

Seeking
Fertile Ground
for a
Green Revolution
in Africa





Photo: UNAMID

Reviving Africa's Ailing Soils, Breathing Life into Food Production

A handful of soil can seem dull and lifeless. And yet, in its healthy state it is actually pulsing with hidden power. That's because the earth beneath our feet hosts a vibrant ecosystem controlled by a wide range of bacteria, fungi, and other organisms. They work in concert with a variety of nutrients like phosphate and nitrogen to transform mere seeds into meals for millions.

So soil deserves respect, particularly in sub-Saharan Africa. It is here—where farmers are racing to keep pace with the food demands of a population growing faster than any other on earth—that so much rests on soil conditions. Healthy soils are a crucial part of an African-led Green Revolution that has the potential to dramatically reduce hunger and poverty across the continent. Unhealthy soils, by contrast, could kill Africa's hopes for a prosperous, food-secure future.

The challenge is daunting because in many parts of the region, soils are naturally low in critically needed nutrients and often highly acidic as well. Compounding this problem is what soil health experts call nutrient mining. A crop like maize or wheat typically extracts nutrients from the soil—that's how they produce food. Nutrient mining is what occurs when crops extract more food than farmers return to the soil.

This nutrient mining, combined with inherently low soil fertility, is a key reason yields in sub-Saharan Africa—the amount of crops harvested per hectare—are far below yields achieved even in other developing countries.

While farmers in many parts of the world regularly harvest up to five tons of maize per hectare (about 2.5 acres), African farmers typically harvest one ton. In Rwanda and Uganda, scientists blame nutrient mining for banana yields that are five to 30 tons per hectare when they should be around 70. Cassava yields in Ghana average about ten to 12 tons per hectare when they should be at around 40 to 60 tons. Overall, soil health issues are costing African farmers US \$4 billion annually in lost crop productivity.

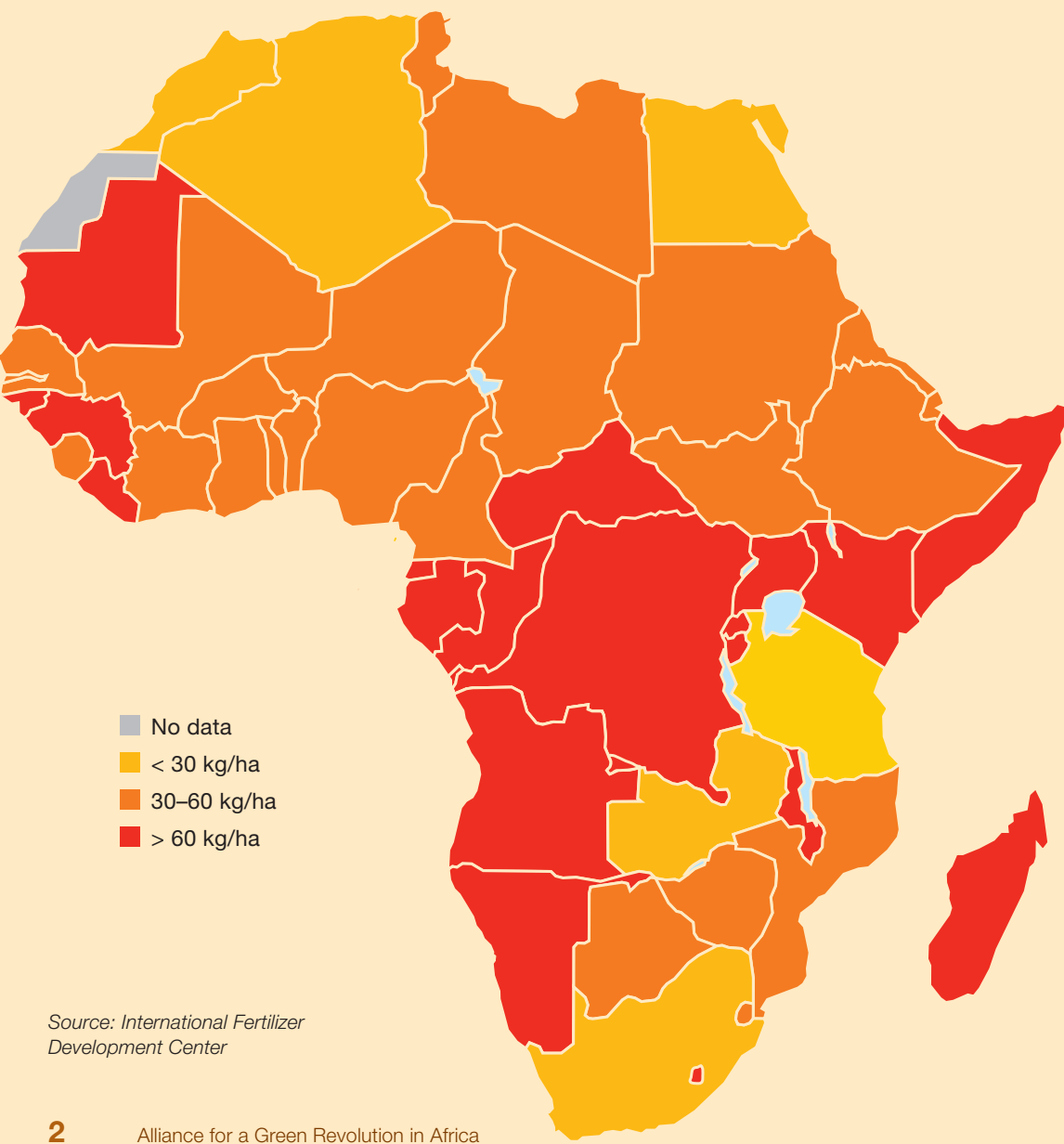
In 2008, keenly aware that soil health is essential to solving the region's food and economic challenges, the Alliance for a Green Revolution in Africa (AGRA), with funding from the Bill & Melinda Gates Foundation and the Rockefeller Foundation, established the Soil Health Program (SHP). The program is now a core component of AGRA's efforts to transform production on smallholder farms across the continent.

Africa is somewhat unique in that most of its food production occurs on millions of small holdings that are around two hectares (five acres) or less in size. So like all of AGRA's endeavors, its Soil Health Program is sharply focused on helping smallholder farmers acquire the skills and inputs they need to revive their lands, boost their yields, and increase food and economic security for the entire continent.

A healthy field with cereal (maize) and legumes (beans) planted side by side. The legume plants naturally enrich the soil with nitrogen and contribute to long-term soil health. They also reduce the need for mineral fertilizers.

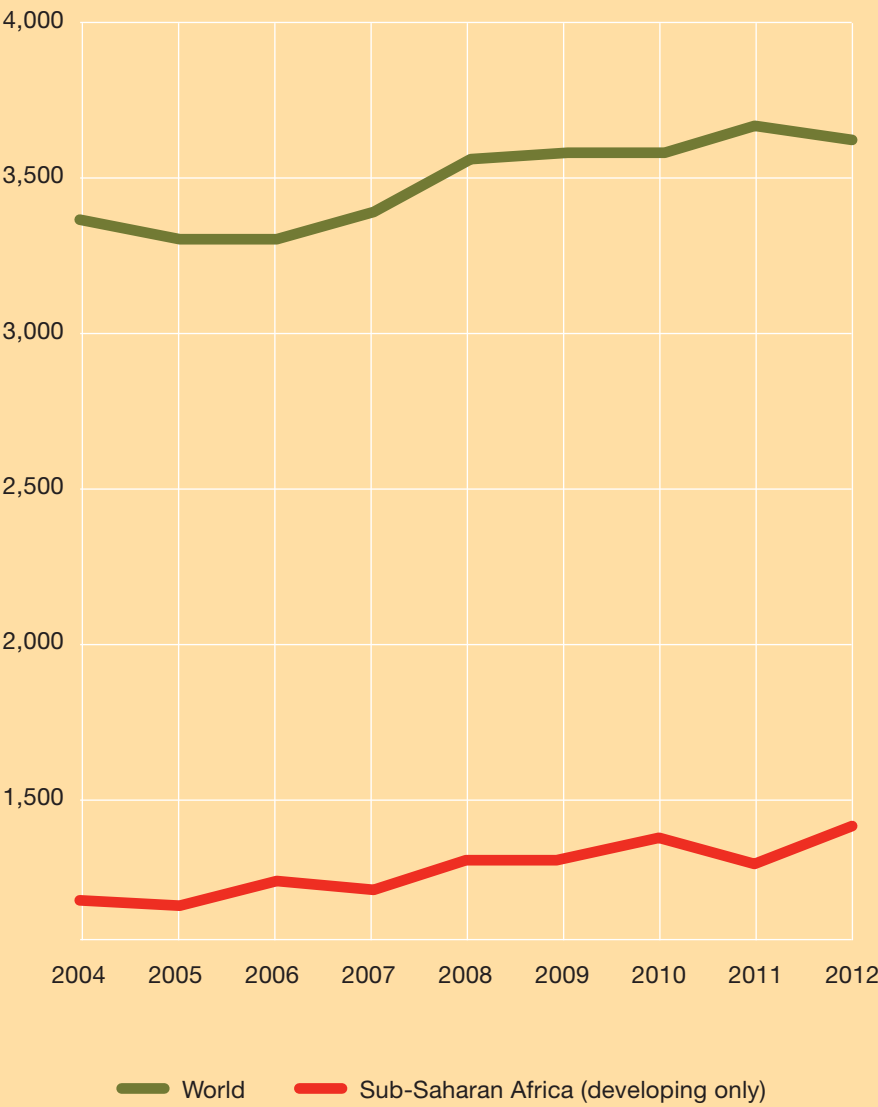


FIGURE 1: Soil Nutrient Mining in Agricultural Lands of Africa, 2002–2004



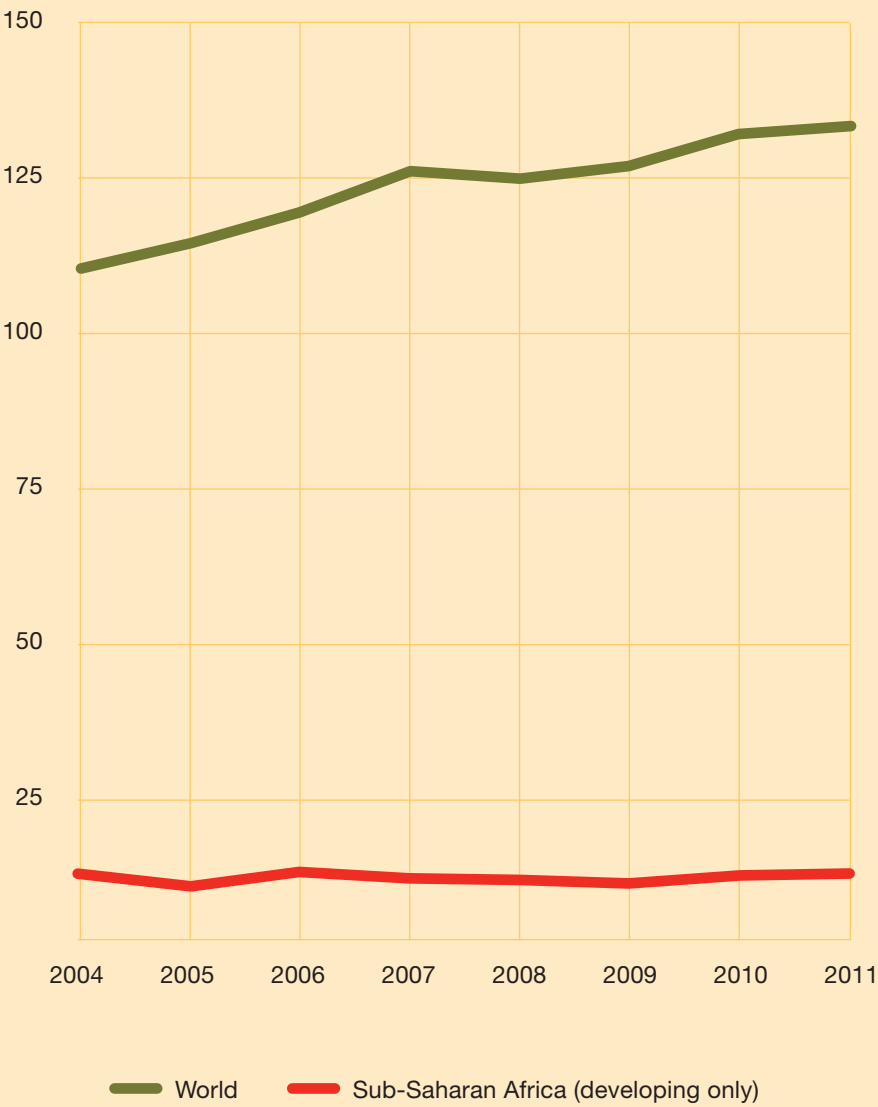
Source: International Fertilizer Development Center

FIGURE 2: Cereal yield (kilograms per hectare), 2004–2012



Source: World Bank

FIGURE 3: Fertilizer consumption (kilograms per hectare of arable land), 2004–2011



Source: World Bank

Anatomy of a Soil Health Crisis

Figure 1. The map on the left is a snap shot depicting the amount of nutrients crucial to producing food that were lost from African soils during a two-year period from 2002 to 2004 and not replaced. This trend has only intensified in the ensuing years. The losses ranged from less than 30 kilograms per hectare in the yellow areas to as much as 60 kilograms in the orange areas to more than 60 kilograms in the red areas. No loss of nutrients is good for farming, but persistent losses above 30 kilograms—a condition prevalent in the orange and red areas—represent a particularly dangerous situation as they indicate that a large and significant portion of Africa is being steadily drained of its capacity to support agriculture.

Figure 2. Poor soils are a key reason yields for cereal crops in sub-Saharan Africa like maize and wheat are far below what farmers elsewhere in the world achieve. AGRA is working with smallholder farmers to help them sustainably and responsibly increase production by increasing yields, rather than by converting natural forests or savannahs into croplands.

Figure 3. One factor behind the deterioration of African soils is that farmers don't have enough nutrients, either organic or mineral, to replenish their lands. For example, average fertilizer use on African farms is about 10 kilograms per hectare. In Germany it's 211 and India it's 179. At a 2006 African Union summit in Abuja, Nigeria, African heads of state pledged to help farmers raise their fertilizer use to at least 50 kilograms per hectare—still far below the global average, but enough to make a major difference in food production.

The Road to Recovery for Soil Health in Africa

It will take a long time to make up for decades of neglect, but in just a few years, AGRA's Soil Health Program, working with a wide range of partners—including farmer organizations, governments, scientists, soil input suppliers, NGOs, banks and micro-lenders—has made major progress.

Embracing the Art of Integrated Soil Fertility Management

First, AGRA has taken the fight for better soils directly to the farm. Since 2009, it has trained about 1.8 million farmers in 13 countries in an approach called “Integrated Soil Fertility Management” or ISFM. It also reached out to another 3.5 million farmers with radio broadcasts and other communication efforts promoting ISFM practices.

Farmers who adopt the ISFM approach employ a wide range of soil management and farming techniques that work together to revive and maintain the capacity of the land to support food production.

ISFM typically involves modest applications of mineral fertilizers and the use of organic matter like crop residues, animal manure and compost to enrich depleted soils. But these interventions, by themselves, are not sufficient.

Farmers practicing ISFM also regularly plant their lands with soil-enriching legume crops like cowpea, pigeon pea, beans or soybean. And they focus on adopting farming practices that reduce erosion and

improve water-use efficiency, like lightly tilling the soil without actually turning over the earth or growing crops in terraced fields that efficiently collect and conserve rainwater.

Many African farmers are also implementing innovative soil health solutions, like fertilizer “microdosing,” which involves placing just a few pinches of fertilizer in each seed hole rather than spreading or “broadcasting” it across an entire field. To make maximum use of their improved soils, farmers practicing ISFM are encouraged to carefully select improved crop varieties developed to thrive in local growing conditions.

Across the region, AGRA is seeing farmers employing ISFM techniques and dramatically boosting yields for crucial staples.

For example, in Tanzania, Malawi and Ghana, farmers participating in AGRA's soil health initiatives are doubling and even tripling yields of maize, pigeon pea and soybean. AGRA has seen every dollar invested in these countries return anywhere from \$5 to \$17 for participating farmers. Similar benefits are now widely seen in AGRA-supported soil projects in Kenya, Nigeria, Rwanda, Ethiopia, Uganda, Mozambique, Zambia, Mali, Burkina Faso and Niger, where a growing number of farmers are embracing soil health as a priority.

Improving Access to Quality Soil Nutrients

To reverse the degradation of African soils, farmers must be able to acquire and properly use quality soil supplements, including conventional mineral fertilizers and locally available inputs like lime, phosphate rock, and manure. African farmers use on average only about ten kilograms of nutrients per hectare, (compared to a global average of more than 130 kilograms). But a crop like maize may extract five times that amount in one season, quickly sapping the soil of its capacity to support food production and sending farmers on an unsustainable search for new crop lands.

AGRA's Soil Health Program has launched multiple initiatives to help smallholder farmers feed their nutrient-starved lands.

For example, it is providing training and other support to thousands of rural entrepreneurs known as agrodealers who, for many poor farmers, are the sole source of farm inputs. This investment has helped train about 9,000 agrodealers who were able to stock about 180,000 tons of additional fertilizers. If used as part of a broader soil management program, that's enough fertilizer to help about 1.8 million smallholder farmers triple the amount of cereals they produce. But farmers need assistance in choosing the right mixtures for their soils and learning how they can be combined with manure and other inputs to increase yields.

Farmers also are learning how to improve the soil by adding grain legumes like beans, soybean, pigeon pea, and groundnuts with their cereal crops. In addition to being highly nutritious, legumes have a unique, natural ability to capture and utilize nitrogen found in the atmosphere and deposit it into the soil. When their seeds are coated with a simple bacteria called rhizobium inoculum, nitrogen production can rise to 200 or even 300 kilograms per hectare, especially when combined with a small amount of fertilizer that contains phosphorous.

AGRA works with smallholder farmers to find legumes that are suitable for local growing conditions and diet preferences, and to show how planting them in particular configurations—for example, mixing them into a field of maize—and adding rhizobium can generate substantial yield increases.

Doing the Groundwork for a Green Revolution

Working with a wide range of partners—including governments, research institutions, investors, banks, farmer organizations, companies and NGOs—AGRA's Soil Health Program has made considerable progress in the push to develop more fertile ground for cultivating a green revolution in Africa.

For example:

- ▶ Over 3 million smallholder farmers have been directly trained in how to revitalize their lands through “Integrated Soil Fertility Management” or ISFM, and 1.7 million have already adopted the practice. This effort is directly responsible for reviving more than **1.6 million hectares of land** where once depleted soils are now yielding two to three times more food.
- ▶ Training programs focused on developing expertise in soil inputs have reached **9,000 small, rural farm supply retailers** known as “agrodealers.” They have used this knowledge to provide smallholder farmers with **180,000 tons of additional fertilizer**, enough to revive **3.5 million hectares of depleted land** and allow some **1.75 million poor African farmers** to triple production of essential cereals.
- ▶ As a co-founder of the African Fertilizer Agribusiness Partnership (AFAP), the Soil Health Program has stimulated new investments in fertilizer supplies and distribution that quickly added **400,000 metric tons of fertilizer** to markets in 13 countries. That's enough to enable **8 million smallholder farmers** to achieve substantial increases in yield and income.
- ▶ AGRA is working with governments in 13 countries to improve fertilizer inspection and quality control and to create transparent regulatory environments, an effort that already is encouraging more investors and companies to enter the market. AGRA also has supported training for **2,800 fertilizer inspectors** and about **200 laboratory technicians**.
- ▶ AGRA is working to replenish Africa's depleted brain-trust of soil health experts. So far, **4,800 extension workers** and **134,000 lead farmers** have been trained while AGRA is also supporting more than **170 students**—half of whom are women—studying soil science and agronomy at African universities.

Meanwhile, AGRA's Soil Health Program through the African Fertilizer Agribusiness Partnership (AFAP), is addressing larger obstacles that are inhibiting access to soil inputs across Africa. Initially focused on Tanzania, Ghana, and Mozambique, the partnership is supporting all aspects of the fertilizer market—including suppliers, distributors, and retailers. Its efforts to stimulate new financing and investments are expected to generate an additional 225,000 tons in those three countries. That's enough to meet the fertilizer needs of 4.5 million smallholder farmers.

AFAP also is providing targeted support for ambitious fertilizer blending initiatives in Ethiopia, Nigeria, and Cote d'Ivoire to help establish domestic capacity to produce fertilizers that use local resources and provide farmers with the particular nutrients their soils need.

Contributing to the project are the New Partnership for Africa's Development (NEPAD), the Africa Development Bank (AfDB), the International Fertilizer Development Center (IFDC), and the Agricultural Markets Development Trust.

As a result of these efforts, fertilizer supplies are starting to rise in several countries. For example, between 2008 and 2013, the number of fertilizer suppliers in Ghana almost tripled—from 12 to 35—and in Tanzania they went from six to 46.

However, as supplies have grown, maintaining consistent fertilizer quality has become a concern. To address this issue, AGRA is working with governments in 13 countries to improve inspection and quality control, and to create a transparent regulatory environment.

The Soil Health Program has engaged agriculture ministries and international institutions, including the International Fertilizer Development Corporation (IFDC), International Center for Research in Semi-Arid Tropics (ICRISAT), and the International Institute for Tropical Agriculture (IITA). Through these partners, AGRA has supported laboratory equipment purchases and training for 2,800 fertilizer inspectors and about 200 laboratory technicians.

This assistance and the broader effort focused on regulatory policies are creating an environment that is encouraging more investors and companies to enter the market for soil inputs.



Photo: AGRA

Cultivating a New Crop of Soil Scientists

Finally, just as soils have been depleted in Africa, government extension agencies and university programs focused on soil health also have endured a steady loss of their human resources.

Compounding decades of short-sighted cutbacks is the fact that some 60 percent of African public sector agriculture professionals are likely to retire in the next five to eight years. It is imperative to invest now to train a new generation of soil scientists, technicians and extension workers.

AGRA's Soil Health Program is taking the lead by focusing on three areas: postgraduate training of students; short courses for technicians and other staff; and refurbishing and re-equipping soil laboratories. AGRA has supported more than 170 students (135 in masters programs and 40 pursuing PhDs) seeking advanced degrees in soil science and agronomy at 11 African universities. And half of them are women. AGRA also has provided assistance to improve the analytical skills of about 200 laboratory technicians working in universities and national agricultural research institutes. In addition, it is helping universities acquire state-of-the-art laboratories and information technology equipment.

Partners in these efforts include Kwame Nkrumah University of Science and Technology in Ghana and Sokoine University of Agriculture in Tanzania, which are serving as regional hubs for training PhDs, and the Wageningen University in the Netherlands, which is participating in staff and student exchanges.

In addition, AGRA has trained 4,800 extension workers to improve their expertise in soil management and 134,000 "lead farmers," who can in turn teach soil management techniques to their peers.

From Demonstration to Transformation: Supercharging Soil Initiatives

Shortly after the Soil Health Program was formed, AGRA realized that it needed to be bold and ambitious and embrace a broad coalition of partners, given the many challenges that had been building up for decades. The program had aspirations to reach millions of farmers and AGRA staff talked about their desire to “go beyond demonstrations.”

Going beyond demonstrations, or GBD, quickly became the catchphrase for an unprecedented push to rapidly improve soil conditions in all its 13 focal countries.

In each country, AGRA and its partners sought out individuals, companies and institutions involved in all aspects of agriculture. Banks, microfinance institutions and farmer associations were brought on board to help farmers obtain credit for fertilizer purchases. Government officials were asked to monitor the use of subsidy programs, and buyers and aggregators of farm produce were consulted to give farmers confidence that investments to improve production could be recouped by selling surplus harvests.

As part of GBD, farmers were taught how to improve soil health by using small amounts of fertilizer, both mineral and organic, and by cultivating maize, sorghum, millet, and cassava with a soil-enriching legume, such as soybean or pigeon pea. They also were encouraged to work together to pool their resources to negotiate discounts for soil inputs.

Some examples of the significant results the program achieved:

- ▶ In Tanzania, 28,000 farmers participated and average maize yields more than doubled, from 1.5 to 3.5 tons per hectare while pigeon pea yields increased from 0.6 to 1.4 tons. The total value of crops produced was US \$54 million over three years, with an estimated return of US \$68 for every \$1 AGRA invested.
- ▶ In Malawi, the initiative attracted 30,000 farmers with maize yields more than doubling from 2 to 4.6 tons per hectare and soybean yields rising from 0.7 to 1.3 tons per hectare.
- ▶ In Ghana, 117,000 farmers participated and maize yields increased from 1.5 to 3.5 tons per hectare and soybean from 0.9 to 1.5 tons.

AGRA estimates the large returns generated by the projects are conservative because they do not capture the fact that by cultivating soybean and pigeon pea, farmers are naturally infusing soils with nitrogen, which over the long-term, should lower their input costs.

Healthy Soils for Africa: the Recipe for Success

Across 13 countries in sub-Saharan Africa, AGRA’s Soil Health Program is helping millions of smallholder farmers with few resources double and triple yields by practicing Integrated Soil Fertility Management (ISFM). In a region where declining soil health is costing US \$4 billion per year—about the GDP of Malawi—the small investments required to follow ISFM practices can make a big difference.

Here is what ISFM can look like on a typical smallholder farm:



▶ Preparing the Soil:

After plowing—often with a pair of oxen, and in a way that does not deeply disturb the earth and cause soil erosion—farmers enrich the soil with organic materials like manure, compost or the leftover stalks and leaves from a previous crop.



▶ Seeding and Feeding:

They then plant the seeds, preferably with an improved crop variety developed specifically for their region, while also adding a small amount of mineral or organic fertilizer to the field. Farmers practicing ISFM typically add about 50 kilograms of fertilizer per hectare—still about a fourth or less that what farmers in other parts of the world use, though the exact amount depends on the nutrient needs of local soils and the crop variety being cultivated. Farmers also may need to add lime if the soils are highly acidic, which is often the case in sub-Saharan Africa.



▶ Adding Legumes to the Mix:

ISFM usually involves planting legumes like pigeon pea or soybean along with a cereal crop like maize because legumes naturally enrich the soil with nitrogen and contribute to long-term soil health. Sometimes, farmers alternate between legumes and cereals, a technique known as “crop rotation.” Smallholder farmers with a limited amount of land often choose “intercropping” instead: intermingling a legume like pigeon pea with a cereal like maize or sorghum. Consistent use of legumes can, over time, significantly reduce the need for adding mineral fertilizers or manure.



▶ Water, Weeding, Pests and Disease:

A range of good farming practices are essential to developing healthy soils. For example, AGRA supports efforts to train farmers in how to create terraced fields that are divided by long, hand-dug ditches that collect and hold rain water, allowing the moisture to slowly seep into crops. Meanwhile, farmers are advised to start weeding about two weeks after planting and to continue at regular intervals. They also monitor for signs of pests and disease, which can inhibit a crop’s ability to absorb nutrients.



▶ Harvesting and Marketing:

Smallholder farmers in Africa adopting ISFM approaches typically harvest two to three times more than farmers who do not. A key to sustaining their soil health practices is finding a market for the surplus that allows farmers to achieve a fair return on their investment. Meanwhile, even the additional stalks and leaves that come along with the improved yield are a benefit: they provide nutritious feed for livestock—almost all African farmers own livestock—and organic matter to add back to the soil.

Soil Health Made Simple: Taking the Guesswork Out of Crop Nutrients

AGRA's Soil Health Program is committed to helping smallholder farmers in sub-Saharan Africa make efficient use of their limited resources to create soil conditions that will produce abundant harvests for years to come. One innovation they are supporting is called the “fertilizer optimization tool.”

The tool originally was developed by Uganda’s National Agricultural Research Organization in collaboration with the University of Nebraska-Lincoln in the United States. It’s a simple computer program that contains data on soil conditions in different parts of the region and can calculate the amount of nutrients required to boost yields for a wide range of crop varieties.

Farmers enter:

- ▶ The amount of money they have to invest
- ▶ The size of their fields
- ▶ Fertilizer costs
- ▶ The market price of the commodity they are cultivating

They then press “Optimize” and the program tells them how much fertilizer they should use to get the best return on their investment. For example, during a test case in Uganda, a farmer’s own estimates for fertilizer were twice as much as what he actually needed.

Originally developed for farmers in Uganda, the tool is now being tested in Kenya, Rwanda, Malawi, Zambia, Ghana, Mali, Burkina Faso, Ethiopia, Mozambique, Tanzania, Niger, and Nigeria. There also are efforts underway to develop a version of the tool that can be accessible via mobile phones.

AGRA also is working on similar efforts through its support for the African Soil Information Service (AfSIS). AfSIS has piloted a text messaging service that could provide farmers with basic advice on improving soil health.

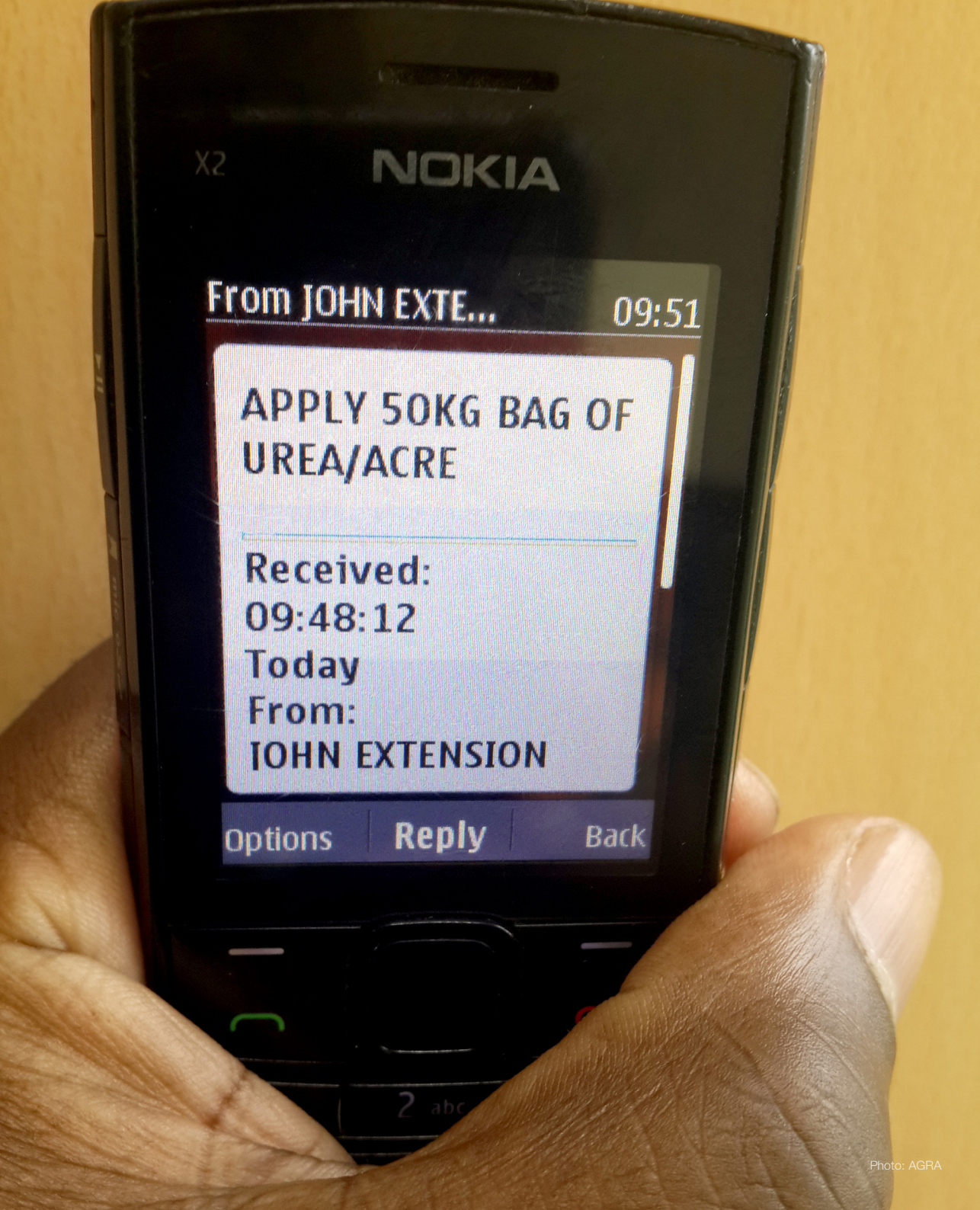


Photo: AGRA

Seeking Good Food for the Soil: No Sticks and Stones

Over the last few years, several African countries have experienced a sharp increase in fertilizers supplies, and while this is overall a good thing, it has raised concerns about quality. There have even been isolated reports of farmers purchasing fertilizers that were little more than sticks and stones.

If African farmers lose faith in the quality of soil inputs, their reluctance to purchase essential products could become a major impediment to improving food production in the region. That’s why AGRA’s Soil Health Program is funding efforts in 13 countries to establish regulatory authorities, train inspectors, improve laboratory testing capabilities, and create public awareness about the importance of high quality soil supplements.

AGRA’s Soil Health Program has worked particularly closely with governments in Tanzania, Ghana, Mali, and Mozambique to increase quality assurance capabilities and to create a dialogue with fertilizer producers, distributors and sellers.

For example, in Mozambique, AGRA has supported efforts to develop a regulatory authority to protect farmers against nutrient deficiencies, misleading claims, adulteration, underweight bagging, and also inadequate labeling. One effect of the new standards is that it is attracting investment in local fertilizer production, as reputable companies need not fear unfair competition from cheap, substandard products.

There has also been a spill-over effect into the broader agriculture sector. More financing institutions like Banco Terra and Banco de Oportunidade are now backing agriculture projects in Mozambique, recognition that setting nationwide standards for a crucial input like fertilizer is likely to translate into a more prosperous agriculture sector.

AGRA's Soil Health Program is building on these efforts by training agriculture extension service workers to recognize counterfeit or substandard soil inputs and share their expertise with farmers. AGRA also supports projects that are using educational videos and mobile phone messaging platforms to help farmers and agrodealers acquire high quality inputs and become more informed and judicious consumers.



Photo: AGRA

Without proper quality control, farmers are at risk of purchasing fertilizers that may be little more than sticks and stones, like this bag of fertilizer here confiscated in Mozambique.

Snapshots of Success

From Jobless to Prosperous in Malawi

In his mid-20s, Amos Chipokosa was just one among millions of young Malawians who was aimless and unemployed and casting about for a means to make a living. But then a chance encounter with a soybean project funded by AGRA's Soil Health Program and implemented by the Clinton Development Initiative changed everything.

Working with his wife, Sofiret, Amos decided to give the project his all. He closely followed the advice on how to take care of his soils and use manure and other inputs to get the most out of his improved soybean variety.

The couple harvested enough soybean to earn about 15,000 kwacha, about US \$150. They used the money as seed capital to start a small store. Earnings quickly rose, in both the store and on the farm, and as the money increased, so did their investments. They started growing maize, groundnuts and sweet potatoes, as well as soybean, and purchased pigs and goats. They built a four-room house for their family and contemplated building a residential rental property.

Asked about the secret to his success, Amos said it was simple: "I used fertilizers and good seeds."

In the Acidic Soils of Rwanda, a Life Transformed by Lime

For many years, Francis Munyengango dutifully worked his family's one acre plot of land in the steep hills of Rwanda, and each season, it provided the same meager yield: about two bags of beans. That was not enough to feed his large family, or enough to provide income for his children's school fees.

The problems Francis faced were not complicated, but no one had ever suggested he test his soils. Eventually, Rwanda's Institute of Agronomic Sciences (the Institut des Sciences Agronomiques du Rwanda or ISAR) invited Francis to join a project supported by AGRA's Soil Health Program. They quickly discovered that like a lot of soils in Rwanda, Francis was trying to grow beans in highly acidic conditions.

What he mostly needed was lime to neutralize the acid. But the ISAR project also taught him how to implement other aspects of an Integrated Soil Fertility Management approach, which included using mineral and organic fertilizers. Yields on his small plot of land quickly jumped from two to five bags and transformed his life. Francis now has enough to feed his family and sell at the local market to earn income, which he is using to expand his farming activities.



Above: Amos Chipokosa and his wife, Sofiret, in the store they started with earnings that originated with a soybean project supported by AGRA's Soil Health Program and the Clinton Development Initiative.

Opposite page, left: A prototype of a machine developed by Burkina Faso's Institute of Environment and Agricultural Research (the Institut de l'Environnement et des Recherches Agricoles or INERA) that could make fertilizer "microdosing" viable for large areas of land.

Opposite page, right: A new warehouse constructed with financing from the AGRA-supported African Fertilizer Agribusiness Partnership Project helped smallholder farmers avoid a fertilizer shortage in an important agriculture region of Ghana.



Photo: AGRA

In Burkina Faso, Seeking a Tiny Solution to a Big Problem

In Burkina Faso, like in so many sub-Saharan countries, poor soils are a major reason yields for food staples like millet and sorghum have remained stagnant for years. And while fertilizers can provide a crucial source of nutrients, their high costs and low availability have discouraged broader use.

AGRA's Soil Health Program has long worked with Burkina Faso's Institute of Environment and Agricultural Research (the Institut de l'Environnement et des Recherches Agricoles or INERA) to help thousands of farmers use a process called fertilizer "microdosing" that makes the most of their limited supply of soil nutrients. Microdosing is relatively simple: farmers dig a small hole, drop in a few seeds and also a pinch of fertilizer. Farmers frequently report that this small amount of fertilizer is sufficient to double their yields. But microdosing is difficult and time consuming, making it a challenge to address the soil health needs of a large field.

AGRA has funded an effort by INERA to bring a new level of efficiency to fertilizer microdosing. Researchers have developed a simple, animal drawn device that is able to microdose a full hectare (about two and a half acres) in about three hours. Manually, the same job would consume about 30 hours. The machine can be pulled by a donkey, cow, or horse and could be the innovation that propels microdosing to the mainstream



Photo: AGRA

With a Simple Building, Farmers in Ghana Avoid a Soil Health Crisis

The image of success in agriculture is typically a field overflowing with large, dark green leafy plants ripe for harvest. But in southern Ghana's Brong-Ahafo region, it might also include a picture of a large, non-descript building with plain concrete walls and a corrugated metal roof.

In 2013, a lack of fertilizer storage capacity in the area generated an acute shortage that made it difficult for farmers to get the inputs they needed to improve their soil. And while the solution seemed simple, the difficulties involved show why African farmers struggle to replace the nutrients their crops extract from the soil.

Essentially, with agriculture production in Ghana growing rapidly, demand for soil inputs quickly overwhelmed storage capacity of North Gate Agro Product Enterprise, the main fertilizer distributor in Brong-Ahafo. But after North Gate started building a new warehouse capable of holding 15,000 tons, it ran into financial problems and work stopped.

A lack of financing is a problem found throughout the agriculture sector in Africa, from farmers and retailers, to suppliers and producers of seed and soil inputs. In Brong-Ahafo, AGRA and its partners in the African Fertilizer Agribusiness Partnership stepped in to provide financing with a matching grant. As a result, North Gate completed a warehouse that now allows it to supply twice as many smallholder farmers—from 20,000 to 40,000.

Conclusion: A Promising Start to Solving a Complex Problem

Over the last few years, AGRA and its partners have shown that it is possible for poor, smallholder farmers in Africa to make rapid progress in creating the soil conditions required to support a Green Revolution. But soil health concerns bring together a unique mix of market, environmental, technical, regulatory, economic and political issues that will take time to resolve.

The following are just a few of the lessons learned by AGRA's Soil Health Program as it works to improve food and economic security for millions of Africans.

Going big and broad is an effective way to succeed in soil health.

AGRA's ambitious three-year effort to expand soil health interventions in Tanzania, Malawi and Ghana illustrated that it's possible to rapidly reach large numbers of farmers and see them adopt soil management practices that quickly pay off in the form of dramatically higher yields in the field. Projects that embrace multiple partners representing all aspects of agriculture—including farm production, policy, inputs, financing, research, regulations, and markets—are likely to have a large and lasting impact on soil health. They also provide a significant return on the initial investment, and could be even more effective if sustained for five to six years rather than just three.

Significant investments are needed to revive the human elements of soil health.

The misguided advice from the 1980s and 1990s that encouraged African governments to divest from agriculture quickly depleted the talent required to provide African farmers guidance on how to get the most from their challenging soils.

The problem is especially pronounced today as climate change is rapidly altering growing conditions in Africa. African farmers must be prepared to adapt and to do so they will need a strong cadre of extension agents and soil and crop scientists who are familiar with the region's many different agricultural ecosystems and aware of how to keep food production vibrant in all of them.

AGRA is making investments in training scientists and extension workers, but with both donors and African governments once again saying that agriculture is a priority, it's time to move aggressively to rebuild this neglected resource.

Access to fertilizers still looms as a major impediment to boosting food production.

While the amount of fertilizer available in Africa is increasing, access remains a logistical as well as a financial problem for most African farmers.

Logistically, millions of African farmers live in remote areas chronically underserved by a range of amenities, farm supplies among them. When fertilizers are available, they routinely cost far more than they do elsewhere in the world. It's not unusual for fertilizers in Africa to cost US \$800 to \$1,000 per ton, twice or more than what farmers pay in the United States, China, Netherlands and Brazil.

In 2006 at the African Fertilizer Summit in Abuja, leaders of the African Union pledged to increase fertilizer use from an average of about eight kilograms per hectare to 50 kilograms—about enough to replace the nutrients lost in an average cropping season. Most countries remain far away from that goal, but some, like Ghana and Mozambique, have shown that when governments develop transparent regulatory policies, quality control programs, and provide targeted subsidies, then fertilizer access and affordability can rapidly improve.

AGRA's Soil Health Program is encouraging countries to take a more active role in addressing fertilizer access and other aspects of soil health by supporting efforts to develop soil health consortia that bring together a wide range of stakeholders, including farmers, researchers, distributors, policy makers and producers. There are now soil health consortia in 13 African countries, all strongly connected to the Africa Soil Health Consortium, a group funded by the Bill & Melinda Gates Foundation that committed to giving smallholder farmers what they need to practice all aspects of Integrated Soil Fertility Management.

Private sector involvement is crucial, but many partners are needed to keep the focus on smallholder farmers.

The private sector will play a significant role in determining the fate of Africa's soils. It is the private sector who will, for the most part, manufacture, store, distribute and sell inputs on the production side and then, on the market side, purchase the surplus farmers produce in their improved soils. But to ensure smallholder farmers are ready to take advantage of what the private sector has to offer—and retain their leading role as Africa's primary food producers—there will need to be support from a variety of organizations.

For example, will there be financing available to assist with input purchases and will smallholder farmers be able to provide commodities at the volume, price, and quality that markets demand? If smallholder farmers lack the means to purchase critical inputs like seeds and fertilizers and cannot recoup their investments in the marketplaces, all of the soil health knowledge in the world will be of limited value.

That's why AGRA's Soil Health Program is linked with AGRA's other initiatives that are focused on developing the seed systems, markets, policies, and farmer organizations required to power sustainable improvements in food production.

The common theme for all is a singular focus on bolstering the capabilities of Africa's resilient smallholder farmers and ensuring they play the leading role in waging a uniquely African Green Revolution.



African Fertilizer and Agribusiness Partnership (AFAP)

The African Fertilizer and Agribusiness Partnership (AFAP) is a collaboration between the New Partnership for Africa's Development (NEPAD), the Alliance for Green Revolution in Africa (AGRA), the International Fertilizer Development Center (IFDC), the African Development Bank (AfDB), and the Agricultural Market Development Trust - Africa (AGMARK). These partners are working together to promote the development of sustainable fertilizer markets in Africa and have designed AFAP to specifically increase private sector participation and investment in their ongoing initiatives.

The Soil Health Program has invested US \$25 million in AFAP which aims to increase fertilizer supply, reduce the price to farmers by at least 15 percent, and double total use per country in three countries (Ghana, Mozambique and Tanzania).

On the supply side, AFAP's intervention promises to have nine new or improved blending and/or granulation plant facilities, 600 new or improved retail or cooperative storage facilities, and to deliver 225,000 tons to farmers in the three focal countries. This goal is in addition to the 187,000 tons that the Soil Health Program is targeting.

The principal operating mechanism of AFAP is through Agribusiness Partnership Contracts (APCs) under which eligible international, regional or local agribusinesses apply to AFAP for assistance and, in exchange, agree to perform significant market development activities with local farmers and/or businesses. AFAP is also working to develop "hub agrodealers," These are agrodealers with large storage capacity and a business that can support smaller dealers in their area. To enhance the process, AFAP provides both matching grants and technical support.

To date AFAP has set credit guarantee facilities with eight banks for suppliers and others in need of large credits and has leveraged US \$1.1 million from other donors, with further proposals submitted and approved valued at US \$3 million. AFAP has so far invested about US \$5.2 million with seven fertilizer companies and approved 35 partnership contracts. AFAP has also signed agreements with the United States Agency for International Development (USAID), NEPAD, and the Common Market for Eastern and Southern Africa (COMESA), and has developed agreements with the Ministries of Agriculture in Ghana, Mozambique and Tanzania. A market information system is up and running at www.africafertilizer.org.

List of Key Partners

National Agricultural Research Systems

- Institut de l'Environnement et de Recherches Agricoles (INERA), Burkina Faso
- Kenya Agricultural Research Institute (KARI), Kenya
- Mozambique Institute of Agricultural Research, Mozambique
- National Agricultural Research Organization (NARO), Uganda
- Rural Economics Institute (IER), Mali
- Rwanda Agricultural Board (RAB), Rwanda
- Zambia Agricultural Research Institute (ZARI), Zambia

Ministries of Agriculture

- Ministry of Agriculture in Ethiopia
- Ministry of Agriculture in Malawi
- Ministry of Agriculture, Food Security and Cooperatives in Tanzania
- Ministry of Food and Agriculture (MOFA), Ghana

Universities

- Ahmadu Bello University, Nigeria
- Columbia University, USA
- Eduardo Mondlane University, Mozambique
- Haramaya University, Ethiopia
- Katibougou Polytechnic University, Mali
- Kenyatta University, Kenya
- Kwame Nkrumah University of Science and Technology (KNUST), Ghana
- Lilongwe University of Agriculture and Natural Resources (LUANR), Malawi
- Makerere University, Uganda
- Sokoine University of Agriculture (SUA), Tanzania
- University for Development Studies, Ghana
- University of Bobo Dioulasso, Burkina Faso
- University of Nairobi, Kenya
- University of Nebraska-Lincoln, USA
- University of Zambia, Zambia
- Wageningen University, Netherlands

CGIAR Consortium Centers

- International Centre for Tropical Agriculture (CIAT)
- International Crops Research Institute for Semi-Arid Tropics (ICRISAT)
- International Institute of Tropical Agriculture (IITA)
- International Maize and Wheat Improvement Centre (CIMMYT)
- World Agroforestry Centre (ICRAF)

Government Agencies

- Agricultural Transformation Agency (ATA), Ethiopia
- Norwegian Agency for Development (NORAD)
- Swedish International Development Cooperation Agency (SIDA)
- United States Agency for International Development (USAID)

International Organizations & Regional Networks

- Africa Conservation Tillage Network (ACTN)
- Africa Development Bank (ADB)
- Africa Soil Information System (AFSIS)
- Africa Women in Agricultural Research and Development (AWARD)
- African Fertilizer and Agribusiness Partnership (AFAP)
- Association for Strengthening Agricultural Research in East and Central Africa (ASARECA)
- CAB International (CABI)
- Centre for Agricultural and Rural Development (CARD), Ghana
- Centre for Coordination of Agricultural Research and Development for Southern Africa (CCARDESA)
- Clinton Development Initiative
- Commercial Products Project (COMPRO)
- Common Market for Eastern and Southern Africa (COMESA)
- Conservation Farmers Union of Zambia (CFU), Zambia

- East African Community (EAC)
- Farm Input Promotions Africa (FIPS)
- Food and Agriculture Organization of the United Nations (FAO)
- Food, Agriculture and Natural Resources Policy Network (FANPARN)
- Forum for Agricultural Research in Africa (FARA)
- Global Environmental Facility (GEF)
- International Fertilizer Development Centre (IFDC)
- International Plant Nutrition Institute (IPNI)
- Millennium Villages Project
- N2 Africa
- Regional Universities Forum for Capacity Building in Agriculture (RUFORUM)
- Rural Outreach Program (ROP)
- Technical Centre for Agricultural and Rural Cooperation (CTA-Netherlands)
- West African Economic and Monetary Union (UEMOA)

Private Sector

- MEA Fertilizers Limited
- Minjingu Fertilizer Company

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