Restoring Soil Health in Africa

Low soil fertility is one of the major factors responsible for depressed yields on small-scale farms across Africa and for Africa's low agricultural productivity relative to other regions.

All crop and livestock production is literally and figuratively rooted in soils. Healthy, fertile soils — those that retain nutrients, water, essential microbes and other soil organisms that promote plant growth — are vital for the sustained agricultural development needed to lift hundreds of millions of Africans out of poverty, hunger and malnutrition.

Africa is home to some of the world's most degraded soils, and three-quarters of African farm land is severely depleted. As a result, Africa simply cannot produce enough food to keep pace with its needs, and per capita food production is declining. Cereal yields in Sub-Saharan Africa averaged less than 1.3 tons per hectare in 2000, as compared to yields in East and Southeast Asia, and South Asia, of 3.4 and 2.9 tons per hectare, respectively. While other developing regions have seen cereal yields grow annually during 1980-2000 from 1.2 to 2.3 percent, cereal yields in Africa grew at an average rate of 0.7 percent, according to the World Bank. Africa's food production lags because its soils are low in nutrients, low in organic matter and have poor water holding capacity. Until those conditions are reversed, Africa's soils will continue to degrade and its food situation will continue to deteriorate.

AGRA is therefore preparing a major Soil Health Initiative that will promote locally appropriate soil management practices that combine the use of organic matter and fertilisers to restore soil health, in an approach known as Integrated Soil Fertility Management.

Africa's Soil Health Crisis

Africa is the world's oldest land mass, and its soils show its age. Many of Africa's soils are derived from ancient granite rocks, created during millennia of weathering. They are inherently low in plant nutrients (Bationo et al. 2006). Compounding this natural deficit, nutrients leach and are taken away from the soil and fields with every pass of the hoe and plough, with wind and water erosion, and with every harvest.

Traditionally, African farmers have used fallows to maintain soil fertility by allowing fields to go back to bush for a number of years between cultivation cycles. The bush was cut and burnt, leaving ashes for nutrients, few weed seeds, and a friable soil that is good for two or three years of cultivation. As Africa's population increased over the 20th century, the cycles got progressively shorter and soils became increasingly degraded. Fallowing is predicted to disappear entirely from 20 African countries in the next several years and is practised on less than 25 percent of land in another 29 countries (Angé, 1993). Traditional practices have not been replaced by new methods of soil management and cropping systems due to lack of essential inputs, knowledge and incentives.

Farmers' removal of the major plant nutrients and essential micronutrients for plant growth has not been offset by additions of nutrients; hence Africa's small-scale farmers are literally "mining" the soil. The International Centre for Soil Fertility and Agricultural Development estimates that Africa loses 8 million metric tons of soil nutrients per year, and over 95 million hectare of land have been degraded to the point of greatly reduced productivity (Henao and Baanante, 2006).

Such severe soil depletion results in a vicious cycle of declining yields, deepening poverty, and increased degradation of the natural resource base that farmers depend upon. Soil mining leads to loss of soil organic matter—the roots, plant residues and other materials that give soil its structure. This loss reduces the soil's biodiversity and limits its ability to retain nutrients and water, and can lead to massive erosion. As soils decline and farm yields drop, impoverished farmers move on to clear forests and savannah, where the cycle begins again.

In contrast, healthy soils are a complex matrix of inert components like sand and clay, organic matter and living organisms. In this mix are molecules that play important roles in releasing nutrients—such as nitrogen, phosphorous and potassium—from organic matter, sand and clay. Once released into water-soluble forms, these nutrients can fuel plant growth.

AGRA at Work

- Programme for Africa's Seeds Systems (PASS)
- **Restoring Soil Health in Africa**
- The Agro-Dealer Development Programme
- Agricultural Education
- Current Applications for the W Phd Programme
- Learning From Farmers

Integrated Soil Fertility Management Provides the Basis for Sustainable Agricultural Growth in Africa

Improving soil health is essential to reversing the negative trends in food production and farm incomes. Organic matter management and judicious use of fertiliser, but neither one alone, will solve farmers' soil fertility problems. Integrated Soil Fertility Management (ISFM) combines the use of both to increase crop yield, rebuild depleted soils and protect the natural resource base. IFSM applies locally adapted soil fertility management practices to optimise the effectiveness of fertiliser and organic inputs in crop production.

Experience has shown that the highest and most sustainable gains in crop productivity per unit nutrient are achieved from mixtures of fertiliser and organic inputs (FAO, 1989; Pieri, 1989; Giller et al., 1998; Vanlauwe et al., 2001). Manufactured fertilisers are concentrated chemical forms of plant nutrients, while organic materials from sources such as manure, crop residues and compost are much more complex materials.

ISFM necessarily includes locally appropriate fertilisers and organic resources, the knowledge needed to conduct local experimentation and testing, and locally adapted grain and legume varieties. Over time, local adaptation to optimise individual practices can rehabilitate degraded soils and restore their agronomic efficiency.

There is no doubt that fertiliser application alone can create big increases in yield, but with a low efficiency that has proved to be too expensive for poor farmers and is environmentally unsustainable. Soil management practices to maintain soil quantity, structure, nutrients, and proper chemistry can be a partial alternative to the use of the mineral fertilisers but alone can not meet nutrient demands. In combination, however, **organic methods increase the efficiency of fertiliser and fertiliser helps increase the returns on organic methods** through positive interactions on soil biological, chemical and physical properties.

Soils in Africa are highly variable in fertility and in how they respond to inputs. Soil fertility can vary dramatically from one end of field to the other. Many soils respond poorly to fertiliser alone. This low efficiency can be raised through complementary management of soil structure and organic matter. Most soils need to be managed for improved soil structure, including water holding capacity. The high variability of soil fertility, cropping systems, and market opportunities mean that it is necessary to adapt the principles of soil health to local situations.

Soil health improvement takes a broad perspective that includes consideration of the complexity of soils, farmer decision-making and farmers' long-term access to knowledge, improved inputs and market opportunities. Farmers' decisions to adopt the labour and knowledge-intensive practices required to improve their soil health depend on the impact of those practices on their food security and incomes. Farmers must have the incentives to both invest in soil health for long-term sustainable agricultural growth and have the short-term ability to purchase and effectively use mineral and organic fertilisers and improved crop varieties.

Fertiliser use in Africa must substantially increase along with improved soil management and land husbandry to stimulate production growth, improve food security and raise rural incomes. Lessons from research and experimentation into increasing organic matter in degraded soils through the use of low-input organic systems can also be applied. Some of these have relied on such techniques as agro forestry, cover cropping, grain-legume rotations, intercropping and composting. Such low-input organic systems each have advantages, but none has proven sustainable or sufficiently attractive to become widely adopted by farmers.

An innovation system needs to be created that brings farmers, their organisations, extension workers, and researchers together in a relationship that takes advantage of the strengths of all and helps farmers select and combine the most appropriate technology elements from among many possible natural resource management elements.

Generating the greatest sustainable deployment and performance out of Integrated Soil Fertility Management will depend upon significant increases in farmer knowledge, investments in continued capacity building and new technologies.