning of the season and pay the rest after the harvest. In some projects, much effort went into overcoming farmers' distrust of the dealers.

Many of the input dealers found that it was profitable to set up their own demonstration plots near their shops to show the results of applying fertilizer and using other integrated soil fertility management techniques.

Examples: ISAR, Rwanda [02]; KNARDA, Nigeria [09]; SARI, Ghana [10]; Kenyatta Univ, Kenya [13]; IIAM, Mozambique [14]; AGRODIA, Burkina Faso [15]; IFDC, Rwanda [16]

Improving supplies of seed

Projects did this in two main ways:

- By linking input dealers and farmers to commercial seed suppliers, government agencies or research institutes that produce certified seed (for example, by facilitating contractual agreements between the seed company and groups of farmers).
- By training farmers how to grow seed and organizing them to set up their own seed-growing schemes.

Examples: ZARI, Zambia [05]; KNARDA, Nigeria [09]; Sokoine Univ, Tanzania [11]; RAB, Rwanda [12]; Kenyatta Univ, Kenya [13]; IIAM, Mozambique [14]

Promoting rhizobium supplies

Projects supported rhizobium producers to increase their production capacity, educated farmers about the benefits of rhizobium and how to use it, and facilitated the supply of inoculant to farmers.

Examples: ROB, Kenya [01]; ISAR, Rwanda [02]; ZARI, Zambia [05]; CDI, Malawi [08]; SARI, Ghana [10]

Building demand for fertilizer and other inputs

Projects did this in three main ways:

- By testing farmers' soils and providing site-specific recommendations for nitrogen and phosphorus fertilizer and for lime.
- Through demonstrations, farmer field schools, training for farmers, using the mass media, and other extension techniques. See the section on *Extension approaches* for more.
- By providing inputs at subsidized prices or on credit (see below).

Supporting credit

Many of the projects set up credit arrangements for dealers to buy supplies, and for farmers to purchase inputs from the dealers, also on credit (see the section on *Access to finance*).

Improving controls of fertilizer quality

Many countries in Africa lack suitable laws and regulations to ensure that fertilizer is of good quality. Two of the projects (in Ghana and Tanzania) focused exclusively on improving controls on fertilizer quality and preventing problems such as fraud, adulteration and mislabelling. These built the capacity of the responsible authorities (for example by equipping laboratories), trained staff, and raised awareness among people in the fertilizer value chain about the law and the need to ensure quality products.

Examples: PPRSD, Ghana [17]; MOAFSC, Tanzania [18]

What should we do differently?

The projects experienced a number of problems with these approaches:

- Some projects, such as those run by CDI (Malawi) and SARI (Ghana), have been successful in getting loans repaid. But in other projects, many of the farmers who got inputs on credit failed to repay.
- Those farmers who bought subsidized inputs may not continue to buy the inputs at the full price after the end of the project.
- Purchasing inputs and providing them on loan to input dealers was extra work for the projects. They had to keep track of the dealers to make sure they repaid their loans.
- Farmers who grew seed that did not go through the regulatory system may have deliberately or unwittingly supplied substandard seed.

Here are some suggestions for overcoming these problems:

Credit and subsidies Projects should not provide farmers with inputs at subsidized prices or on direct credit. Rather, they should encourage farmers to save money to buy inputs, or link them with credit providers which can arrange loans. AGRA and other development agencies should work with policymakers to ensure that input subsidies are provided and that they reach the intended beneficiaries. "Smart subsidies" (where the government collaborates with the private sector to implement a voucher scheme) should be developed and made to work.

Packaging Manufacturers should package fertilizers and seed in smaller quantities, such 1, 2, and 5 kg bags. This will reduce the risk of adulteration if repackaging is done outside the factory.

Seed AGRA should facilitate the production and supply of legume seed, which is in short supply. Projects should work closely with governments, private companies and local producers to produce high-quality legume seed. Seed grown by farmers should be certified by appropriate bodies before it can be sold.

Collaboration AGRA projects should interact with each other more to create synergy and promote new techniques such as rhizobium inoculation and lime. Further awareness campaigns, research and public-private partnerships are needed to promote such innovations and make the inputs required more widely available.

EXTENSION APPROACHES

This section covers the extension techniques used by the projects: demonstrations, farmer organization, extension training, radio programmes, etc. Of the 24 projects, 18 used such approaches (Table 5).

Why is this area of work important?

For any new technology to be adopted, it has to overcome a series of hurdles. Farmers must first become aware that it exists. They then have to be convinced that it works and can bring them benefits. They have to find out where to get the right equipment and supplies, and how much it costs. And they have to learn how to use it.

That is relatively simple for some farm technologies, such as planting in rows or applying fertilizer. But others, such as conservation agriculture, are more complex: they require farmers to master a whole set of new skills: digging planting holes at measured distances, sowing seeds and applying fertilizer, using mulch, suppressing weeds, and rotating crops. Planting legumes may mean accepting a new crop, obtaining seed and rhizobium inoculant, learning how to grow, harvest and cook the beans, and finding a buyer. Setting up a marketing group requires skills in group organization, bookkeeping, credit management and marketing.

Some innovations, such as phosphate or lime applications, are applicable only in certain areas. Farmers need information (such as the results of lab tests) to tell them whether investing in these inputs is worthwhile.

Solving one problem may lead to others: selling the extra output requires skills in marketing. Getting credit may mean that some farmers default. Producing a surplus means farmers have to find out the current market price if they are to sell at a profit.

All this means that information and skills are vital if farmers are to improve their soil-management practices and boost their yields and incomes. This information can come from various sources: extension agents, researchers, business service providers, NGOs, banks, traders, input suppliers, local and national government, and (most importantly) other farmers.

The traditional conduit for such information has been the extension service. However, extension agencies in many African countries are weak and inefficient. Extension workers are few, poorly paid and overworked, and have skills in technical production rather than aspects such as marketing or group organization. Most lack skills and experience in integrated soil fertility management. The few commercial farm advisers tend to serve larger farmers close to metropolitan areas, rather than smallholders out in the bush.

What do we do about it?

Because the information that farmers and others need comes from many different sources and through many channels, the AGRA projects use a diversified strategy. Farmers are the main targets for most of the projects, but they also work with intermediaries such as extension staff and input dealers. Some projects also target other stakeholders, such as financial institutions (see the section on *Access to finance* below), policymakers (see *Policy and institutions*), and support organizations such as regulatory agencies, universities and training institutions (see *Education and training*).

In terms of topics, the projects have focused mainly on technical aspects of soil fertility management. Other topics include group organization, savings and credit, business management,

marketing, postharvest handling and value addition. Much effort has gone into building linkages, mainly between farmers and input suppliers, credit providers and potential buyers.

Many of the projects were labelled as "going beyond demonstrations". As this name implies, demonstrations of improved technologies were indeed central to many of the projects. But they also used a range of other, complementary extension approaches, including field days, farmer-led extension, farmer field schools, farmer-to-farmer visits, study tours, mobile phones, printed materials (pamphlets, guides, posters, booklets, etc.), radio and television, music and drama. Here we focus on just a few of these.

Demonstrations plots and field days

Demonstrations were the main way that the projects showed farmers the benefits of the new technologies. The projects worked with groups of collaborating farmers to set them up. The demonstration plots were sited on land provided by the collaborators, near a road so the sites were visible and easy to reach. Several were located in school grounds so the pupils could learn the techniques. Separate plots side-by-side compared the farmers' normal practice (typically a traditional crop variety sown without fertilizer or manure) with various alternatives: usually a new crop variety grown with different levels of inputs. Project staff trained the collaborators how to lay out the plots and manage the crops. Each project established a large number of such demonstration sites – sometimes hundreds a year. Some of the demonstrations were maintained on the same sites several years in a row, for example to show the benefits of crop rotation or the multi-year effects of applying manure, rock phosphate and lime.

The plots performed a double function: they demonstrated the new technologies to farmers, and also tested various technologies (such as different varieties and fertilizer application rates) under farmers' conditions. The farmers could then see for themselves which combinations of technologies were successful, and which ones they wanted to use.

Some projects used an approach called **mother and baby demonstrations**. The researchers set out a big "mother" demonstration plot with large number of varieties and fertilizer combinations. Visiting farmers could then choose those combinations they wanted to test further on their own land; they set up "baby" trials with just those combinations.

Each demonstration plot was the site of one or more **field days**, when local farmers came to check on the crop growth and yield, to question project staff and extension agents, and attend training sessions. Such events enabled farmers who were not members of the collaborating groups also to see the new technologies. They were also convenient occasions for community leaders, government officials, input dealers and others to see the technologies and meet farmers. Some of these events were covered by national and local radio and television stations.

Examples: Rural Outreach, Kenya [01]; ISAR, Rwanda [02]; Millennium Villages, Uganda [04]; INERA, Burkina Faso [06]; IER, Mali [07]; CDI, Malawi [08], KNARDA, Nigeria [09]; SARI, Ghana [10]; Sokoine Univ, Tanzania [11]; RAB, Rwanda [12]; Kenyatta Univ, Kenya [13]; IIAM, Mozambique [14]; UDS, Ghana [23]; Ahmadu Bello Univ, Nigeria [24]

Farmer-led extension

Having farmers take on some of the roles of extension staff has several advantages. Because they live and work in villages, they know what the local problems are, and can apply practical rather

than theoretical solutions. They enjoy their neighbours' trust and credibility. They do not earn a salary, incur lower transport costs, and can be consulted day and night. In areas with few extension workers (which means in most places), they can complement the formal extension service and fill a big gap.

Many of the AGRA projects have relied on community facilitators, lead farmers or farmer-extensionists to spread the word about soil fertility management. They have trained these farmers in improved fertility-management techniques, as well as in skills such as training, running demonstrations, setting up and managing groups, and marketing.

A common issue in farmer-led extension is providing incentives for the farmer-extensionists. While many villagers are eager to learn new skills and pass them on to their friends and neighbours, voluntarism can only go so far. Some projects have covered the costs of the farmer-extensionists, but this is not sustainable when the funding inevitably runs out. One way around this (used by the Africa 2000 project in Uganda) is to arrange for the farmer-extensionists to sell repackaged inputs; the profit they make is an incentive for them to continue providing advice.

Examples: Africa 2000, Uganda [03]; ZARI, Zambia [05]; CDI, Malawi [08]; KNARDA, Nigeria [09]; Ahmadu Bello Univ, Nigeria [24]

Input dealer-led extension

Several projects trained **input dealers** to set up and run demonstrations of improved fertility-management techniques. The dealers were interested in doing this because they could attract potential customers and showcase the products they sold. Because of this incentive, the dealers were willing to bear much or all of the costs, so relatively little support was required from the project or the extension service. Plus, the dealers could reach a larger and different clientele from that normally served by the project of extension service.

Other projects trained the dealers about their products so they could advise farmers what to buy. See the section above on *Access to inputs* for details.

Examples: Africa 2000, Uganda [03]; AGRODIA, Burkina Faso [15]; IFDC, Rwanda [16]

Radio

Radio can reach a much larger number of people than face-to-face meetings, and is a good way to create awareness of a new technique. While it cannot convey complex, technical or visual information, it has a big advantage over printed materials in regions where many farmers are marginally literate. Community radio is especially important, as such stations broadcast in the local language and are eager to carry information that local listeners will find relevant and useful. Projects trained radio staff on soil-fertility and other issues. Programme formats included talk shows, call-in programmes where experts fielded farmers' questions, and market price updates. Some project organized listener groups to get together to listen to particular broadcasts and to phone in their feedback.

Examples: Rural Outreach, Kenya [01]; Africa 2000, Uganda [03]; Millennium Villages, Uganda [04]; INERA, Burkina Faso [06]; IER, Mali [07]; SARI, Ghana [10]; Sokoine Univ, Tanzania [11]; IFDC, Rwanda [16]; PPRSD, Ghana [17]; MOAFSC, Tanzania [18]; UDS, Ghana [23]

Anchor farm

One project (CDI in Malawi) used an "anchor farm" approach to promote new techniques (in this case, soybean cultivation). This is based on a large commercial farm owned by CDI, which grows maize and soybeans. CDI encourages the surrounding farmers to work in "clubs" of 10–20 people; each club elects a lead farmer as its contact person for the anchor farm's services. The hub provides a range of services, including demonstrations of improved techniques and training of extension workers and the lead farmers. These in turn train other farmers. The anchor farm also facilitates input supplies, financial services, and contracts with buyers.

Example: CDI, Malawi [08]

What should we do differently?

Increasing farmer ownership of demo plots So far, extension workers have taken on much of the responsibility for conducting demonstration plots. Farmers should be given more responsibility and control; the role of extension workers should be limited to facilitation to ensure that such plots continue beyond the end of the project life.

Using a value chain approach The Soil Health Programme's current approach is based on boosting production; it should be refocused on helping farmers grow crops that have a high market demand. Extension workers need to learn how to use the value chain approach in their work.

Incentives for extension workers Incentives for both formal extension staff and farmer extensionists need to be improved. Private extension services should be encouraged.

Tapping local potential Projects should identify and build on local potential. In Kenya, Rural Outreach has trained young people and women farmers as village promoters. This approach could be tested elsewhere.

New communication techniques Mobile phones and video are powerful but under-used tools to gather and disseminate information. Projects need to explore how they could be used more effectively.

Capacity building skills of extension staff Private and public training colleges should build the capacity of trainees in integrated soil fertility management and other soil-related skills. Many colleges teach that organic manure and artificial fertilizers are mutually exclusive alternatives; in fact, a combination of the two is more sustainable. The courses offered by UDS in Ghana are an example of this.

Promoting sustainability Too often, projects run in parallel to the government extension system. When the project ends, the extension agencies have not been directly involved, so cannot continue the project's good work. The solution is to involve the extension department in all stages: inception, planning, implementation, review and evaluation.

Tanzania offers a possible model to emulate: here, the extension service is decentralized to district authorities. A government officer in each district oversees agricultural activities (including extension) there, and keeps the local authority informed. The authority can then allocate one or more extension agents to work with a project operating in its area. This system creates ownership and sustainability, as extension staff who are trained in a certain technology can continue their work beyond the project end.

Exit strategy Projects must have a clear exit strategy, stating who will take over responsibilities after the project end, and how these people and organizations will be prepared for this role. Possibilities include:

- Creating partnerships with local institutions that will be on the ground in the long term, such as the government, church organizations and community organizations.
- Organizational development of the farmers' groups and associations to provide extension services, and training their staff to provide the services.
- Promoting private-sector service providers such as input dealers, traders and processors. Projects can support these to take on extension roles by offering business training courses, giving on-the-job training, and mentoring new service enterprises.

See the section in Chapter 6 on *Sustainability* for more.

OUTPUT MARKETS

This includes initiatives to promote processing and storage, the organization of marketing groups, and efforts to improve the marketing of produce. This was an important one for many of the projects: 14 of the 24 projects listed in Table 5 had initiatives in this area.

Why is this area of work important?

Without someone to buy their produce at a reasonable price, farmers see little point in trying to produce a surplus, or in producing particular types of crop. They will instead grow just enough of their staple foods to support their families. A lack of markets thus condemns rural people to perpetual subsistence farming; it requires them to look for work outside so they can earn money; and it throttles the growth of the rural economy.

Most agricultural development projects used to focus exclusively on solving production problems. They tried to find ways for farmers to increase their yields – by planting new varieties, improving the soil fertility, preventing erosion, combatting pests, and so on. They relied on technical fixes: seeds, fertilizers, soil conservation measures, pesticides, etc. But they ignored the need for farmers to sell their produce. Many technology-based projects have failed for this reason.

What do we do about it?

AGRA's Soil Health Programme retains its concentration on solving production problems (another AGRA programme has market access as its central focus). But the Soil Health Programme also includes a healthy dose of marketing – as shown by the number of projects with initiatives in this area. These initiatives addressed various activities in the chain from harvest through to sale (or home consumption). They focused mainly on helping farmers handle and find a market for newly introduced legume crops such as soybean, climbing beans and pigeonpea. They also covered the main cereal staple (such as maize), and secondary crops such as legume seed and poles for climbing beans. Training of farmers was central to many of these efforts.

Postharvest handling and storage

A number of projects trained farmers how to handle produce after harvest, including drying, pest control, and suitable storage methods. They helped farmers acquire or build equipment such as mats and tarpaulins for sun-drying, and various types of storage facilities, ranging from jute or polythene bags to clay pots, metal and cement silos, and warehouses.

Examples: Rural Outreach, Kenya [01]; Africa 2000, Uganda [03]; Millennium Villages, Uganda [04]; INERA, Burkina Faso [06]; IER, Mali [07]; CDI, Malawi [08]; IIAM, Mozambique [14]

Processing

Most farmers already do the most elementary forms of processing: dehusking, threshing and drying. But these have to be done properly to prevent contamination, preserve quality and prolong the storage life. And if farmers process the produce further, they may be able to raise the value of what they sell, so earn more money. Several projects trained farmers how to do this. They also taught farmers how to process unfamiliar crops (such as soybean) for home consumption and to

make snacks and other items. They emphasized the nutritional value of eating legumes, especially for children.

Farmers in western Kenya found that they could not sell the soybean they had grown at an acceptable price, so Rural Outreach got a loan to buy three soy processing machines. The farmers bring their soy to be milled into flour. Rural Outreach says this was a "stopgap" measure to continue to encourage farmers to grow the legume; it was possible because of the organization's long-term involvement in the project area, which will continue after the end of the AGRA project. But it raises questions about the long-term sustainability of soybean as a crop in this area. None of the other AGRA grantees found it necessary to take on such a role.

Examples: Rural Outreach, Kenya [01]; Africa 2000, Uganda [03]; Millennium Villages, Uganda [04]; KNARDA, Nigeria [09]

Marketing groups

Smallholders do not produce enough volume of a crop to be able to market it effectively. For most projects, the answer was to organize farmers into groups and train them how to bulk their produce, store it in warehouses, and market it as a group. The extra volume gives them greater bargaining power when negotiating with potential buyers.

Examples: Africa 2000, Uganda [03]; ZARI, Zambia [05]; CDI, Malawi [08]; SARI, Ghana [10]

Linkages with buyers

Forging linkages with buyers was an important activity for many of the projects. This was beneficial for both farmers and buyers. The farmers' groups learned about potential markets and their requirements; the buyers (traders or processors) gained suppliers who were trained, organized and able to produce according to their needs. Sometimes the arrangements between farmers were ad hoc and informal; others were more regular, formal and even involved contracts.

Examples: Rural Outreach, Kenya [01]; Africa 2000, Uganda [03]; Millennium Villages, Uganda [04]; ZARI, Zambia [05]; CDI, Malawi [08]; KNARDA, Nigeria [09]; SARI, Ghana [10]; IIAM, Mozambique [14]

Market information

Farmers, particularly those in remote areas, often find it difficult to get accurate, timely information about market prices. Such information is critical at two times of year: before the start of the season, when farmers are deciding what to grow, and at the end of the season, when they have to decide whether to sell now (and where and to whom), or whether to hold onto their produce for another few weeks in the hope that prices will rise.

Price information is becoming easier to gather, and for farmers to get, as mobile phones become more widespread and as government or private information schemes disseminate more and better information. Projects used various means to disseminate data on prices and other market information: radio, telephone, field days, word of mouth, print media and information boards.

Example: SARI, Ghana [10]

Inventory credit

Several projects promoted schemes where farmers put their produce into secure storage after harvest, then used it as collateral to get credit. See *Access to finance* below for details.

What should we do differently?

Savings and credit associations Some farmers have to sell their produce at a low price before the harvest in order to pay urgent expenses. Village savings and credit associations can help farmers avoid this by lending the money to tide them over this difficult period (see *Access to finance*).

Diversification Projects should help farmers diversify their enterprises, for example by processing their output to add value to it, growing seed, or producing inputs such as poles (for climbing beans).

Warehouses Bigger yields mean more grain to store. Well-managed, secure warehouses are vital to store crops after the harvest, and for inventory credit schemes to work. More such warehouses are needed, and existing ones need to be rehabilitated and their management improved. AGRA should support such initiatives and press governments to put them into effect.

ACCESS TO FINANCE

This area covers initiatives to ensure farmers can get credit from banks and microfinance institutions, as well as organizing savings and credit groups, dealer credit, voucher schemes, warrantage, warehouse receipt systems, and informal sources of finance.

Despite its importance, only half of the 24 projects listed in Table 5 had interventions in this area.

Why is this area of work important?

New technologies require farmers to invest more: they need to buy inputs such as seed, fertilizer and equipment. They may wish to rent extra land in order to boost their output. Bigger yields may make it necessary to hire extra labour for harvesting, and to pay more for transport, storage and processing.

Finance for farmers

Farmers need four main types of financial services: loans, savings facilities, money transfer and insurance.

Loans Farmers need loans because they have to pay for expenses at times when they do not have the money available. This happens at three stages in the agricultural cycle:

- **Input credit** Before the start of the season, they need loans to buy inputs such as seed and fertilizer.
- **Operating credit** While the crop is growing, they may need money to tide them over the hungry period before the harvest.
- **Inventory credit** After harvest, prices tend to be low. Farmers may want to delay selling their output until the price has recovered.

Many farmers borrow from their relatives, or rely on **moneylenders** who charge high interest rates – way above the commercial market rate. They have few other alternatives. **Banks** are few and far between in rural areas, and most regard lending to farmers as commercially uninteresting or too risky. Their loan services are not designed for farmers: they want security (farmers are unwilling to put their only asset – their land – at risk by offering it as collateral), and their loan repayment periods do not match the farming cycle. Interest rates charged on bank loans are often prohibitive. For example, farmers with CDI project in Malawi paid interest rates of around 40% per annum. Despite the growth in **microfinance institutions**, there are still relatively few of these.

Savings services are even scarcer. A few farm products (milk, eggs and maybe vegetables) can produce a regular income. But most farmers tend to earn money in a few big chunks during the year – after they harvest each major crop. They use the windfall to pay off their debts… but what to do with what is left over? Few farmers have **bank accounts**, and getting to a distant branch to deposit money is a hassle. Some use **livestock** as a savings bank: they increase in value as they gain weight; they produce milk and offspring to sell; and they can be sold easily if the owner needs cash urgently. Others invest their surplus cash in **small enterprises** such as trading or food processing. Still others hide the money in a pot, where it does not earn interest and might be stolen. The temptation is to spend it all at once, then muddle through the rest of the year somehow.

Transferring money is difficult and risky for many farmers. A lack of bank accounts means that transactions have to be made face-to-face, and in cash. And cash can be lost or stolen. Mo-

bile money transfer systems such as Safaricom's M-PESA scheme offer an alternative and indicate huge demand: Safaricom says that 60% of adult Kenyans use M-PESA (about the same number as have a bank account), and 43% of Kenya's gross domestic product flows through the service.

Crop insurance is a neglected area of agricultural finance. Farmers in developed countries can insure their crops and animals against various types of loss: disease, drought, or a fall in prices. Such facilities are still rare in Africa.

Finance for input dealers, traders and processors

Other actors in the value chain need **working capital**. Input dealers need to buy large amounts of fertilizer and seeds and have them in stock at the right time of year. They also need to maintain inventories of expensive equipment, drugs and chemicals. Farmers are often able to pay for inputs only after the harvest. Input dealers are left in a quandary: if they demand payment on receipt, they will lose the farmers' business; if they supply the inputs on credit, they run the risk of the farmers not repaying their loans. So the dealers need loans that will let them buy supplies before the start of the season, but accept payment after the harvest.

Similarly, traders and output processors have to buy lots of output when farmers want to sell it. Farmers do not want to wait for the trader or processor to sell the product to the next buyer in the value chain before they get their money: they want payment immediately.

New input dealers and processors need **investment capital** so they can set up their shops or businesses. This may require longer-term loans, repayable over several years: long enough for the entrepreneur to establish a business and get it going.

Business management and financial skills

Farmers and small-scale input dealers and processors often lack the skills to plan and manage their businesses in an efficient and profitable way. In some areas, suitable financial services exist, but farmers and other stakeholders do not make use of them. They do not know about the services, do not trust the service provider, or lack the financial literacy to be able to make informed decisions. This is true also of financial service providers: they do not trust farmers or understand their needs.

What do we do about it?

The AGRA projects have focused mainly on loans and somewhat on savings; they have not addressed the issues of money transfers or insurance.

Input credit

Individual loans At least one project (KNARDA in Nigeria) helped farmers get individual loans from a bank. It did this by training them in business planning and financial literacy, and by linking them with a bank with a suitable credit window.

Group loans This was a more common approach. Projects helped groups of farmers get together to apply for a joint loan. The groups then loaned out smaller amounts of money to their members, and handled interest payments and repayments of the loan principal. The projects deposited a sizeable sum with the bank as security. CDI in Malawi required farmers' groups to deposit 15% of the loan amount before they could qualify for a loan.

Examples: ISAR, Rwanda [02], Africa 2000, Uganda [03]; Millennium Villages, Uganda [04]; CDI, Malawi [08]; KNARDA, Nigeria [09]; IIAM, Mozambique [14]

Loans for input dealers

Several projects provided credit to input dealers – either for the dealers themselves to use, or so the dealers could in turn offer credit to their farmer customers. There were several models for doing this.

Loaning inputs Some projects purchased the inputs and loaned them to dealers. The dealers sold the inputs and then repaid the project.

Credit for dealers Here, the project arranged for dealers to get a loan from a bank so they could buy the inputs. The project in Burkina Faso was an example of this: the project deposited a sum with a bank, which the bank and AGRODIA, the dealers' association managed. The association vetted requests for loans from its members, and passed on the requests to the bank.

In-kind and voucher schemes To ensure that farmers used the loans for farming and not for other purposes, most of the projects linked farmers to credit facilities or provided loans in the form of fertilizer or seed. In Ghana, the Center for Agriculture and Rural Development ran such a scheme in conjunction with the Savanna Agriculture Research Institute. Voucher schemes, where farmers get vouchers they can take to an input dealer and exchange for inputs, need to be designed carefully. A government scheme works fairly well in Rwanda, but the Sokoine University project in Tanzania ran into problems because farmers did not repay their loans.

Repayment in kind Working with dealers made it possible to allow farmers to repay their loans in kind. The Rwanda Agricultural Board, for example, arranged for the farmers to get fertilizer at the start of the season; after the harvest, they had to repay the loan in the form of seed.

Examples: CDI, Malawi [08]; SARI, Ghana [10]; Sokoine Univ, Tanzania [11]; RAB, Rwanda [12]; AGRODIA, Burkina Faso [15]; IFDC, Rwanda [16]

Savings and credit associations

Savings and credit associations help address farmers' need for savings services. Rather than putting their money in a non-existent bank, members pay it into the association's fund. The association loans money out to members who want to borrow. These borrowers repay with interest, making the fund grow. Such associations can also have other functions, such as marketing produce or bulk-purchasing inputs. Because they are organized and have money-management skills, they may also qualify for loans from banks or microfinance institutions. Several of the projects helped groups of farmers set up such associations. The best-managed schemes not only let members borrow when they need it; they also pay out members' savings at the end of a savings cycle. The amount paid out is enough to cover inputs for the next season, freeing the members from the need to get an external loan.

Examples: Africa 2000, Uganda [03]; Millennium Villages, Uganda [04]; CDI, Malawi [08]

Revolving funds

Revolving funds operate like a savings and credit association: they are managed by farmers themselves, and members must pay in on a regular basis. In addition, they are "seeded" by a grant

or loan from the project budget. That has the advantage that the members can start borrowing money immediately; a disadvantage is that it may create dependency on the project.

The Rural Outreach project in Kenya established such a revolving fund using KSh 1 million seed money from the AGRA grant. This was slow to start, but has grown fast in 2014.

Example: Rural Outreach, Kenya [01]

Inventory credit

Immediately after harvest, prices of crops tend to be low. Rather than selling immediately, farmers can put their produce into a secure warehouse managed by a trusted party. They can then use the produce as collateral for a bank loan. They can use the loan to pay their expenses or to buy inputs for the next season's crop. The farmers can wait for prices to rise, then ask the warehouse to release the produce. They use the proceeds to repay the loan and still make more money than if they had sold immediately after harvest.

Such "inventory credit" schemes include "warrantage" (where the farmers' group and a bank jointly hold keys to the locked warehouse), and "warehouse receipts" (where a trusted third party manages the warehouse). Several of the projects, including INERA in Burkina Faso and IER in Mali, promoted such schemes. Banks are still suspicious of such arrangements, however: they required the projects to back it up with a sizeable deposit as security.

Examples: INERA, Burkina Faso [06]; IER, Mali [07]; CDI, Malawi [08]

Contract farming

The most integrated set of financial services among our projects was that offered by CDI in Malawi. Here, the commercial "anchor farm" that acted as a base for the project provided a range of services for the surrounding farmers, including input loans from two local banks, and assistance with marketing. At harvest time, the farmers bring their produce to bulking centres, where it is weighed and picked up by the buyers. Bank agents use these occasions to collect the loan repayments. This arrangement reduces the risk of farmers' defaulting on their loans.

Examples: ZARI, Zambia [05]; CDI, Malawi [08]

Revolving seed

Loans do not have to involve money at all. The IIAM pigeonpea project in Mozambique and the Rural Outreach project in Kenya both had allowed farmers to "borrow" seed at the beginning of the season and "repay" it after harvest: either the same amount, or double the amount received. Such arrangements help overcome the shortage of seed of legumes and other species.

Examples: ISAR, Rwanda [02]; KNARDA, Nigeria [09]; Kenyatta Univ, Kenya [13]; RAB, Rwanda [12]; IIAM, Mozambique [14]

Business management and financial literacy

Training was a key aspect of all these efforts to improve finance. Many projects trained farmers and input dealers in various aspects of business management, financial record-keeping, and how to get and manage loans.

Examples: Rural Outreach, Kenya [01]; KNARDA, Nigeria [09]; AGRODIA, Burkina Faso [15]; IFDC, Rwanda [16]

Training for bank staff

To facilitate loans for input dealers, it was also necessary to familiarize bank staff with the dealers' business models. In Rwanda, IFDC did this through training, by arranging visits by bank staff to the dealers' shops, and by holding joint meetings with dealers who were prospective borrowers.

Example: IFDC, Rwanda [16]

What should we do differently?

A number of finance approaches have proven successful and should be replicated in other countries. These include:

- The **inventory credit** (warrantage) system in West Africa.
- Training in risk management and financial literacy for **input dealers** in Rwanda.
- Revolving of **seed** among farmers in Mozambique and Kenya.
- **Cashless financing** of inputs managed by the Center for Agriculture and Rural Development in Ghana.

Some ideas for improving other aspects of finance:

Training People who get credit should be trained on financial literacy and how to manage loans. This is not just for farmers: input dealers and credit-management committees also need training.

Working with banks AGRA and its grantees should work with banks to develop farmer-friendly financial products (including insurance), and to market them to potential clients. Bank staff need to learn about farming and its potential as a source of revenue and customers for banks. Banks and microfinance institutions, in turn, can provide valuable services to projects, such as offering farmers training in financial literacy and business management.

AGRA support AGRA should boost its support to grantees in the area of finance, for example in advising grantees about suitable financing mechanisms for beneficiaries. AGRA should also ensure that funds used as bank guarantees are disbursed on time.

Interest rates Commercial interest rates are prohibitive in most countries. If interest rates are too high, farmers will not take loans, and so will not be able to benefit from the improved technologies.

Ensuring credit reaches farmers In some projects, depositing a loan guarantee was not enough to ensure that farmers got a loan. In some, the bank kept the interest rates too high or applied overly strict criteria for borrowers. In others, dealers refused to provide farmers with inputs on credit even though the dealers had been given a loan for this very purpose.

Ensuring repayment Another problem in some projects was that farmers failed to repay their loans. Rather than having the grantee (a generalist organization) managing credit, it may be better for a specialist organization that is experienced in ensuring repayment to take on this task.

Farmers' groups Savings and credit associations are valuable ways to mobilize savings in a village. But they need skills to establish and manage. They should be started early on in a project, as one of the first things a farmer group does, rather tacked on as an extra function later on. They should be registered with the authorities so they can get their own bank accounts and qualify for borrowing.

Revolving funds The experience with revolving funds has not been good. The initial amount of money is typically too small to go round a large number of farmers. Many farmers defaulted because they assumed the money was a government handout. If they are used in the future, they should be managed by an experienced specialist organization.

Voucher schemes also need careful design to ensure that farmers repay the credit.

Women Women farmers remain at a disadvantage in financial matters. According to law and tradition, many do not own property, so have no collateral. Advocacy is needed to get this changed.

EDUCATION AND TRAINING

All of the projects engaged heavily in training various people – farmers, input dealers, processors, extension personnel, soil scientists and agronomists, bank staff, and others involved in improving soil fertility and in growing and marketing of crops.

This section, however, focuses more narrowly: on the projects' support for training of professional specialists in soil fertility at universities and training institutions. It covers university certificate, diploma, MSc and PhD courses in soil science and non-degree training of laboratory technicians, extension officers, input dealers, inspectors and NGO staff.

Twelve of the 24 projects listed in Table 5 supported such training. The training hubs are shown on page 86.

Why is this area of work important?

Africa's soils are anything but uniform: they vary widely in their chemical, physical and biological characteristics, as well as in their history and current use. Blanket fertilizer recommendations are inappropriate: one soil may be acidic and need liming, while another nearby may be deficient in phosphorus. At the same time, soils have been depleted by continuous cropping and poor management. Erosion and the nutrient depletion are the rule. Stopping and reversing this damage will require skilled professionals who understand its soils, who can operate the equipment needed to examine them, and who can advise farmers how to conserve them and boost their fertility.

But years of neglect of the profession mean there are few people who can do research, design and manage projects, test soils, advise farmers, help steer policy and teach the next generation about this fundamental resource. The New Partnership for Africa's Development (NEPAD) estimates that only 2% of Africa's agricultural scientists are in the soil sciences. Soil science curricula are outdated; they neglect relatively recent topics such as integrated soil fertility management, as well as skills such as training and interacting with farmers. With ageing equipment and inadequate staffing and supplies, laboratories cannot serve farmers' demand for soil tests and advice on fertilizer applications.

In addition, the profession is dominated by men. Most professionals, from professors to laboratory technicians to extension personnel, are male. This imbalance is despite the fact that the majority of Africa's farmers are women. It ignores the potential that women could bring to the profession, and creates biases in the subjects researched and the clientele served.

What do we do about it?

Needs assessments

Training at both degree and non-degree levels was based on needs assessments in various countries, as well as a continent-wide review with inputs from organizations such as NEPAD, the World Agroforestry Centre (ICRAF) and universities.

Training hubs

The training is concentrated at selected universities and specialist institutions (see map on page 86). The PhD training is being done at two regional hubs: Kwame Nkrumah University of Science and Technology Studies in Kumasi, Ghana, for West Africa, and Sokoine University of Agriculture

in Tanzania for Eastern and Southern Africa. For non-degree training of soil professionals, the projects contracted universities, research institutes or private-sector firms.

For other types of training, specialist local providers were identified. In Ghana, for example, a consortium of two universities and a research institute offered training for extension workers. In Tanzania, the World Agroforestry Centre trained fertilizer inspectors for the Ministry of Agriculture's fertilizer regulatory authority. Some projects used a two-step training model: first they trained a group of senior staff; this first batch of trainees later helped to train their colleagues.

Curriculum revision

Task forces of university faculty and outside specialists redesigned university curricula in soil science at the undergraduate and graduate levels. This revision did two things: it updated the curricula to include new concepts and techniques such as integrated soil fertility management, geographical information systems and climate change, and it expanded the scope to cover previously neglected areas, such as agribusiness and communication and writing skills.

Where appropriate, curricula were shared among institutions to avoid each one having to reinvent the wheel. The idea was not to design a curriculum just for AGRA, but to develop one that all the institutions can use and adapt beyond the end of AGRA's support.

Student recruitment

The participating universities embarked on a drive to recruit promising students, especially women, to the field of soil science. This drive included advertisements in the print and electronic media, and contacts with research institutions throughout Africa. AGRA and the universities jointly vetted and approved the candidates. So far, 40 PhD students (33% women) have been enrolled and are well-advanced in their training programmes. In the MSc programme, 113 students (54% women) have been enrolled.

The projects arranged for the successful candidates to get leave from their jobs, and provided them with scholarships to cover part of their relocation, accommodation, course fees and research and living expenses. For women with young children, it also supported child care.

The students had to do research on practical problems in their home countries. They were encouraged to work with, and get support from, their home institutions or other development projects.

Strengthening university capacity

Good-quality training requires the right facilities and equipment, and faculty who are themselves up-to-date. The projects upgraded laboratory and other equipment, and brought in visiting professors to teach courses and refresh staff skills. An exchange programme for PhD students and a few faculty has been set up through a grant to Wageningen University in the Netherlands.

Examples: Kenyatta Univ, Kenya [19]; Univ of Zambia [20]; Univ of Bobo-Dioulasso, Burkina Faso [21]; KNUST, Ghana [22]; UDS, Ghana [23]; Ahmadu Bello Univ, Nigeria [24]

What should we do differently?

Degree training

In degree training, the devil is in the detail. This is because degree training focuses on a relatively small number of students. If one student drops out, for whatever reason, that represents a proportionally big loss for the programme as a whole. Careful design and clear rules are needed to avoid this.

Three-way contracts There must be a three-way commitment from the student, his or her employer, and the university. The student must confirm his or her commitment, and should understand the scholarship is intended to provide only partial support (some students expect it to cover their full expenses and even more). The employer must provide appropriate support to staff attending training and agree to the study leave conditions. Universities must agree to provide parallel funding – and they should be held to this pledge.

Support for women and families Projects have found it difficult to meet the target of 50% women students. Incentives such as family support packages and other affirmative actions are needed to attract women. Many students – men and women – are married and have families, but scholarships currently cover only one round-trip home during the multi-year study period. The scholarships should be made more family-friendly, for example to allow the student to visit home once a year, or to permit the student's family to live with him or her in the study location.

Research supervision Supervising students – especially those from abroad – is a major commitment in terms of time and effort. Faculty, both in the host university and in the student's home country, must be compensated appropriately for their work. Research sites in the student's home country must be selected carefully to permit effective supervision and ensure adequate institutional support.

Non-degree training

Standardized courses The content and duration of short courses on integrated soil fertility management should be standardized within a region to reflect the needs of specific stakeholders. Universities can offer such courses on a regular basis for a fee, and offer their services to NGOs and government agencies. Some courses – such as troubleshooting and follow-up training – can be put online.

Cascading training This is an effective model: the university or specialist institute trains a cadre of technicians, who in turn train others in their organizations.

Training extension staff AGRA projects should support the training of more extension and NGO staff in soil fertility management skills. Courses should be designed for young people to give them the skills needed to work in extension or private advisory firms.

POLICY AND INSTITUTION BUILDING

This covers the establishment and strengthening of dealer associations, university and college departments, and fertilizer regulatory services, as well as efforts to influence national and local government policy. Ten of the 24 projects engaged in this type of work.

Why is this area of work important?

To understand the need for strong institutions in the area of soil fertility, consider what happens when they are weak. In such a world, few specialists are trained, input dealers cannot get the supplies of fertilizer and seed, and inputs may be substandard or adulterated. Weak services work their way through to farmers, who cannot get the inputs and advice they need. They grow what they can in the ways they are used to – which means continuous cropping of cereals with minimal inputs. Soil fertility and yields decline further.

Sounds familiar? Such a situation is common in many African countries.

For the investments described in this book to be effective, it is essential to develop an enabling environment for pro-poor agricultural growth. Governments need to establish supporting legal, administrative, and regulatory systems to correct for market failures, facilitate efficient operation of the private sector, and protect the interests of the disadvantaged.

What do we do about it?

The AGRA projects strengthened four main types of institutions: farmers' groups, associations of input dealers, university soils departments, and input regulation agencies. This section deals with the last three. For farmers' groups, see the sections above on *Extension approaches* and *Output markets*.

Associations of input dealers

Improving access to fertilizers and seeds was central to many of the projects (see the section on *Access to inputs* above). Projects have helped form and strengthen associations of input dealers in Burkina Faso and Rwanda, train individual dealers in technical and business skills, and helping them form networks and develop links with their customers and with financial institutions. Many dealers have gained trading licenses and have been registered with the authorities. Inspectors visit their premises to ensure that they comply with regulations and sell good-quality items.

Examples: AGRODIA, Burkina Faso [15]; IFDC, Rwanda [16]; PPRSD, Ghana [17]; MOAFSC, Tanzania [18]

University laboratories

Efforts to strengthen university soil laboratories centred on three aspects: improving equipment, training staff, and improving the services the labs provide. The projects upgraded and expanded equipment and trained laboratory managers and technicians. That made it possible for the labs to expand the range and volume of services they offer – such as testing soil, plant and water samples.

Examples: Kenyatta Univ, Kenya [19]; Univ of Zambia [20]; Univ of Bobo-Dioulasso, Burkina Faso [21]; KNUST, Ghana [22]; UDS, Ghana [23]

Input regulatory services

Two projects supported regulatory agencies in Ghana and Tanzania. They had a similar to-do list to the projects that assisted the laboratories: improving equipment, training staff, and developing services. They had a bigger task, though, as they were creating institutions from scratch rather than strengthening existing ones. They also needed to develop partnerships – with the organizations they regulate (fertilizer wholesalers and retailers, seed companies) as well as law-enforcement agencies and farmers' groups.

Examples: PPRSD, Ghana [17]; MOAFSC, Tanzania [18]

Partnerships

Partnerships (see next chapter) are key to pooling resources and coordinating efforts in order to achieve results. Most of the projects were implemented by more than one organization – NGOs, universities, research institutes, national ministries, private companies, etc. – with each one contributing its own expertise. For example, Rural Outreach partnered with the Kenya Agricultural Research Institute; CDI worked with Bunda College in Malawi; the Zambia Agriculture Research Institute (ZARI) trained over 30,000 farmers in integrated soil fertility management in collaboration with the Zambian Department of Agriculture. Many projects also entailed partnerships with buyers, such as between ZARI and ZAMBEEF in Zambia; CDI with Senwes Grainlink in Malawi; and SARI with the Centre for Agriculture and Rural Development for loans in Ghana.

Examples: Rural Outreach, Kenya [01]; ZARI, Zambia [05]; CDI, Malawi [08]; SARI, Ghana [10]

Policy

All the projects worked closely with national and local governments, and supported the application of government policy. Some were even more closely involved: the fertilizer PPRSD project in Ghana and the MOAFSC project in Tanzania were managed by arms of the government to set up and strengthen regulatory agencies.

The projects generated experience-based evidence that will be useful in guiding future policies. The writeshop that drafted this book also drafted policy briefs on fertilizer supplies, the "going beyond demonstrations" approach, and education and training, which will be published separately by AGRA.

Examples: PPRSD, Ghana [17]; MOAFSC, Tanzania [18]

What should we do differently?

Information and skills Individual input dealers need further training on various topics, including technical issues. This could be provided through various forms of training: modular courses, refresher training, on-the-job training, and via e-learning courses and mobile phones. AGRA should encourage projects to share information they have developed or found useful with other grantees.

Partnerships among input dealers, development organizations, grantees and other organizations should be strengthened.

Staff retention Some laboratories have lost newly trained staff to other institutions that offer better pay and conditions. Universities should revise their pay scales to retain skilled staff.

Generating resources Soils departments at universities should seek ways to generate income from other sources. For example, they can strengthen their soil-testing services and charge clients for test results and advice, or offer short-term training in specific topics on a fee basis.

Appropriate equipment Soil science laboratories must be brought up to international standards. At the same time, the equipment used for training must be appropriate: it is counterproductive to train people how to use the latest equipment if they have none in their home institutions. It may be better to invest in (and train people how to use) cheap field kits rather than expensive laboratory equipment.

Quality control The quality of inputs remains a problem in many countries. More effective regulation is needed, with more and better-qualified staff. Associations of input dealers should be strengthened to ensure quality control. Many national laws and policies regarding inputs exist, but farmers and input dealers are not aware of them. Laws should be translated into local languages, disseminated, and enforced.

Influencing policy AGRA should gather evidence from the projects it supports and formulate it into policy recommendations. Universities and research institutions often regard policy as an area to be avoided; they should become more adept at trying to inform and influence policymakers.

6 Issues

Previous page:

Soybean fetches a good price in the market – and it enriches the soil with nitrogen

THIS FINAL chapter looks at five issues that cut across the 24 projects: partnerships, replicability, sustainability, equity and targeting, and impact and value for money.

PARTNERSHIPS

Partnerships play a vital role in all the AGRA projects. Indeed, the first word of AGRA's name – Alliance for a Green Revolution in Africa – reflects the importance of partnerships in its work.

Partnerships are important because no one organization has all the skills and resources necessary to bring about the sorts of changes that AGRA wants on the scale that it intends.

This section looks at two types of partnerships: that between AGRA and the grantee, and between the grantee and other implementing agencies under the AGRA project.

Partnerships between AGRA and its grantees

Many donors agree to fund a project, hand over the money, and expect the implementing organization to get on with the job on its own. The donor's involvement is restricted to periodic monitoring reviews and insisting that reports are submitted on time. In such a situation, the relationship between the donor and implementer can easily become adversarial: the donor tries to pick holes in the implementation, and the implementer tries to hide its failures.

Close relationship AGRA is an unusual donor: it does not do this. Rather, it maintains a close relationship with the grantees throughout the implementation of a project life cycle. It tries to help the grantees anticipate and overcome problems as they occur, without interfering in the day-to-day running of the project. It acts as an equal partner, rather than as the holder of purse-strings that has to be obeyed. Such an approach imposes costs: it takes a lot of specialist staff time on AGRA's part, and means that the grantees must devote more resources to donor coordination. But it leads to more effective projects.

Constant learning Both AGRA and the grantees engage in constant learning. AGRA introduces new ideas and procedures during the implementation that were not part of the original project design. Examples include the "going beyond demonstrations" approach, new data-collection protocols, regionalization of the training programmes, harmonization and synchronization of activities, and changes in project implementation. This results in better projects, but can be disrupting and cause delays. Some of the grantees have to request no-cost extensions so they can complete the agreed activities.

Partnerships between grantees and other implementing agencies

Productive partnerships between the grantee and other collaborating organizations are also important for successful projects. The partners each bring their own sets of expertise to the table: one may offer training; another, financial expertise; a third, laboratory testing; a fourth, technical input; and so on. Such partners also include actors in the value chain: seed suppliers, input dealers, processors, etc.

Ensuring partners' commitment Some projects suffered from a lack of commitment from partner organizations, leading to weak implementation of the agreed activities. Sometimes this was related to disputes over budgets: who should control project funds, and how should they be spent? Such problems can be overcome by involving the prospective partners in the project design,

having the partners sign a memorandum of understanding defining their roles, and establishing a steering committee to oversee the budget and activities of the various partners.

Expanding partnerships Partnerships should go beyond AGRA partners to add value and expertise for the project implementation. An example of this is in Zambia, where the project holder (the Zambia Agricultural Research Institute) partnered with a fertilizer company, input dealers, seed companies and soybean buyers. This enabled the project to introduce a soybean production kit that includes seed, fertilizer, inoculant and herbicide for a half-hectare of land.

Leveraging outside funding Despite AGRA's emphasis on partnerships, the grantees have not been successful in leveraging funding from other sources. Projects have remained mainly funded by AGRA. This has potentially serious consequences for the sustainability of the activities beyond the end of the AGRA funding, as well as for the grantee's own funding: it is risky to be too dependent on any one donor, even one as committed as AGRA.

Public-private partnerships Projects can make more use of partnerships with the government and the private sector. Such partnerships may be most valuable in helping farmers obtain inputs and in selling their crops.

Networking among AGRA grantees AGRA grantees all work in the same broad field (soil fertility), and could learn much from one another. In some countries (such as Mozambique), this worked well: the various grantees there formed a strong network; in other countries (such as Ghana), such networking was weaker. AGRA has established country-level soil health consortia to strengthen networking and grantees' institutional capacity. These consortia are made up of stakeholders working on soil health-related issues.

EQUITY AND TARGETING

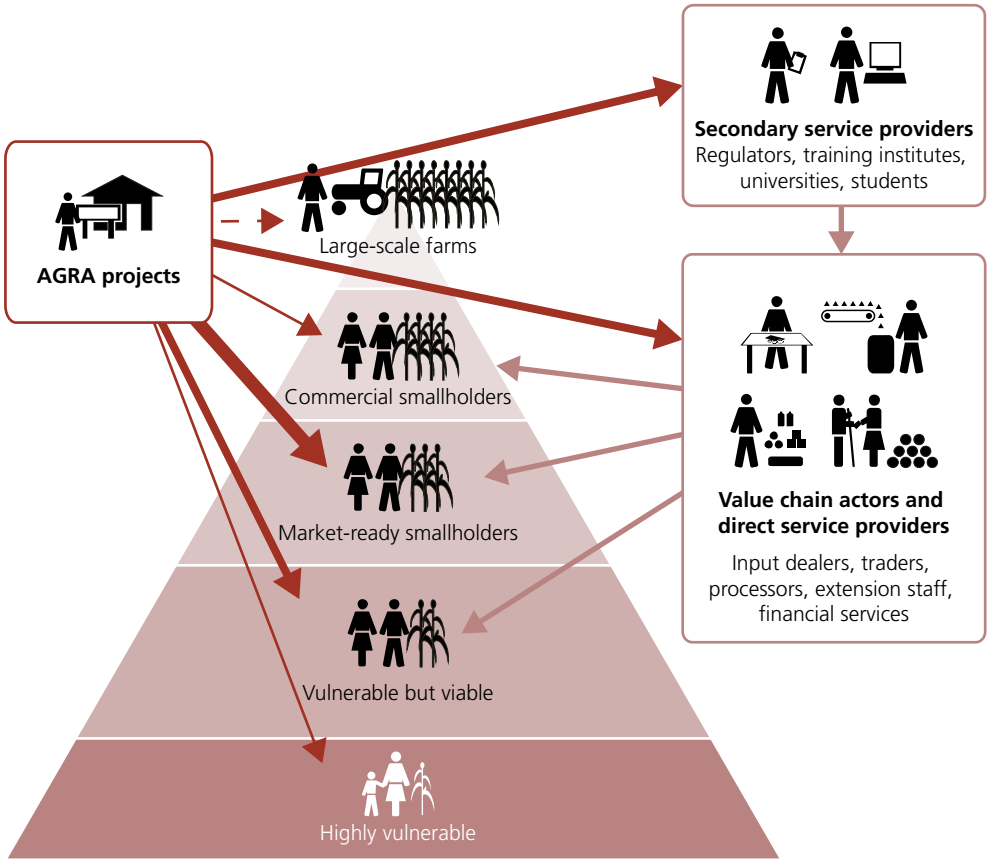
Are we actually reaching the people we want to reach? In particular, do we aim to serve women, young people, the elderly, minorities, the disadvantaged? Are we actually doing so?

A choice of targets

Development projects have a choice of targets (Figure 25).

Highly vulnerable These are the poorest and most vulnerable people in the community. They include people with little or no land, single women and their families, orphans, the elderly, sick and disabled. Such people attended events such as field days, but initiatives to improve access to finance and inputs focused on other groups.

Vulnerable but viable This is a large group, ranging from slightly better off than the previous group to the somewhat less-vulnerable. On their small farms they can produce enough to eat for most of the year, though some may still go hungry for several months. They may use some fertilizer and other farm inputs. They sometimes sell surplus produce after harvest, but buy food at other



Source: adapted from CRS

Figure 25 AGRA soil health projects generally target market-ready smallholders, vulnerable-but-viable farmers, chain actors and service providers

times of the year. Many of the projects targeted these farmers: they organized them into groups, provided training and advice, facilitated access to inputs, and helped them market their output.

Market-ready smallholders These are smallholders who occasionally produce a surplus, but who do not regularly sell their output. They tend to have slightly larger farms (a hectare or more) than the previous group, and may buy some fertilizer and other inputs, and rent extra land. They were also a major target for many of the projects.

Commercial smallholders These are better-off and better-educated local people, who are often local leaders and innovators. They were not an explicit target, but some projects included them to get their support and to influence their less well-off neighbours.

Large-scale farms Here, an outside investor (usually a private company or sovereign wealth fund) invests in a big farm (hundreds or thousands of hectares) with a lot of equipment and capital. The aim is to produce as much output as possible, often for export, rather than to benefit local people. For the government, this approach is attractive because it generates foreign revenue, builds infrastructure and creates employment (for example in processing industries).

Big farms were not a target for AGRA, but could be used as intermediaries to reach small-scale farmers nearby. In Malawi, for example, a CDI farm served as a service hub for the surrounding smallholders. This was possible because CDI has a strong corporate social responsibility agenda. In other projects in Mozambique and Ghana (not included in this review), AGRA also works with large farmers that contract surrounding smallholders as outgrowers.

Value chain actors and direct service providers These include input dealers, traders and processors, as well as extension staff and financial service providers. Many of the projects targeted these explicitly: the idea was to encourage them to change the types of service they offer and extend them to a larger range of clients. Input dealers, for example, normally sell products to better-off farmers in the "commercial smallholders" category. The projects aimed to get them to stock a different range of products and increase their customer base to include people in the "market-ready" and "vulnerable-but-viable" categories. Similarly, those projects that worked with financial institutions aimed to help them expand their lending to groups they would not usually consider as viable clients. By influencing a small number of these intermediaries, the projects hoped to benefit a much larger number of farmers.

Secondary service providers These include regulators, training institutes and universities, and students. They do not serve farmers directly; instead, they work with others who do. Or, in the case of students, they may return to (or take up) positions in organizations that provide such secondary services. Several of the AGRA projects focused exclusively on this set of targets. The assumption is that by increasing their skills and capacity, the projects would have a larger multiplier effect than if they had targeted the farmers directly.

Women and disadvantaged groups

Women The majority of Africa's farmers are women. The menfolk are often away working elsewhere, leaving their wives and children to manage the farm. Other women farmers are widows. But women are at a considerable disadvantage in agricultural development. They are subject to a plethora of social and economic restrictions: they have little say in the household or community; they find it harder to get information, travel and negotiate deals; extension services typically target the "head of the household" – i.e., a man.

The AGRA projects specifically aimed to reach women farmers, technicians and students. For the 12 projects for which data are available, the proportion of women in these categories ranged from about one-third to over a half. The best performer was Rural Outreach's project in western Kenya, where 60% of the nearly 35,000 beneficiaries overall were women, as were 90% of the 2,161 users of a credit scheme. Perhaps the best improvement was reported by Kwame Nkrumah University of Science and Technology in Ghana, where the number of female postgraduate students in soil science rose from zero at the start of the project to 46% (16 of 35 students) by 2014.

Other disadvantaged groups Efforts to serve other disadvantaged groups were patchy. The Millennium Villages project in Uganda assists groups of HIV widows to grow soybean to enhance their diets. Rural Outreach relies on a cadre of young people to provide extension services. One project in Ghana found that a blind person and someone with a physical disability were good farmers. Other projects could learn from their success.

Promoting inclusion While the projects have been successful at including women and integrating gender issues into their work, they have paid less attention to other groups. AGRA needs to do more in this area. It should study what has worked, and document the best practices for replication. AGRA-supported projects should empower the beneficiaries to actively participate in their own development, and to hold their leaders accountable. Projects should aim for inclusion and target specific disadvantaged groups, and monitoring systems should track their performance in this regard.

SUSTAINABILITY

What happens after the end of the project?

Issues of sustainability boil down to a number of questions:

Farmers' use of technology Will farmers continue to manage their soil in a way that boosts fertility and yield? Or will they revert to the bad old habits of continuous monocropping and nutrient mining?

The farmers who have tried the technologies recommended by the project have seen their yields rise significantly. They know that the profits will cover the cost of the next season's inputs. They have acquired the knowledge they need to continue to use these techniques. So they have both the incentive and means to use the improved technology. Some will undoubtedly drop out, especially if those who have been attracted primarily by subsidized input prices. But the majority should continue to use the technologies.

If all goes well. But the farmers are now dependent on outsiders: if they cannot get seed and fertilizer, they will not be able to use the new techniques. And if the weather is bad and the crop fails, they will not have enough money next season to buy inputs – so will have to try to get a loan. Without affordable credit, some will be back to square one.

In many projects, farmers who have not been directly involved in the projects have started using technologies such as planting in rows and rotating crops. Some use these techniques even if they do not have fertilizer: they say it is better than random dibbling or broadcasting the seed. This indicates that such farmers will not abandon everything after the project ends. They will continue with certain aspects. Plus, lead farmers do most of the technology dissemination; they will stay in their communities after the project and can continue to promote the new ideas.

Input supplies Will input suppliers continue to stock and promote the right types of supplies? Will they sell them to farmers at an affordable price?

The input dealers find it profitable to stock fertilizer, but rely on the right type of fertilizer being available at the right time, and at the right price. That depends largely on government policies, as well as things outside an individual government's control, such as the world prices of fertilizer and grain. However, the dealers can be expected to do what they can to stock and sell the products.

The availability of legume seed is more questionable. Commercial seed suppliers do not find it profitable to produce and sell such seed, as farmers can merely buy one batch, then grow their own seed for the next season. This market failure means the government may have to step in to subsidize or stimulate legume seed production.

Credit Will financial institutions offer farmers affordable credit? This is doubtful. Credit institutions see farming as too risky, and serving lots of scattered farmers as too unprofitable. The projects have found that even with a hefty deposit to guarantee loans, banks still want to charge sky-high interest rates. Without such guarantees, they are likely to cease lending to farmers altogether, or to tighten loan conditions, making them less attractive.

A solution is to organize farmers into savings and credit associations so they can generate their own credit. But that takes a lot of training and organization, and has not been a major focus of the projects. Even the most successful projects have organized only a fraction of their farmer clientele into such groups.

Information and advice Do farmers still need advice? Will other organizations take over the task of promoting integrated soil fertility management?

Once you know how to plant soybeans and apply a basal fertilizer, you do not need to be told twice. But conditions change, new problems arise, the weather may be bad, and as technology becomes more sophisticated, farmers need more support, not less. Where can they get it?

From several potential sources. Follow-on projects are necessarily a stopgap measure: what happens after the follow-on ends? Commercial farm-advisory services are rare in Africa and target large-scale farmers rather than smallholders. Farmer-to-farmer extension is effective but relies on goodwill and voluntarism, so is hard to sustain without support – though marketing groups and savings-and-loans associations might be able to pay the farmer-extensionists' costs. The extension service in most countries is weak, and is not able to serve the needs of every farmer. Input suppliers are perhaps the most promising source of advice, but they have an incentive to tell farmers about the products they sell, and not in providing unbiased advice about other topics.

Improving sustainability

The AGRA projects were designed for sustainability: they introduced profitable, low-risk technologies; they established or strengthened the relevant institutions; they ensured that key actors had built-in incentives to carry on; and they provided farmers and others with the necessary skills. So the key innovation, integrated soil fertility management, should have a chance of continued use even without project support.

Filling gaps As indicated above, the key weaknesses seem to be in advisory services, the availability of affordable credit, and supplies of legume seeds. AGRA and its grantees need to convince governments of the need to strengthen and support these aspects.

Educational interventions Sustaining educational interventions is trickier. The soil laboratories and other bits of infrastructure have been improved, but the universities have not yet found ways to generate money to pay for supplies and operations. One solution is obvious – to offer soil-testing and analysis services for a fee. But that requires an entrepreneurial approach and a well-thought-out business plan, which the universities have not developed. The private sector might start offering soil-analysis services; doing so would help generate employment in rural areas.

Without the carrot of scholarships, will students still flock to soil departments? This is doubtful. Soil departments will have to find alternative sponsors of scholarships. And their ability to attract high-grade students depends not only on the availability of funding for study, but also on potential jobs and the attractiveness of a career in the field.

Soil departments need to work with potential employers, such as extension agencies, input suppliers, regulators and ministries of agriculture, to help them upgrade existing staff and recruit new personnel. They need to convince these employers of two things: the value of a soil science degree specializing in soil fertility management, and the need to sponsor staff to earn such a degree.

Exit strategy Exit strategies can take on different forms (Figure 26).

A. **Abrupt end of support** This is where the project either has no exit strategy or has deliberately decided to cease activities without any managed transition. The latter may be appropriate if, for example, a project consists largely of training and all the targeted trainees have learned what they need to know.

B. **Continued involvement with new funding** The project implementer may be able to find new funding to continue its work – from the same donor, a new donor, the government or a commercial source. An example of this is where a university soil department finds another organization to provide scholarships for graduate students.

C. Gradual handover to another institution This is where a project tries to build an institution (such as farmers' organizations or a dealers' association) to take over certain functions. The project tries to build the capability of the other institution and gradually hand over responsibilities to it, enabling it to learn and grow in the process.

D. Spinoff to a commercial unit In some cases, it may be appropriate to set up a unit within the project implementing organization, and to spin this off as a separate, commercial organization towards the end of the project. Such an approach may be appropriate for Rural Outreach in Kenya, which runs equipment to mill farmers' soybean into flour. It is hard to see Rural Outreach running such a unit in the long term; by converting it into a separate enterprise, it could continue to provide the service to farmers without distracting Rural Outreach's management from its principal mission.

Many of the projects lack a well thought-out exit strategy. Whatever the most appropriate strategy, AGRA and its grantees should plan it from the start of a project, not try to develop it near the end.

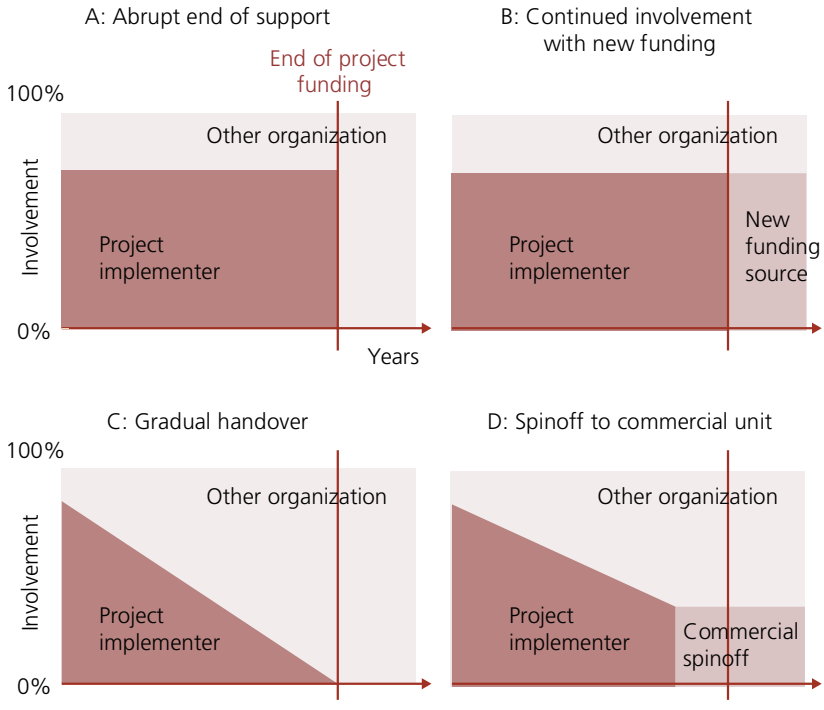


Figure 26 Exit strategy models

REPLICABILITY

AGRA is a major donor, and its Soil Health Programme is ambitious: it aims to reach 4.1 million farmers: 2.1 million farmers directly and another 2.0 million indirectly. But Africa is big, and 2.1 (or 4.1) million is still a small number compared to the continent's farming population. To benefit more people, the projects' approaches have to be replicable – ideally by farmers and other clients, as well as by the grantees themselves and by other donors and implementers.

In an ideal world, a project intervention would replicate itself, without any further outside support. Farmers would see the benefits of using the improved technology, and would invest in it because it is low risk and produces clear profits. Eager to make a profit, input dealers would stock the right products to sell to farmers. Traders and processors would fight each other to buy the farmers' products.

Alas, the real world is rarely like that. Soil fertility improvements can be complex and require many changes to a farmer's current enterprise: new crops or varieties, expensive inputs, unfamiliar procedures, novel marketing methods. They also require a range of support services – inputs, advice, finance and marketing. If one of these is missing, the whole innovation fails to take off.

That means that replicating soil fertility improvements usually takes outside stimulation, in the form of information, institutions, projects and policies. The AGRA projects have promoted replication in various ways.

Disseminating information One key to replication is disseminating information and skills outside the original target beneficiaries. The projects have put a significant effort into doing this through radio broadcasts, by inviting outsiders to demonstrations, by training extension workers and input dealers, and by producing manuals.

Input supplies A reliable supply of inputs such as seed and fertilizers is vital if the integrated soil fertility management approaches are to spread. The projects have tried to ensure such supplies by setting up seed-multiplication schemes, training input dealers, and establishing associations of input dealers. In Burkina Faso and Rwanda, the dealer networks cover the whole country. By stimulating demand for inputs, the projects have made it possible for dealers to set up new shops and expand the range of products and services they provide. Many have found that one way to boost business is to hold technology demonstrations on their own land.

Building institutions A project does not itself have to be replicable in order to affect a large number of people. Working with input dealers (see above) is an example of this. Another is building the capacity of university soils departments and training institutions. By training new professionals, they will automatically spread the improved soil management techniques.

Influencing others The success of an AGRA-funded project stimulates others to adopt similar approaches. In Zambia, for example, the government has replicated the Zambia Agriculture Research Institute's legume project using a $30 million loan from the World Bank.

Sometimes the replication is unforeseen: in Uganda, the Millennium Villages Project promoted soybeans as a way to increase soil fertility. That has led farmers to also use fertilizer on potatoes, sorghum and vegetables, as well as to plant trees.

Ensuring a profit To adopt a new practice spontaneously, people must think it is in their own interest – they have to make a profit. That is true for everyone in the value chain: input suppliers, farmers, traders and processors. In designing projects, AGRA and its grantees should use a value-chain approach to ensure that the crops they recommend do have a potential market and will be profitable for everyone involved. Where there are bottlenecks or market failures, such as

in the supply of legume seeds, ways need to be found to overcome these, including community revolving-seed schemes and subsidized production by the government or research institutes.

Cost of replication Can a project be replicated or scaled up? Its attractiveness to governments and other donors will depend on various things, including the impact on production and farmers' incomes, and the cost per farmer reached. We discuss this issue in the section below.

IMPACT AND VALUE FOR MONEY

Are the projects having the hoped-for impact? How do we know – or is it too early to tell? And is AGRA investing its money wisely? Are the projects reaching enough farmers per dollar invested? Should AGRA be investing in something else instead?

Assessing impact

AGRA uses a technique known as IPTT (indicator performance tracking table) to monitor the progress of its projects. For selected indicators, this gives the baseline value (i.e., at the start of the project), the target, and the actual value. The indicators measure **outputs** (such as number of farmers trained), **outcomes** (e.g., the percentage of farmers who have adopted a technique), and **impacts** (e.g., the crop yield).

At the time of writing, most of the projects described in this book were still running, or had only recently been completed. So the final evaluation data are not yet available. But indications so far are encouraging:

- Over 95% of the targets for key indicators such as fertilizer supply and dealers trained have been achieved.
- Yields have increased 2–3 times over the baseline.
- 1.5 million of the 2.1 million farmers targeted are using integrated soil fertility management techniques.
- Fertilizer supply has reached 178,000 t, 95% of the target of 187,000 t for the 5 years of the programme.
- Over 95% targeted input dealers have been trained.

Many of the data presented in Chapters 2–4 reflect outputs rather than outcomes or impacts, so they must be treated with caution. For example, some projects have data on things like numbers of farmers "reached", the number of people trained, and yields from demonstration plots rather than farmers' fields.

Judging whether the projects had the desired impact will become possible when the final evaluations have been completed. The data can be compared to the baseline surveys to discover whether farmers' yields, production and income have actually risen, and by how much.

Value for money

We can divide the projects into three groups:

- Those that aimed to reach **farmers** directly (or indirectly through lead farmers).
- Those that targeted a smaller number of **intermediaries**, such as input dealers, inspectors and extension workers, through in-service courses and short-term training.
- Those that supported **students** to get their master's and PhD degrees.

For each of these groups, we can compare the total project costs with the numbers of individuals reached (or targeted, since we do not have consistent data for the numbers actually reached). That gives an idea of value for money (though see the caveats at the end of this section).

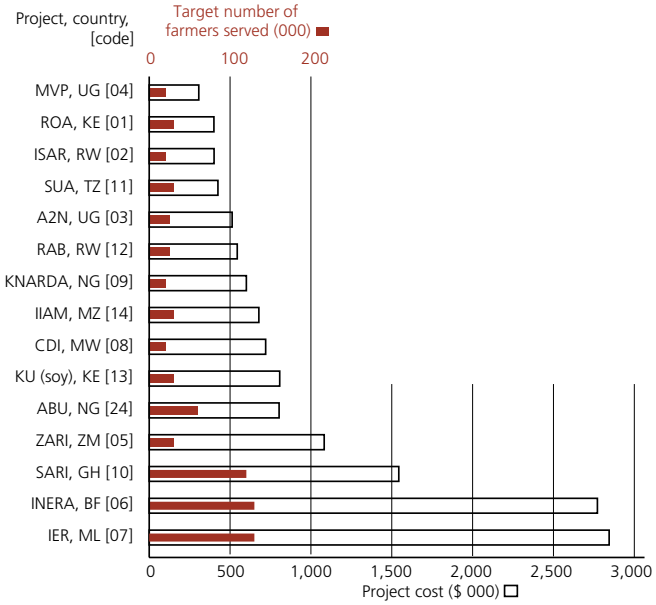


Figure 27 Total project costs and number of farmers served for 15 projects that targeted farmers directly

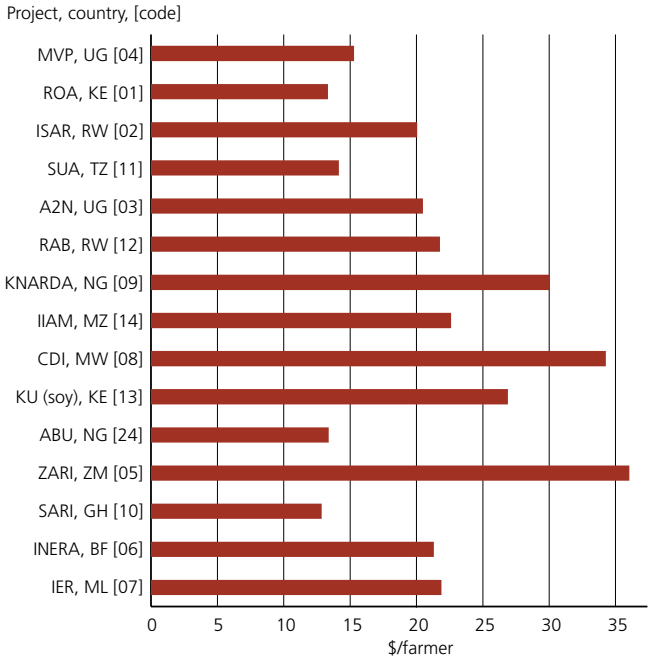


Figure 28 Cost per farmer reached for 15 projects that targeted farmers directly

Projects targeting farmers directly

Figure 27 shows the total cost of the projects and the number of farmers they aimed to serve.

The projects run by SARI in Ghana, INERA in Burkina Faso, and IER in Mali each aimed to reach 120,000–130,000 farmers. Most of the other projects aimed to serve between 20,000 and 30,000 farmers each.

Most of the project budgets were around $500,000. A small number of projects invested more: over $2 million in the cases of INERA in Burkina Faso and IER in Mali.

Dividing the number of farmers reached by the cost of a project gives an idea of whether a project delivers value for money. It also shows whether it is replicable – whether other donors or governments might consider replicating it in other regions or countries.

Figure 28 shows the cost per farmer reached for the 15 projects that targeted a specific number of farmers. The lowest costs were between $13 and $15 per farmer, for the projects run by SARI (Ghana), Rural Outreach (Kenya), Ahmadu Bello University (Nigeria) and Sokoine University (Tanzania). The most expensive projects in terms of cost per farmer were those of CDI in Malawi and ZARI in Zambia, at around $35 per farmer.

Projects targeting intermediaries

Projects that did in-service training and short courses trained between 133 and over 1,000 people such as input dealers, inspectors and extension workers. The costs ranged from around $400,000 (the fertilizer regulator projects in Tanzania and Ghana) to $1.7 million (the AGRODIA project in Burkina Faso, which trained input dealers) (Figure 29).

PPRSD's regulator project in Ghana trained 133 individuals at a cost of about $3,500 each, presumably because of the technical nature of the training required (Figure 30). UDS's project (also in Ghana) trained over 800 in-service trainees at a cost of only $600 each.

Projects supporting MSc and PhD students

Four projects focused mainly on helping master's and PhD students get their degrees. As might be expected, these projects supported a much smaller number of individuals – between 15 and 35 people (Figure 31).

As any parent of a student knows, postgraduate education is expensive. Getting a PhD naturally takes longer and costs more (between $23,000 and $28,000 a year) than a master's ($15,000 to $20,000 a year).

The most expensive project in terms of cost per person was that run by KNUST, which was the only project to support PhD students (Figure 32). The cost of training in some universities (especially KNUST) was high because it includes investments in infrastructure (lab equipment and computers), incentives for women, and the cost of bringing in visiting professors to support teaching and research.

A pinch of salt

While these graphs give an indication of the relative costs, they should be treated with caution:

- Costs and conditions vary widely from place to place. A project in an area with difficult terrain or poor infrastructure will cost more than one in an easier location.

Figure 29 Total project costs and number of trainees trained by five projects focusing on intermediaries

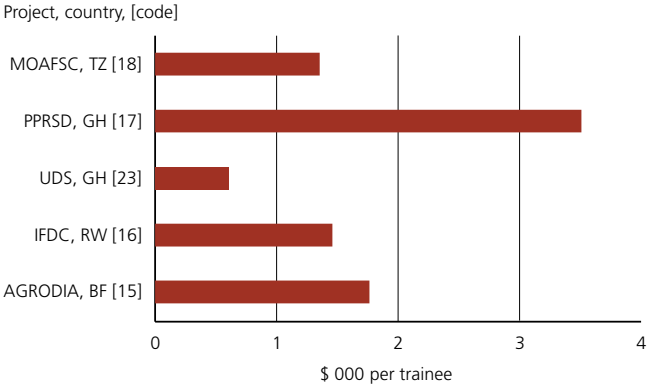


Figure 30 Cost per trainee for five projects focusing on intermediaries

- Each project had a different set of components, only some of which go into training or education. Other costs include establishing farmers' organizations and refurbishing a laboratory; these will have long-term effects that are not reflected in a mere "number of people served" measure.
- The graphs show targets, not the actual numbers of people reached or the numbers of people who actually adopted the technologies. Just because a farmer has been "reached" does not mean she has necessarily adopted the technology, or has increased her yields because of it. A more thorough analysis based on actual impact data would be necessary to reveal the cost-effectiveness of the projects.

Multiplier effect

Comparing the costs of the three types of project enables us to calculate an implicit "multiplier" for the different types of projects.

- The projects that worked directly with farmers aimed to reach a total of 750,000 farmers and cost a total of $14.4 million, or $20 per farmer.

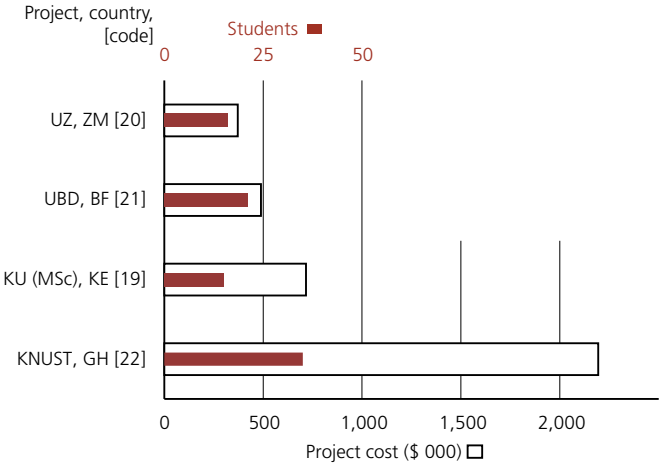


Figure 31 Total project costs and number of students trained for four education projects

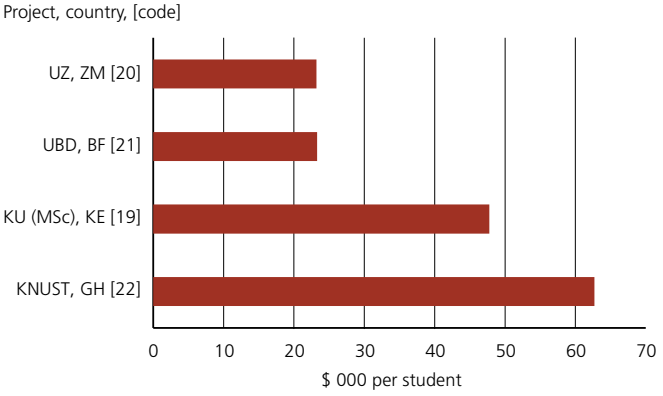


Figure 32 Cost per student for four education projects

- The five in-service and short-course projects aimed to reach a total of 3,300 individuals at a cost of 4.6 million, or about $1,410 per person.
- The projects that supported MSc and PhD students aimed to serve just 87 students in all, at a cost of around $3.8 million.
- Overall, the sample of 24 projects cost a total of $23 million.

Table 6 compares these figures. The final column shows the ratio of costs per person served. Putting an input dealer, extension staff member or inspector through in-service training costs 70 times as much as serving a single farmer. Helping a student get a master's or doctoral degree costs a massive 2,165 times as much.

Are these costs justified? We can also regard the final column in Table 6 as a multiplier. If an in-service trainee goes on to influence 70 farmers to the same extent as the project might have, then the project breaks even. If the trainee influences 71 people, then it wins. For the sorts of people who attend in-service training and short courses (extension personnel, input dealers, in-spectors), such numbers seem very modest. In just a single year (not to speak of an entire career), an extension person can expect to serve many more than that number of farmers. Investing on short courses and in-service training would thus seem to be money well-spent.

Table 6 Implicit multiplier effect of projects

Target group	Number of projects	Total cost of projects ($ million)	Individuals targeted	Cost per person	Ratio*
Farmers	15	$14.4	721,000	$20	1
In-service trainees	5	$4.7	3,306	$1,410	70
MSc and PhD students	4	$3.7	87	$43,348	2,165
All projects	24	$22.9			

***** Comparative cost per individual targeted. Farmers = 1

How about postgraduate degrees? Here, the multiplier (2,165) is much higher. People with postgraduate degrees tend to work in influential positions, so they certainly have the potential to benefit thousands of farmers. But how many of them actually do so? The risk of "leakage" is high: highly qualified people may emigrate, or find a job outside the field of soil science. Because there are so few of them, that would represent a loss to the country's soils (though presumably it would mean a gain for whatever other field they went into).

AGRA and its grantees can reduce the risk of such leakage by insisting that MSc and PhD candidates be drawn from the staff of specific institutions, or be guaranteed a job there once they graduate. Each student can be required to sign a contract undertaking to work for a minimum period (say, 5 years) in their home institution before they are allowed to look for another job.

More value for money

Some other ways that AGRA and its grantees can increase their impact and value for money:

- **Promote technologies more aggressively** Some technologies, such as microdosing and legume seed production, have a big potential outside the immediate project area. The projects should promote them to a wider audience, for example by getting them mainstreamed in the national extension service or in other donor-funded projects, and by publicizing successes via the media, in print and on the internet.
- **Work more with intermediaries** The projects have worked extensively with input dealers and other intermediaries in the hope they will induce farmers to use improved technologies. The projects can do more in this direction: for example, by working more closely with traders, processors and credit institutions to ensure farmers have a market and can get loans.
- **Better coordination** AGRA, the grantees and project partners can coordinate their interventions better to avoid duplication, learn from one another, share resources, and use those resources more effectively. This is why the AGRA has launched country-level soil health consortia, and why the Bill and Melinda Gates Foundation is supporting an Africa-wide one.
- **Study impact** Special studies are needed to evaluate the impact of projects and adjust project interventions to achieve still greater impact.

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Investing in soil

Cases and lessons from AGRA's Soil Health Programme

How to heal Africa's soils? Its soils impoverished and degraded by decades of overuse, Africa cannot produce enough food for its rising population. Radical changes are needed: a combination of organic and mineral fertilizers, intercropping and rotations with nitrogen-fixing legumes, tree planting to prevent erosion, and practices such as conservation agriculture and mulching that conserve water and improve organic matter levels. This combination is known as integrated soil fertility management.

Such techniques work: but they are not enough. The continent's smallholders also need to be able to buy inputs such as improved seed and fertilizers; they need affordable loans; they need markets where they can sell their produce; and they need reliable information and advice.

This book describes how the **Alliance for a Green Revolution in Africa** (AGRA) promotes these approaches through its Soil Health Programme. It summarizes 24 projects in 11 countries (Burkina Faso, Ghana, Kenya, Malawi, Mali, Mozambique, Nigeria, Rwanda, Tanzania, Uganda and Zambia) that the programme has supported. The cases fall into three broad categories:

- **Beyond demonstrations**, where efforts focus on helping farmers get the inputs, credit, markets and advice they need.
- **Input supplies**, which aim to improve the availability of fertilizer and other inputs.
- **Training and education**, describing initiatives to train soil specialists and extension workers for Africa's future.

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The book analyses these cases in terms of six types of interventions: access to inputs, extension approaches, output markets, access to finance, education and training, and policy and institution building. It then draws lessons in terms of five key issues that will be familiar to all who design and implement agricultural development projects: partnerships, equity and targeting, sustainability, replicability, and impact and value for money.

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