Food and Agriculture Organization of the United Nations

SAVE AND GROW FARMING SYSTEMS
FACT SHEET 9

MAIZE/FORESTRY

Agro-ecological zone
Tropical, rainfed
Main cereal Maize
Other crops/products
Meat, milk, fodder, fuelwood

Where trees and shrubs cost less than fertilizer

Food security in Malawi and Zambia depends on maize production. However, in both countries, yields average a low 1.2 tonnes per ha. Only about one in four smallholder farmers in Zambia and one in five in Malawi grow enough maize to sell in markets. Since maize is almost entirely rainfed, the crop is highly vulnerable to fluctuations in rainfall and temperatures, a vulnerability that is likely to increase with climate change.

One of the main obstacles farmers face in increasing maize production is low soil fertility. Many maize farmers can neither afford mineral fertilizer nor obtain sufficient amounts of organic fertilizer, such as animal manure. Decades of intensive cultivation without fertilization have drained nutrients, particularly nitrogen, from the soil.

To address the problem, the Zambia National Farmers' Union has explored ways of integrating nitrogen-fixing trees into maize production systems. The most promising candidate was found to be *Faidherbia albida*, an African acacia species with an unusual growth habit. The tree is dormant in the early rainy season and loses its leaves just as field crops are being established; the leaves only grow back at the end of the wet season. Maize can be grown directly under the leafless *Faidherbia* canopy, as the trees do not compete with the crop for light, nutrients or water while the maize is growing.

Thanks to the decaying leaves, the soil under the trees contains up to twice as much organic matter and nitrogen as soil outside the canopy. There is also a marked increase in soil microbiological activity, and an increase in water holding capacity. Numerous studies have noted increases in yields when maize is grown in association with *Faidherbia*, and those increases tend to be higher where soil fertility is low. In Zambia, maize planted outside the tree canopy produced average yields of 1.9 tonnes per ha, compared to 4.7 tonnes when the crop was grown under the canopy; in Malawi, maize yields increased by 100 to 400 percent when the crop was grown with *Faidherbia*.

Both countries promote *Faidherbia* as part of conservation agriculture (CA) systems that offer smallholder farmers a means of increasing maize productivity and earning higher incomes from sales. National recommendations are to grow 100 trees per ha in a 10 m x 10 m grid pattern.

Faidherbia is now grown in conservation agriculture maize

KEY POINTS

Maize agroforestry is practised on 300 000 ha in Zambia and half a million farms in Malawi.

By keeping native 'fertilizer trees' in their fields, farmers have boosted maize yields by **as much as 400 percent**.

Leguminous trees and shrubs add from **100 to 250 kg of nitrogen** per ha to the soil in two to three years.

Growing maize with leguminous shrubs generates **higher net returns** than growing maize with subsidized mineral fertilizer.

The system uses water more efficiently and is **more resilient to drought**.

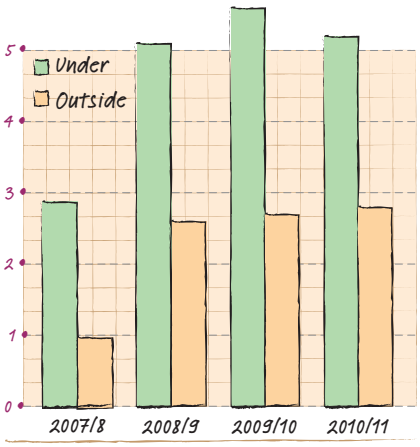
Agroforestry provides **fuelwood and fodder**, improves water filtration and sequesters carbon.

systems covering some 300 000 ha in Zambia. In Malawi, there are about half a million farms with the trees. Farmers have been able to establish most of the *Faidherbia* stands simply by assisting the natural regeneration of tree seedlings on their land.

Although *Faidherbia* is one of the fastest growing acacia species, it is not a quick fix for low soil fertility. In a survey of 300 Zambian farmers, one-third said that yields increased over a period of one to three years, while 43 percent said that it took up to six years before they saw benefits in production.

Planting leguminous coppicing trees, such as *Gliricidia sepium*, which take less time to establish, is another way of increasing maize production sustainably. On small landholdings in southern Malawi, the World Agroforestry Centre is promoting a system in which farmers plant *Gliricidia* in rows in their maize fields, prune them back two or three times a year, and mix the leaves into the soil. Findings from a decade-long study indicate that on unfertilized plots where *Gliricidia* is intercropped with maize, yields average 3.7 tonnes per ha, and reach 5 tonnes per ha in good years. On unfertilized plots without *Gliricidia*, average yields were only 0.5 to 1.0 tonne per ha.

Average yields of maize under and outside *Faidherbia albida* canopy (t/ha)



In areas where land holdings are larger than 1 ha, growing leguminous shrubs such as *Sesbania sesban* on fallow fields is another option for revitalizing the soil and increasing maize yields. Leguminous trees and shrubs add from 100 to 250 kg of nitrogen per ha to the soil in fields that are left fallow for two or three years. Even though fields are unproductive for two out of every five years, returns on investment are higher when maize is grown in rotation with nitrogen-fixing shrubs and trees.

In eastern Zambia, one study found the average net profit was Us$130 per ha when farmers cultivated maize without fertilizer; Us$309 when it was grown in rotation with *Sesbania*; and Us$327 when it was intercropped with *Gliricidia*. For each unit of investment, farmers who integrated trees with maize benefited from higher returns than those who used mineral fertilizer, subsidized or unsubsidized, for continuous maize production. The study confirmed that maize agroforestry is both socially profitable and financially competitive, compared to maize production using only mineral fertilizer.

Agroforestry practices have helped smallholder farmers overcome one barrier to the adoption of conservation agriculture: the lack of crop residues to maintain a constant soil cover. Because most African smallholders also raise livestock, they often use crop residue biomass as animal fodder. With trees growing on their farms, there is now enough biomass to both meet livestock needs and improve maize yields. The trees also provide fuel for rural households – in Zambia, farmers were able to gather 15 tonnes of fuelwood per ha after the second year of fallow with *Sesbania* and 21 tonnes after the third year.

Agroforestry also improves soil structure and water filtration, which makes farms more resilient to drought. Moreover, it can play an important role in climate change mitigation. Conservation agriculture with trees sequesters from 2 to 4 tonnes of carbon per ha per year, compared to 0.2 to 0.4 tonnes under CA without trees. In addition, by increasing maize production and the supply of fuelwood, farming systems that integrate trees with maize reduce the need for converting forests to farmland, which is a major source of greenhouse gas emissions.

Agroforestry does not require large investment. Low-income farmers are often quicker to embrace it than farmers who are better off. Although more labour is required initially, farm labour can be used more efficiently once farmers master the new practices. However, incorporating trees into crop production is a knowledge-intensive activity. Policy support, continued research and rural advisory services that engage smallholder farmers are crucial for the long-term expansion of farming systems that integrate maize, shrubs and trees.

Adapted from:
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http://www.fao.org/3/a-i4009e.pdf
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