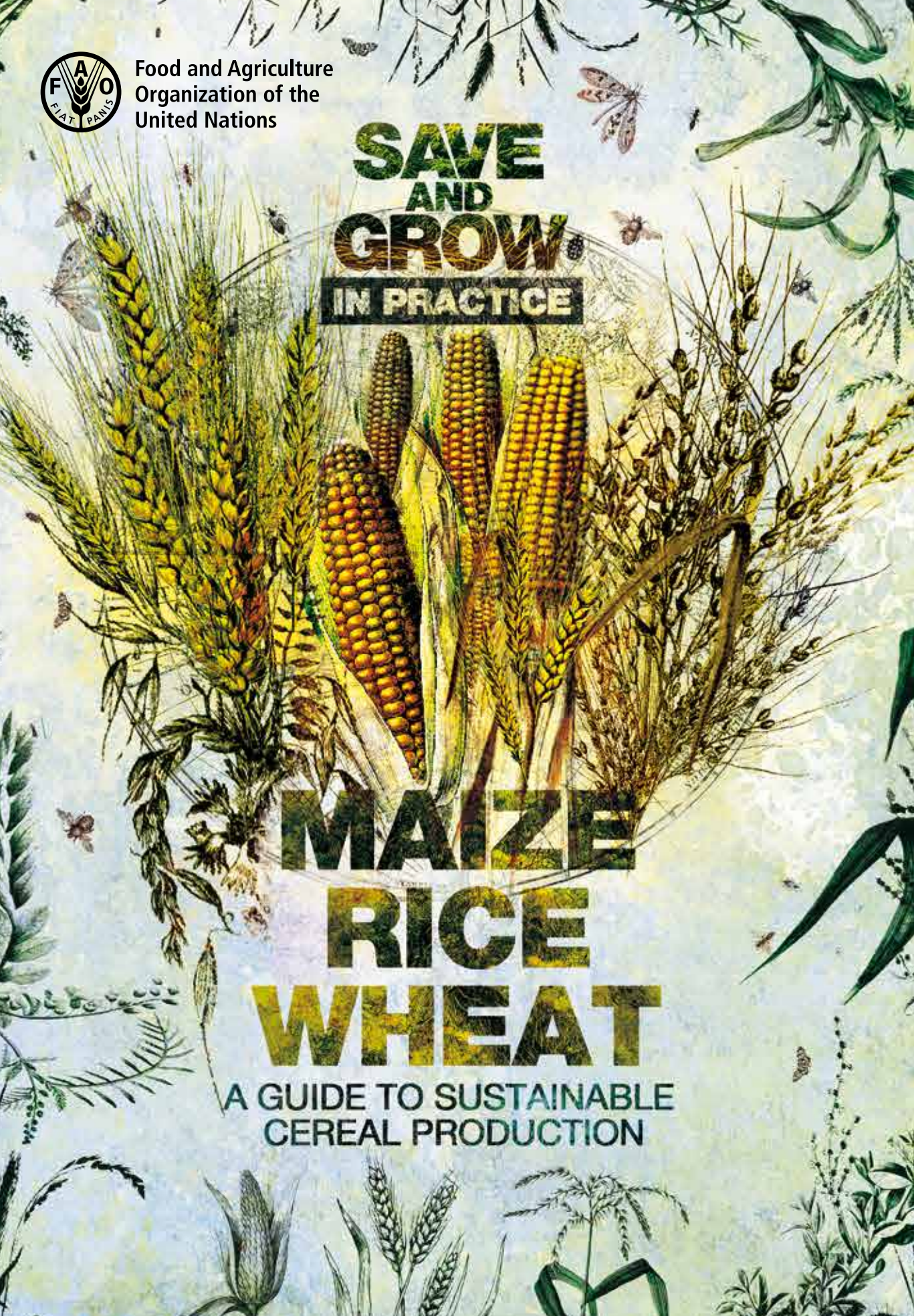

Food and Agriculture
Organization of the
United Nations
SAVE
AND
GROW
IN PRACTICE
MAIZE
RICE
WHEAT
A GUIDE TO SUSTAINABLE
CEREAL PRODUCTION

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

**1 · Maize/livestock** **East Africa**

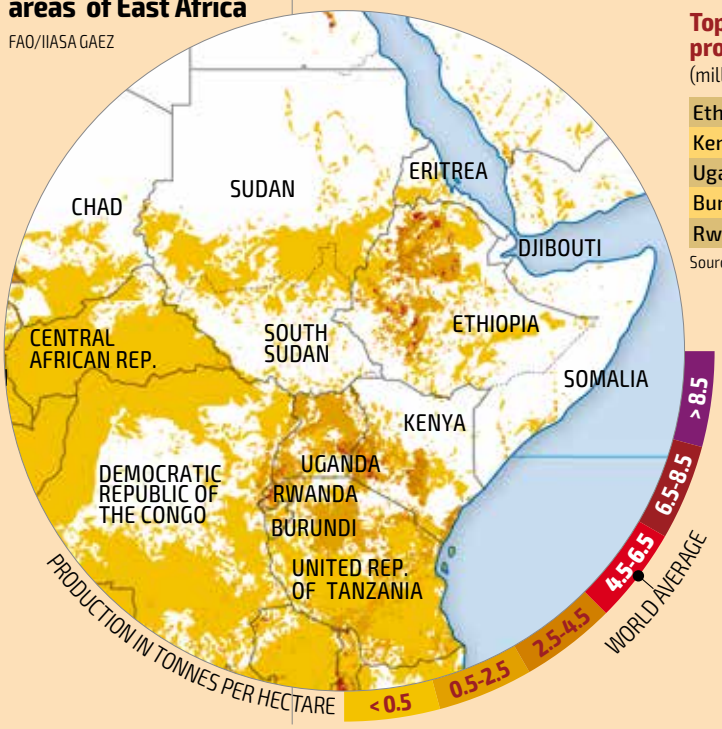
# 'Push-pull' fights pests, boosts milk production

**Two of Africa's most serious maize pests have been overcome by growing two local plants in maize fields. The 'push-pull' system produces other benefits, including high quality cattle fodder**

Stem borers and the parasitic weed *Striga* are the bane of maize fields in Africa. The larvae of an indigenous moth, stem borers eat into the succulent stalks of maize and devour them from within, causing crop losses of from 20 to 80 percent. Ministries of agriculture often recommend the use of synthetic pesticide to control stem borers, but most smallholder farmers cannot afford it[1].

*Striga*, a parasitic plant that attaches itself to the roots of cereal crops and siphons off water and nutrients, grows on some 40 percent of sub-Saharan Africa's arable land. In western Kenya, it infests as much as 76 percent of land planted to maize and sorghum, causing annual losses valued at more than Us$40 million. Sometimes, *Striga* infestations can lead to complete crop failure. Control of *Striga* is extremely difficult, as each plant produces thousands of tiny seeds that can remain viable in the soil for many years. As farmers abandon heavily infested areas to cultivate new land, *Striga* follows them[1].

**Maize producing areas of East Africa**
FAO/IIASA GAEZ




**Top 5 maize producers, 2013**
(million tonnes)

| | |
|---|---|
| Ethiopia | 6.67 |
| Kenya | 3.39 |
| Uganda | 2.75 |
| Burundi | 0.16 |
| Rwanda | 0.67 |

Source: FAOSTAT

In 1993, the International Centre of Insect Physiology and Ecology (ICIPE), in Nairobi, began working with the Kenya Agricultural Research Institute, Rothamsted Research (United Kingdom) and other partners to find affordable, environmentally friendly ways of controlling stem borers. What emerged from their work is now known as the 'push-pull' system of integrated pest management, which controls the borers by harnessing complex chemical interactions among

Napier grass (at left) and *Desmodium* (at right) protect maize from borers and weeds

plants and insects in a biologically diverse agro-ecosystem[1].

In push-pull, maize is intercropped with the leguminous plant *Desmodium*, while a popular fodder crop, Napier grass, is planted as a border around the field. *Desmodium* produces volatile chemicals that attract predators of maize pests. More importantly, by giving a false distress signal to the moths that the area is already infested, these chemicals 'push' the egg-laying moths to seek out habitats where their larvae will face less competition for food[1].

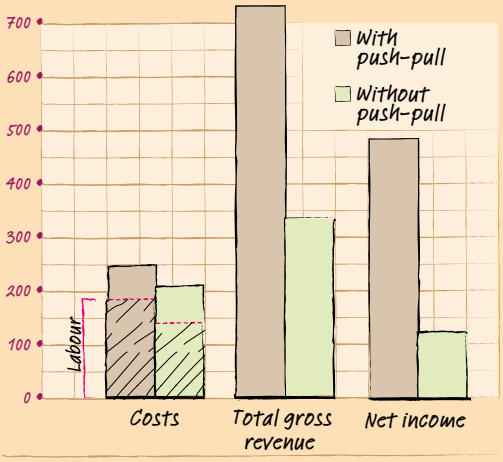
That's where the Napier grass comes in. It also produces volatile chemicals that 'pull' the moths towards them, and then exudes a sticky substance that traps the stem borer larvae as they feed on its stems. Few larvae survive to adulthood. Napier grass also attracts stem borer predators, such as ants, earwigs and spiders[1]. In trials, the number of stem borer eggs, and plant damage caused by stem borer feeding, have been found to be significantly higher in monocropped maize plots than in push-pull fields[2].

**During the course of their work,** ICIPE researchers made a startling discovery: *Desmodium* also acts as a 'false host' to *Striga*, first exuding chemicals that induce germination of its seeds, then releasing other chemicals that inhibit the weed's root growth[1]. Trials of the push-pull system showed that maize plots not only suffered little stem borer damage, but were almost completely *Striga*-free after two seasons[3].

The push-pull system of pest control delivers other benefits. Both *Desmodium* and Napier grass are peren-

THE SYSTEM HARNESSES COMPLEX CHEMICAL INTERACTIONS AMONG PLANTS AND INSECTS

Figure 3.1 Economics of maize production, Kisii district, Kenya (US$/ha)




Source: Adapted from Table 1, p.6[1]

nial crops that provide year-round soil cover, which helps retain soil moisture, improves soil structure, prevents erosion, and makes the agro-ecosystem more resilient to drought and other extreme weather events. Since it is a leguminous plant, *Desmodium* also fixes nitrogen in the soil and makes it available to the maize crop.

Beginning in 1997, ICIPE and its partners introduced the push-pull system to maize and sorghum farmers in Kenya and eastern Uganda, using 'farmer teachers' to help them spread the word. By 2010, more than 25 000 farmers around Lake Victoria had adopted it. An impact assessment conducted in 24 villages found that 19 percent of farmers had adopted push-pull primarily to control pests, especially *Striga*, and to increase crop productivity. Seventy-five percent of those farmers said their yields were three to four times higher than before. Some were harvesting 5 tonnes of maize per ha from fields that had previously produced less than 1 tonne[3]. In Kisii district, the income of push-pull maize farmers, per hectare, was three times that of their neighbours |FIGURE 3.1|[1].

The voracious maize stem borer causes crop losses of up to 80 percent

Almost half of the push-pull farmers had adapted the system to allow for the intercropping of maize with beans and other grain legumes, such as groundnuts, soybeans and cowpeas, and vegetables such as kale. Integrating beans in the system does not reduce *Desmodium*'s effect on *Striga* and stem borers[3].

**As well as helping farmers to increase food production,** the Napier grass used in the system has boosted the supply of feed for livestock. In fact, the ICIPE

assessment found that fodder production was an important factor motivating farmers to adopt push-pull[3]. For example, farmers in one district on Lake Victoria could satisfy only half of local milk demand owing to the lack of good quality feed. After 700 farmers adopted the push-pull system, milk production increased from 7 million to 8 million litres a year[1].

More livestock fodder means more manure is available for farmers to apply to their fields, which reduces the need for mineral fertilizer. Push-pull farmers have been able to diversify their production in other ways as well – for example, by selling organic produce and raising poultry. Farmers interviewed for the ICIPE assessment said they used the extra income from higher production for a variety of purposes, including paying their children's school fees and improving their housing[3].

The assessment found, however, that some farmers had not adopted push-pull because they did not have enough information about it. Although push-pull saves on labour by reducing the need for weeding, some farmers did not have enough household labour – or enough cash to hire extra help – to establish the system in their fields.

In addition, farmers with one-year land leases were reluctant to invest in a technology that did not produce rapid benefits. The lack of *Desmodium* seeds and their high cost also limited rates of adoption[3].

**By 2014, as many as 70 000 smallholder farmers** in Ethiopia, Kenya, the United Republic of Tanzania and Uganda – of whom more than half are women – were controlling *Striga* with *Desmodium* intercropping[4].

The International Centre of Insect Physiology and Ecology and partners have adapted push-pull to drier areas and to climate change by identifying and incorporating into the system two drought-tolerant companion plants: Greenleaf desmodium as an intercrop, and *Brachiaria* grass as a border plant[5].

Push-pull is now seen as the basis of an integrated crop-livestock production system that does not require high levels of external inputs and could significantly improve food security in East Africa. A recent survey of 900 farmers in Ethiopia, Kenya and the United Republic of Tanzania found a high potential for adoption of the system, especially among women and those who were aware of the damage caused by *Striga* and had good access to inputs[6].

Establishing push-pull as a permanent part of agriculture in the region will require continued support from government extension services and the use of community-based extension strategies, such as farmer field schools, farmer-teacher events and local public meetings[3].

It will also require an assured supply of *Desmodium* and *Brachiaria* seed, along with the seed of improved maize varieties and hybrids.

THANKS TO PUSH–PULL, MILK PRODUCTION INCREASED BY 1 MILLION LITRES A YEAR