



Frederick Kinyua has turned a poor hillside into a verdant paradise, thanks to a new farming system based on agroforestry.

feeding the soils of africa

In Kenya, Brad Collis finds a new kind of agroforestry that holds the promise of food security for millions of Africans.

In the Embu district on the rolling slopes below Mt Kenya they call Frederick Kinyua 'the professor'. It comes from his loquacious enthusiasm for new, high-yielding and sustainable farming practices that appear to be offering the first real chance for African food security.

In 10 years, Kinyua has turned a typically poor hillside plot into a verdant paradise in which every tree and shrub is either a source of food for his family and local markets, or a source of fodder for his four dairy cows.

Beautifully terraced rows of fruit and nut trees are interspersed with a multitude of crops, climbing up from a stream. His land comfortably supports his family of five, and he and others like him are challenging the perception that African agriculture and food production is a lost cause.

'This place now brings me joy and peace,' he says of his transformed 1.5-hectare farm. 'I can earn a living without travelling away from my family. People come to me from near and far for advice and it makes me glad when they come back again and again.'

'The technology being promoted is simple, and within the grasp of even the poorest farmers.'



The family's order of priority has been food, shelter, clothes and education, and the fact that school fees are now on the farm ledger is considered an extraordinary achievement.

Frederick is one of the 'early adopters' of a new farming system using agroforestry to restore fertility to poor soils, and to provide high-quality fodder for dairy cows, without compromising food crops.

Soil fertility is the key to the African food conundrum, and legumes and cows are at the crux of the agrarian revolution now under way, and which is aimed at resolving this issue once and for all. Drawing on knowledge painstakingly built up by the Nairobi-based International Centre for Research into Agroforestry (ICRAF), Kenyan farmers are leading the way in the move from 'subsistence' living to 'sustenance'. Sustenance production and food security is regarded as the starting point for the type of diverse agricultural economy that offers true income-earning and life-changing possibilities.

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The practice, quite simply, begins with planting legumes in the ley period between the traditional maize crop. Legumes transfer nitrogen, an essential fertiliser, from the air to the soil. Before this, the main source of nitrogen for their leached soils was urea, a commercial product priced beyond the reach of most small-holder farmers.

Fertility from trees

ICRAF was able to show farmers that leguminous tree fallows, using species such as *Sesbania sesban*, *Crotalaria grahamiana* and *Tephrosia vogelii* in rotation with maize, could recycle 100 to 150 kilograms of nitrogen a hectare, and produce maize yields of two to three tonnes a hectare. By contrast, most African farmers measure their maize harvests by the bag. There's never enough to last a whole year and the annual shortfall means chronic hunger and

Top left: Purity Wanjiku Njagi has built a sturdy stone house for her family of 11 with milk money created directly from her small farm's improved productivity.

Left: Increased soil fertility through agroforestry and the use of cow manure as fertiliser has enabled Peter Ngige and his family to diversify into export flowers.

a desperate search by every member of the household for work to buy food.

But the nitrogen-fixing legumes are only part story of how African farmers are tackling for themselves the continent's endemic hunger and poverty. In hedge-rows around farm boundaries or along paths and roadsides another shrub-like legume called *Calliandra calothyrsus* links the agroforestry with new, high-yielding milk production. *Calliandra* has been introduced from Mexico and central America as a low-cost source of high-protein fodder to replace or supplement dairy meal – again, an expensive commercial product that only the wealthiest farmers could afford.

Cows, whose milk production and general health are dramatically increased by *calliandra*, also generate manure for further enriching the soil. The combined influences of manure, and nitrogen-fixing legumes, is having an extraordinary impact on the fertility of farms, while protein and nutrition in the milk is improving people's health. As milk yields increase through the legume diet, there is surplus milk for sale to district dairy cooperatives.

It is now common to hear of milk money paying for school fees, or a new house with a galvanised iron roof instead of mud and straw. On the outskirts of Nairobi, Francis and Margaret Ngige, for example, have even managed to send two of their four sons to university. The farm's restored soil, through the use of legumes and manure, is also allowing diversification from food crops to cash crops such as flowers for export.

At Embu, one of the 'professor's neighbours, Purity Wanjiku Njagi, has built a sturdy stone house for her family of 11 with milk money created directly from her small farm's improved productivity.

Her tidy home boasts numerous wooden and stone buildings that house 18 chickens, two goats, one sheep and three cows. When her cows are producing at full capacity the income from each cow can be as high as 6000 Kenyan shillings (US\$100) a month.

'That's what I can get from milking the cows three hours a day and it's much more than I can make working all day in the coffee,' she says.

To ensure the change she has made is permanent, Wanjiku Njagi has established



Frederick Kinyua allows cow fertiliser to 'mature' under maize litter before digging it in. Improved soil fertility is the key to the African food conundrum.

her own *calliandra* nursery, maintaining a supply of seedlings for herself and her neighbours.

Similarly, with his own immediate food needs satisfied, the professor, Frederick Kinyua, has also been able to plan for the future – something rare for African farmers. Timber, especially hardwood, is always in short supply, so around his farm's boundary he has planted grevilleas and eucalyptus trees. Because yields from his staple crop, maize, are no longer measured in bags, but tonnes, he has also been able to set aside a small area for another longer-term venture, *Prunus africana*, a native

tree which is the source of a drug used to treat enlarged prostate condition in men.

Always eager to experiment with new agroforestry techniques, Frederick last year planted a 120-metre row of mulberry as yet another source of fodder for his animals, fruit for his children and fibre for making rope. He has started sowing a new legume called *Desmodium* among rows of napier grass because it fixes nitrogen, prevents soil erosion, and acts as a biological weed control. And he's waiting for the *Tephrosia vogelii* tree he planted last year to produce seed. 'I learned that when the leaves are crushed and mixed with water it



Prostate cure faces **extinction**

SMALL-HOLDER farmers in Africa are being encouraged to plant a native tree, *Prunus africana* to save it from extinction as awareness of its potential to treat prostate conditions in older men spreads.

Researchers with the International Centre for Agroforestry (ICRAF) are promoting the cultivation of this and other medicinal trees to help conserve plant biodiversity and natural resources, plus improve rural economies. The trees also help to prevent soil erosion.

Most farmers are planting the tree around farm boundaries, or in small plots when they can afford to set aside areas usually needed for food crops.

The medicinal properties of prunus are extracted from its bark and most trees in the wild have already been plundered as the worldwide herbal medicines market climbs above US\$5 billion a year.

Plantations now have to be guarded, but researchers hope that increased numbers of trees on farms will ease the black market pressure on the resource.

What makes prunus so special is that until a decade ago, the only cure known to western doctors for prostate cancer was an operation to remove part of the prostate gland.

In contrast, the medicinal properties of prunus have long been known in Africa,

where such groups as the Bakweri in Cameroon traditionally pound the bark to powder, add water and drink the resultant red liquid as a remedy against stomach ache, as well as prostate disorders.

Western science 'discovered' prunus in the mid-1960s, when the first patent for a herbal remedy for prostate disorders was lodged. Today, thousands of sites on the Internet advertise similar remedies, which consist mainly of capsules of bark powder. Global trade in this particular product is worth about US\$220 million a year, and its demand is expected to double or triple in the coming decade as the population in developed countries ages.

The result of this runaway demand is a species threatened with extinction. A slow-growing evergreen that reaches maturity in 15 to 20 years, prunus grows only at altitudes of 1000 metres and above. It is restricted to pockets of moist highlands in a handful of countries, including Cameroon, Kenya, Uganda, Congo and Madagascar.

The bark of the tree can be harvested sustainably by removing the lower part of two opposite panels of the trunk, then to allowing eight years for regeneration before harvesting the other two panels. The yield obtained in this way averages about 55 kilograms per tree per harvest,

which fetches around US\$10–20 when delivered to a processing factory. When completely stripped, a large tree may yield up to a tonne of bark worth US\$200, a year's income for many of Africa's rural poor. There's just one snag: stripping the tree in this way kills it.

'Attempts to manage the tree sustainably in the wild seem doomed,' says Dr Anthony Simons, leader of ICRAF's Tree Domestication Program.

Overexploitation is associated with the breakdown of traditional tribal authority and the growth of the cash economy. Village elders who used to control harvesting are no longer heeded by today's young men, who are hungry for cash to buy a motor bike or a stereo.'

The plight of prunus is such that in 1995 it was added to Appendix II of the Convention on International Trade in Endangered Species (CITES). Appendix II means that, although trade is not banned, it must be regulated under a licensing regime.

Simons says deliberate cultivation on farmers' fields is the only option that will ensure the sustainability of bark supply. The tree grows well in the open and is therefore suitable for intercropping with cereals and other crops.

'After three years we now have tens of thousands of small-holder African farms using agroforestry to revitalise their soils and lift food production.'

can be used as an insecticide,' he says. 'If it works well, I plan to tell people about it.'

A message for millions

As news spreads of the dramatic progress being made by farmers such as Kinyua and Wanjiku Njagi, they find more and more of their time taken up in talking to other farmers and village councils, some of whom travel long distances to see for themselves the 'soil miracle'.

Because there's no burden of mechanical equipment or expensive chemicals, the main advocates of the changes are no longer scientists or aid workers, but farmers, as word and the evidence of people's own eyes spreads farm-to-farm, village-to-village.

CARE Kenya, for example, already envisages the day when its agricultural extension services will be as important as its traditional aid work. It is one of several

international aid organisations now working with ICRAF in the belief that agroforestry might at last be the tool that gives African farmers a genuine chance of famine-proofing their communities, and stimulating rural economies.

'People have been talking about the need for crop improvement for so long, but small-scale farmers just can't afford chemicals and fertilisers,' says CARE's deputy coordinator for household food security, Alloys Omolo. 'But where farmers have been working with ICRAF you can see enormous change and potential.'

What really excites aid organisations is that the natural resources of these progressive farmers – their soil and rainfall – are similar to that on which millions of other farmers in Kenya, Ethiopia, the Sudan, Uganda and Somalia rely.

ICRAF's director general, Dr Pedro Sanchez, says that using agroforestry to

improve soils in Africa is the equivalent circuit-breaker to the high-yielding rice varieties used to achieve food security in Asian in the 1960s 'Green Revolution'.

'Soil fertility here is the critical issue behind the constant spectre of famine. After three years we now have tens of thousands of small-holder African farms using agroforestry to revitalise their soils and lift food production. It sounds impressive . . . but of course to end hunger we need millions farmers to change.'

It's a massive challenge, but Sanchez believes it will happen because agroforestry is emerging as an agricultural system that once begun, allows farmers to develop independently, perhaps a factor not previously appreciated by Africa's past benefactors.

And as 'the professor' points out, there are benefits from trees that have no commercial value, but simply make life worth living.

'I can now sit under the shade of an umbrella tree where the air is cool,' he says. 'I can eat pawpaw to quench my thirst, and look at the calliandra's beautiful red flowers . . . and just feel happy.'



International Centre for Research into Agroforestry nursery manager, Julius Aduwo, with a *Prunus africanus* seedling. The overexploitation of wild prunus trees, whose bark yields a remedy for prostate disorders, is associated with the breakdown of traditional tribal authority and the growth of the cash economy. Deliberate cultivation on farmers' fields is the only way to ensure the sustainability of bark supply.

Abstract: Drawing on knowledge accrued by the Nairobi-based International Centre for Research into Agroforestry (ICRAF), Kenyan farmers are leading the way in the move from 'subsistence' to 'sustenance' living. Sustenance production begins with planting legumes in the ley period between the traditional maize crop, thereby increasing yields. Farmers are also planting the legume *Calliandra calothyrsus*, a high-protein fodder, to replace or supplement dairy meal. The combination of legumes and cow manure is raising milk production and allowing diversification into cash crops such as flowers for export. International aid organisations are working with ICRAF in the belief that agroforestry might give African farmers a genuine chance of famine-proofing their communities, and stimulating rural economies.

Keywords: sustenance agriculture; agroforestry; soil fertility; soil rehabilitation; *Calliandra calothyrsus*; dairy farming; milk production; Kenya; medicinal plants; *Prunus africanus*; bark; prostate disorders.