To feed a growing world population, we have no option but to intensify crop production. But farmers face unprecedented constraints. In order to grow, agriculture must learn to save.

Soil health: technologies that save and grow

Agriculture must, literally, return to its roots by rediscovering the importance of healthy soil, drawing on natural sources of plant nutrition, and using mineral fertilizer wisely.

The following examples describe crop management systems that have high potential for intensification and sustainable production. They address specific soil fertility problems in different agro-ecological zones and have been widely adopted by farmers.

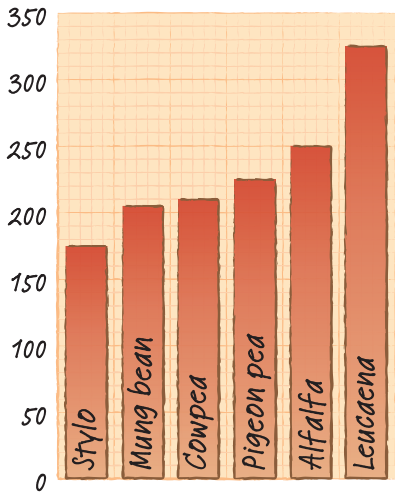
Increasing soil organic matter in soils in Latin America

Oxisols and ultisols are the dominant soil types in Brazil's Cerrado tropical savanna and Amazon rainforest regions, and they are also widespread in Africa's humid forest zone. Among the oldest on earth, these soils are poor in nutrients and very acidic, owing to their low capacity to hold nutrients – and cations in particular – in their surface and subsoil layers. In addition, being located in regions with high rainfall, they are prone to erosion if the surface is not protected by vegetative cover.

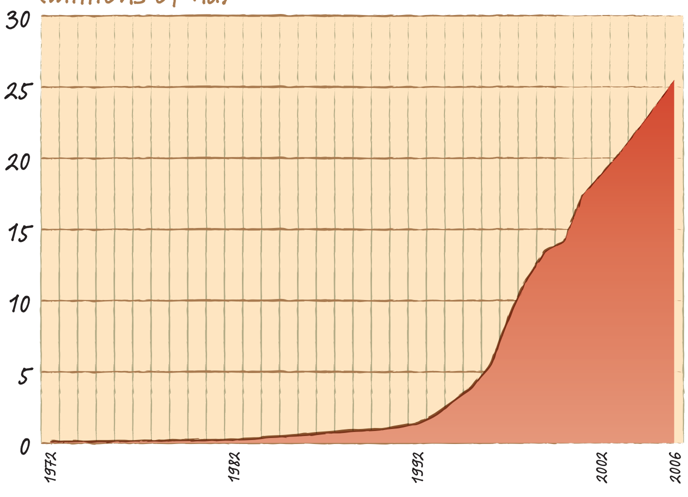
Upon conversion of the land from natural vegetation to agricultural use, special care has to be taken to minimize losses of soil organic matter. Management systems for these soils have been designed to conserve or even increase organic matter by providing permanent soil cover, using a mulching material rich in carbon, and ensuring minimized or zero tillage of the soil surface. These practices are all key components of the SCPI approach.

Such systems are being rapidly adopted by farmers in many parts of Latin America, and particularly in humid and subhumid zones, because they control soil erosion and generate savings by reducing labour inputs. Adoption has been facilitated by close collaboration between government research and extension services, farmer associations and private companies that produce agrochemicals, seed and machinery. Zero-till farming has spread rapidly and now covers 26 million hectares on oxisols and ultisols in Brazil.

Average amounts of nitrogen fixed by various legumes (kg N/ha/yr)



Expansion of zero tillage area in Brazil (millions of ha)



Biological nitrogen fixation to enrich N-poor soils in African savannas

Crop production in the savanna regions of western, eastern and southern Africa is severely constrained by a lack of soil nitrogen (N) and phosphorus (P) and of micronutrients such as zinc and molybdenum. The use of leguminous crops and trees that are able to fix atmospheric nitrogen, in combination with applications of mineral P-fertilizers, has shown very promising results in on-farm evaluations conducted by the Tropical Soil Biology and Fertility Institute, the World Agroforestry Centre and the International Institute of Tropical Agriculture (IITA).

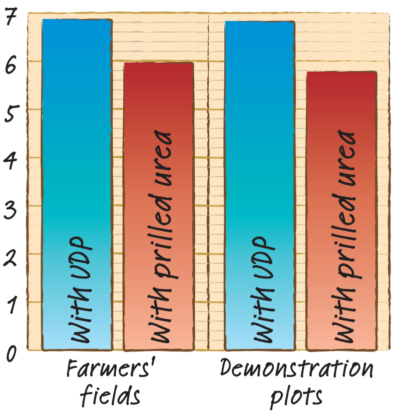
The combination of mineral fertilizer application and a dual-purpose grain legume, such as soybean, intercropped or relay-cropped with maize, increased maize yields in Kenya by 140 to 300 percent and resulted in a positive N-balance in the cropping system. Dual-purpose grain legumes produce a large amount of biomass with their haulms and roots, as well as an acceptable grain yield. In eastern and southern Africa, N-deficient maize cropping systems have become more productive thanks to improved fallows using leguminous trees and shrubs. Per hectare, species such as *Sesbania sesban, Tephrosia vogelii* and *Crotalaria ochroleuca* accumulate in their leaves and roots around 100 to 200 kg of nitrogen – two-thirds of it from nitrogen fixation – over a period of six months to two years. Along with subsequent applications of mineral fertilizer, these improved fallows provide sufficient N for up to three subsequent maize crops, resulting in yields as much as four times higher than those obtained in non-fallow systems. Research indicates that a full agroforestry system with crop-fallow rotations and high value trees can triple a farm's carbon stocks in 20 years.

"Urea deep placement" for rice in Bangladesh

Throughout Asia, farmers apply nitrogen fertilizer to rice before transplanting by broadcasting a basal application of urea onto wet soil, or into standing water, and then broadcasting one or more top-dressings of urea in the weeks after transplanting up to the flowering stage. Such practices are agronomically and economically inefficient and environmentally harmful. The rice plants use only about a third of the fertilizer applied, while much of the remainder is lost to the air through volatilization and surface water run-off. Only a small amount remains in the soil and is available to subsequent crops.

One way of reducing N losses is to compress prilled urea to form urea super granules (USG) which are inserted 7 to 10 cm deep in the soil between plants. This "urea deep placement" (UDP) doubles the percentage of nitrogen taken up by plants, reduces N lost to the air and to surface water run-off, and has produced average yield increases of 18 percent in farmers' fields. The International Fertilizer Development Center and the United States Agency for International Development are helping smallholder farmers to upscale UDP technology throughout Bangladesh. The goal is to reach two million farmers in five years.

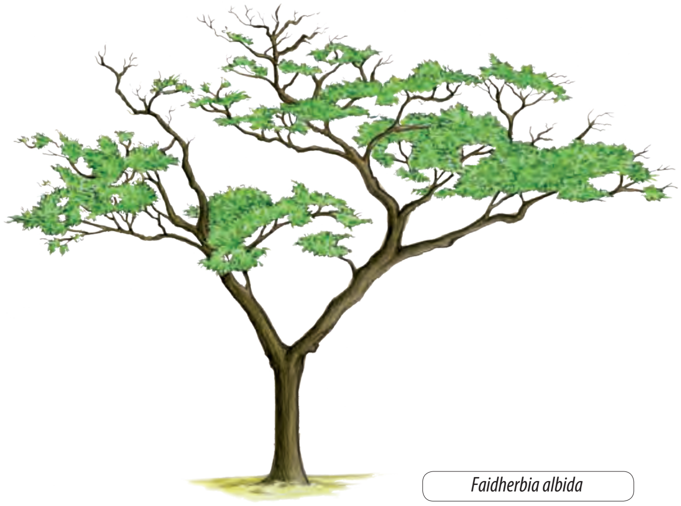
Average rice yields using prilled urea and urea deep placement (UDP)*, Bangladesh, 2010 (t/ha)



* Data from 301 farmers' plots and 76 demonstration plots

Site-specific nutrient management in intensive rice

The International Rice Research Institute (IRRI) and its national partners have developed the site-specific nutrient management (SSNM) system for highly intensive rice production. SSNM is a sophisticated knowledge system focused on double and triple rice mono-cropping. Tests at 180 sites in eight key irrigated rice domains of Asia found that the system led to a 30 to 40 percent increase in N-use efficiency, mainly thanks to improved N management. Across all sites and four successive rice crops, profitability increased by an average of 12 percent. In several provinces of China, SSNM reduced farmers' use of N-fertilizer by one third, while increasing yields by 5 percent. A site-specific N-management strategy was able to increase uptake efficiency by almost 370 percent on the North China Plain. The complex SSNM technology is being simplified in order to facilitate its wider adoption by farmers.



Faidherbia albida

Evergreen agriculture in Africa's Sahel

The African acacia, *Faidherbia albida*, is a natural component of farming systems in the Sahel. It is highly compatible with food crops because it does not compete with them for light, nutrients or water. In fact, the tree loses its nitrogen-rich leaves during the rainy season, thus providing a protective mulch which also serves as natural fertilizer for crops. Zambia's Conservation Farming Unit has reported unfertilized maize yields of 4.1 tonnes per hectare in the vicinity of *Faidherbia* trees, compared to 1.3 tonnes from maize grown nearby, but outside of the tree canopy. Today, more than 160 000 farmers in Zambia are growing food crops on 300 000 ha with *Faidherbia*. Similarly promising results have been observed in Malawi, where maize yields near *Faidherbia* trees are almost three times higher than yields outside their range. In Niger, there are now more than 4.8 million hectares under *Faidherbia*-based agroforesty, resulting in enhanced millet and sorghum production.

Adapted from *Save and grow* (FAO, 2011), a policymaker's guide to the sustainable intensification of smallholder crop production
Save and grow can be purchased from: fao@earthprint.co.uk or through the FAO online catalogue: www.fao.org/icatalog/inter-e.htm

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