Key fact
EverGreen Agriculture - where trees are intercropped in annual food crop and livestock systems - is restoring exhausted soils with richer sources of organic nutrients, helping smallholders increase crop yields and incomes, and adapt to climate change.

Summary
Researchers from the World Agroforestry Centre (ICRAF) and national agricultural and forestry institutions in Africa have been evaluating and promoting the use of fertiliser trees and shrubs since the late 1980s. Results from a study by the Conservation Farming Unit in Zambia found that unfertilised maize yields in the vicinity of Faidherbia trees averaged 4.1 tonnes per hectare, compared to 1.3 tonnes per hectare nearby but beyond the canopy. In Malawi, analysis of 140 farmers showed that plots with Gliricidia sepium, Tephrosia candida or Tephrosia vogelii generated between 1.4 and 2 tonnes per hectare more of maize grain compared to other maize plots on the same farms.

The success of EverGreen Agriculture has prompted national governments to deepen their support for the expansion of the practice. There has also been vigorous political action at the continental level. A broad alliance is emerging of governments, international donors, research institutions and international and local development partners, in order to expand EverGreen Agriculture.

Facts & figures
- More than 160,000 Zambian farmers now grow food crops under Faidherbia trees. More than 200,000 farmers in Malawi have recently been testing tree-maize intercrop systems.
- In Niger, around 4.8 million hectares of landscapes have been re-greened, many with Faidherbia and other trees which improve soil fertility.
- With a benefit cost ratio ranging between 2.77 and 3.13, EverGreen Agriculture in eastern Zambia performed better than maize grown in subsidised fertilised fields (2.65), non-subsidised fertilised fields (1.77) and non-fertilised fields (2.01).
- ICRAF analysis found that, given the current tree densities farmers have on their fields, the average impact of a combination of soil fertility trees on cereal yields is around 30% in the Sahel.
- Trials in Malawi and Zambia revealed rain use efficiency increases of up to 380% where maize was intercropped with fertiliser trees. Emissions of 1.6-3.5 tonnes of carbon dioxide equivalent were mitigated per hectare annually.
- EverGreen Agriculture has also been shown to accumulate carbon both above and below ground in the range of 2-4 tonnes of carbon per hectare per year.
European funding
Research on agroforestry has been supported by a number of European donors. These include direct funding to ICRAF from the Swedish International Development Cooperation Agency (Zambia), Irish Aid (Malawi), the European Union (Burkina Faso, Kenya, Malawi and Mali), the Flanders International Cooperation Agency (Malawi and Mozambique) and BMZ-Germany (Malawi, Tanzania, Zambia and Zimbabwe). Additionally, ICRAF has been given unrestricted funding from Austria, Belgium, Denmark, Finland, Germany, Ireland, the Netherlands, Norway, Portugal, Sweden, Switzerland and the United Kingdom.

Project milestones
• Late 1980s: On station research with different agroforestry based soil fertility improvement practices finds significant maize yield impacts in southern Africa.
• Early 1990s: Initial on farm trials lead to significant adaptations by farmers, making the technologies less costly in terms of labour and lower opportunity costs of land.
• Mid 1990s: First wave of large scale dissemination begins and research monitors on farm performance in southern and eastern Africa.
• Late 1990s: A new, more adapted system of intercropping is developed for high population areas, such as southern Malawi.
• Early 2000s: On station research in Mali with various fertiliser tree species and shrubs (examples include Gliricidia sepium, Tephrosia spp. and Sesbania sesban) significantly improves cotton and cereal production.
• Early 2000s: Renewed research attention to natural regeneration of native African species in the drylands and potential for scaling up in other dryland areas and to transfer species to sub-humid areas.

Costs and benefits
With respect to returns per investment, field studies of improved fallow systems in Zambia have shown that EverGreen Agriculture performed better with a benefit cost ratio ranging between 2.77 and 3.13 (for maize grown with Gliricidia or Sesbania) in contrast to 2.65 in subsidised fertilised fields, 1.77 in non-subsidised fertilised fields and 2.01 in non-fertilised fields. Over a five year cycle, the net profit from unfertilised maize was US$130 per hectare compared to US$269 and US$309 for maize grown as an intercrop with Gliricidia or in rotation with Sesbania.

The returns to research costs have not been calculated globally, but a 2005 study of costs and returns in the case of improved fallow research in Zambia found that the annual costs of between US$230,000 to US$350,000 over a 15 year period, generated an internal rate of return of 15 per cent over a 25 year period. A more recent adoption study in the same region of Zambia found that a very high percentage of initial adopters were still using the technology and thus this return appears to be justified. A global cost and benefit analysis related to natural regeneration of Faidherbia and other species would be much more favourable given that relatively few resources have been needed for research or extension.

Multimedia material
Trees for Life: A Story of Agroforestry in Malawi
Harvesting Hope

More information
World Agroforestry Centre - www.worldagroforestry.org
EverGreen Agriculture: re-greening Africa’s landscape

In the context of climate change, increasing population, deforestation, reduced landholdings and declining soil productivity, EverGreen Agriculture is emerging as an affordable and accessible science-based solution that will help smallholders protect and enrich soils, increase food production, adapt to climate change and reduce greenhouse gas emissions.

EverGreen Agriculture - where trees are intercropped in annual food crop and livestock systems - sustains a green cover on the land throughout the year. It bolsters nutrient supply through nitrogen fixation and nutrient cycling, and provides food, fodder, fuel, medicine, fibre and income. The trees also increase carbon storage above and below ground, enhancing opportunities for rewards in the form of agricultural carbon offsets. Trees on farms also increase resilience to climate variability.

Research on the integration of new fertiliser tree practices into cropping systems began in the late 1980s, through the collaboration of researchers from the World Agroforestry Centre (ICRAF) and national agricultural and forestry institutions in Malawi, Tanzania, Zambia and Zimbabwe. Tree species such as Sesbania, Gliricidia sepium and Tephrosia improve soil fertility by drawing nitrogen from the air and transferring it to the soil through their roots and leaf litter. In recent years, research on a native African tree, Faidherbia albida, has been reinvigorated following on a body of research conducted by French institutions in West Africa.

This nitrogen-fixing tree has a deep penetrating tap root, making it resistant to drought and, unlike most trees, it sheds its leaves in the rainy season, providing valued biomass. By remaining dormant throughout the crop-growing period, Faidherbia does not compete with food crops for light, nutrients or water. The tree is also important for livestock feed and for fuelwood.

In Zambia, the Conservation Farming Unit (CFU) realised that more mulch and nutrients were needed to make the practice of conservation farming successful. Conservation agriculture consists of three principles: minimum soil disturbance, legume-based cropping and use of organic mulch. The Unit decided to test the potential for planting rows of Faidherbia in maize fields. This proved to be very successful and, to date, more than 160,000 Zambian farmers have extended conservation farming to include Faidherbia trees, over an area of 300,000 hectares. A

Scientists have been evaluating fertiliser trees for many years © World Agroforestry Centre

“We see EverGreen agriculture as nothing less than the radical, but entirely practical, pathway to a reinvention of agriculture. The opportunities provided by EverGreen agriculture should inspire the next generation. We need to take heart at the success already achieved and grab onto the momentum.”

Dennis Garrity, director general, World Agroforestry Centre

Aaron Nahawa has increased his maize yields by intercropping with Gliricidia © World Agroforestry Centre/Charlie Pye Smith

EverGreen Agriculture: re-greening Africa’s landscape

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2008 CFU study found that unfertilised maize yields in the vicinity of *Faidherbia albida* trees averaged 4.1 tonnes per hectare, compared to 1.3 tonnes per hectare nearby but beyond the canopy. Similar results were obtained in the 2009 growing season.

In eastern Zambia, farmers have used trees and shrub species - including *Sesbania sesban*, *Tephrosia vogelii* and *Tephrosia candida* - to increase fertility in fallow land. Farmer innovations, such as use of bare-rooted rather than bagged saplings, planting more than one tree species, and changes to the planting time, have encouraged the adoption of improved fallows by around 70,000 farmers in the region. More than 70 per cent of farmers who were testing the system in the early 2000s were found to be still using it in 2010, with the system, generating between 57 and 114 extra person days of maize consumption per year, based on the average sized fallow of 0.2 hectares.

In neighbouring Malawi, work by ICRAF and partners led to over 50,000 smallholder farmers experimenting with fertiliser trees by 2005. More recently, a further 200,000 families have benefited from increased food production through the scaling-up of agroforestry systems by Malawi’s Agroforestry Food Security Programme, supported by Irish Aid. The programme provides seeds, nursery materials and training for a range of agroforestry practices, including the planting of fertiliser trees. An ICRAF analysis of data from 140 farmers in 2012 found that maize yields increased between 1.4 and 2 tonnes per hectare in plots with *Gliricidia* and *Tephrosia* compared to plots without any agroforestry practice.

“A successful examples of EverGreen agriculture from Africa urgently need further research and scaling up to create a real EverGreen revolution.”

*Professor MS Swaminathan, Founder, MS Swaminathan Research Foundation*

A 2012 study by ICRAF in the Sahel found that, given current tree densities in farmers’ fields, planting a combination of fertiliser trees would increase cereal yields by, on average, 30 per cent. Producing maize, sorghum and millet under these agroforests has also been shown to dramatically increase their drought resilience in dry years, due to positive soil moisture regimes and a better microclimate. Trials in Malawi and Zambia reveal rain use efficiency increases of up to 380 per cent where maize was intercropped with fertiliser trees. Emissions of 1.6-3.5 tonnes of carbon dioxide equivalent were mitigated per hectare annually.

In West Africa, around 4.8 million hectares has been naturally regenerated with parkland tree species such as *Faidherbia*, *Acacia*, *Pliostigma reticulatum* and *Combretum* species. One study has estimated that this transformation has resulted in an average of at least 500,000 additional tonnes of food produced per year, covering the requirements of 2.5 million people. The re-greening of the Sahel, well documented in Niger, is spreading to include parklands across Mali’s Seno Plains as well as in Burkina Faso and Senegal.
EverGreen Agriculture has also been shown to accumulate carbon both above and below ground in the range of 2-4 tonnes of carbon per hectare per year, compared to 0.2-0.4 t C/ha/year for conventional farming. Consequently, there is considerable interest in the creation of bio-carbon investment funds in Africa to channel carbon offset payments from developed countries to stimulate more carbon sequestration in African food crop systems. Such investments will assist smallholder food crop farmers to become more resilient to adverse climate change by reducing yield losses due to drought.

The success of EverGreen Agriculture has prompted national governments to deepen their support for the expansion of the practice. In April 2009, at a meeting organised by the African Union, Ministers of Agriculture, Land and Livestock from across the continent published a declaration committing them to ramping up efforts to increase the number of farmers practising agroforestry and conservation agriculture. They also called for increased international support for these efforts.

In Malawi, the Agriculture Sector Wide Approach (ASWAP) strongly supports upscaling of agroforestry and conservation agriculture. Kenya has also introduced a bold policy under its new Greening Kenya Initiative to achieve ten per cent tree cover whilst Ethiopia has made a commitment to increase agroforests to 15 million hectares by 2015, particularly focusing on desertified areas with a low density of trees.

A broad alliance is now emerging of governments, international donors, research institutions and international and local development partners, in order to expand EverGreen Agriculture throughout Africa. Preparatory work for national programmes is already underway in Mali, Niger, Senegal, Tanzania and 12 other countries, supported by ICRAF and partners.

References


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