



FODDER FOR A BETTER FUTURE

How agroforestry is helping to transform the lives of
small-scale dairy farmers in East Africa



World Agroforestry Centre
TRANSFORMING LIVES AND LANDSCAPES

Trees for Change

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The World Agroforestry Centre, an autonomous, non-profit research organization, aims to bring about a rural transformation in the developing world by encouraging and enabling smallholders to increase their use of trees in agricultural landscapes. This will help to improve food security, nutrition, income and health; provide shelter and energy; and lead to greater environmental sustainability.

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FODDER FOR A BETTER FUTURE

How agroforestry is helping to transform the lives of
smallholder dairy farmers in East Africa



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Front cover: Fodder crops have helped to improve the incomes of large numbers of dairy farmers in East Africa.

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Foreword

It is now almost 20 years since the World Agroforestry Centre and its partners began research on fodder trees in Kenya. The aim was to identify species that farmers could grow as a source of protein for their dairy animals. By 2006, over 205,000 smallholders in East Africa had planted fodder trees. By improving the diet of their cows and goats, they significantly increased milk yields and incomes.

The demand for milk products in East Africa has risen rapidly, almost doubling over the past decade in Kenya. Around 80% of the milk is supplied by smallholder dairy farmers, with an average of less than two cows each. Dairy farming is a notable pathway toward poverty alleviation for over a million farmers in the region. However, until recently the rapid increase in demand was not matched by increases in productivity. This is beginning to change. The introduction of improved breeds – for example, Friesians and Ayrshires – has helped to increase yields. And so has the introduction of protein-rich fodder trees.

This booklet describes one of the major agroforestry research and development success stories of recent years. Besides helping to improve livestock diets and milk yields, fodder trees provide a range of other benefits. Their nitrogen-fixing properties increase soil fertility;





they provide firewood for cooking and pollen for honey bees; and they can be used to control erosion on steep slopes. It is estimated that a farmer with one cow and 500 fodder trees, which cost less than US\$8 to establish, can increase net income by US\$60–115 a year – a significant sum of money in rural East Africa.

The personal testimonies of smallholder dairy farmers, told here, provide an insight into the life-changing benefits of using fodder trees. However, large numbers of smallholders have yet to be introduced to this relatively cheap and easy-to-use agroforestry technology. The World Agroforestry Centre is currently involved in a project that aims to transform the lives of 179,000 more families in East Africa by doubling dairy incomes over a ten-year period. Fodder trees are very much a part of this story.

We are grateful to the many organizations that have funded our research, and the dissemination of our research, in East Africa. Particular appreciation is extended to the Swedish International Development Agency (SIDA), the UK Department for International Development (DFID), the United States Agency for International Development (USAID) and the Bill & Melinda Gates Foundation for their sustained support.

Dennis Garrity
Director General
World Agroforestry Centre

◀ *By improving the diet of her livestock, Mercy Nyoike has significantly increased her milk yields.*



The ingredients of success: improved breeds and a better diet.

Introduction: An idea whose time has come

“When I first began planting fodder trees in 1999,” explains Juma Gichohi as he shows us round his smallholding in the hilly country to the south of Mount Kenya, “I thought I might be wasting my time. But I soon realized that this was one of the best things I’d ever done.”

In the 1990s, Gichochi’s dairy cows yielded 7–8 litres of milk a day. Now, he gets up to 15 litres from each cow. Part of the increase can be attributed to the fodder he provides for his two cows. Every day Gichohi feeds them home-grown protein in the form of leaves harvested from fodder trees like calliandra and mulberry. He estimates that this has increased yields by around 2 litres a day. He now has more milk to sell and he has established a thriving business selling fodder tree seeds.

When the World Agroforestry Centre and its partners launched their first fodder tree farm trials in Kenya’s Central Province, the focus was on improving the milk yields of dairy cattle. However, fodder trees have also proved highly beneficial to the growing numbers of farmers who keep dairy goats. Take, for example, the experience of Gill Kamau, secretary of the



▲ Juma Gichohi believes that a protein-rich diet has significantly increased his milk yields.

Kagundi-ini Dairy Goat Farmers' Group in Maragwa District. He now feeds the leaves of fodder trees to a dozen goats, one cow, two heifers, several hutches of rabbits and a small flock of hens.

"My life's completely changed over the last 10 years, and a lot of that's due to fodder trees," explains Kamau. "With the money I've made from selling milk, fodder seeds and livestock, I've bought a motorbike, a television and a solar system to light my house." He can now afford to pay school fees for his children, something he struggled to do in the past.

Besides increasing milk yields, fodder trees provide farmers with a range of other benefits. Gichohi, for example, uses inch-thick calliandra poles to support his beans, and fodder trees yield a constant harvest of firewood. Most of the species promoted by the World Agroforestry Centre and its partners are nitrogen-fixing legumes, and these help to increase



▲ Preparing fodder on a farm in Central Province.

soil fertility. Farmers also use fodder trees to control erosion on steep slopes. In short, these are plants with many talents.

The challenge

The demand for milk in East Africa has climbed rapidly during the past two decades. In response, production in Uganda rose from 365 million litres in 1991 to 900 million litres by 2001. In Kenya, where milk consumption averages 140 litres per person per year, production rose from 2.3 billion litres in 2000 to 4.1 billion litres by 2008, and around 80% is supplied by farmers like Gichohi and Kamau.

In 2006, there were an estimated 1.8 million smallholder dairy farmers in Kenya and many hundreds of thousands more in the neighbouring countries of Ethiopia, Rwanda, Tanzania and Uganda. Their numbers will have swelled since then. The majority farm small plots of land, between 0.5 and 1.5 hectares, at 1200 metres or more above sea level, and have an average of 1.7 cows. Most dairy farmers grow cash crops such as coffee and tea, alongside a variety of vegetables and fruits, as well as the fodder needed to sustain their livestock – which are mostly stall fed, or ‘zero-grazed’ – in wooden shelters beside their homes.



▲ *By crossing local cows with exotic breeds – this is an Ayrshire cross – farmers have significantly improved their milk yields.*

But there's a problem: although milk production has risen dramatically in East Africa, productivity has remained relatively low, averaging roughly 7–8 litres per cow per day in intensive smallholder production systems using improved breeds of cattle. This compares with average daily yields of around 25 litres for dairy cows in the United States and the United Kingdom.

Various factors influence milk production, breeding being the most obvious. Holstein, Friesian, Ayrshire, Guernsey and Jersey cows are far more productive than the indigenous breeds, and this has long been recognized by East Africa's dairy farmers. When you travel around the highland smallholdings you'll frequently see glossy posters touting the virtues of Holstein sires with names like Soldier and Veto, and many dairy farmers now use artificial insemination (AI) to improve their breeding stock. Most smallholders prefer cross breeds, which produce substantial amounts of milk, but are more resistant to tropical diseases than pure breeds.

However, animal health and diet also have a strong influence on milk production. "To get the best out of improved breeds of cattle, it's important to feed them a balanced diet with sufficient protein," says World Agroforestry Centre scientist Frank Place, "and if a farmer is going to do that he either has to buy dairy meal, which many can't afford, or grow his own protein." Thanks to pioneering research by the World Agroforestry Centre and its partners, increasing numbers of farmers are choosing the latter option.

The introduction of fodder trees is a great agroforestry success story. By 2006, over 205,000 smallholder dairy farmers had planted fodder trees in East Africa. This is just the beginning, according to Steve Franzel, who directs fodder tree research at the World Agroforestry

Centre. “The technology could raise milk yields and improve incomes for hundreds of thousands of other farmers throughout the highlands of Africa and in other parts of the developing world,” he says. This booklet provides a brief portrait of the achievements so far, focusing in particular on research and dissemination in Kenya’s Central Province.



World Agroforestry Centre scientist Steve Franzel (centre) and dissemination facilitator Esther Karanja (left) with dairy farmers in Kenya's Central Province.

1. RESEARCHING THE BEST FODDER CROPS

In dryland Africa you will often see goats stripping leaves from trees, and pastoralists like the Maasai and Samburu frequently tear down branches for their cattle to graze. This has been going on for thousands of years. And traditionally farmers in East Africa have used a wide range of local fodder species to feed their dairy livestock, using the ‘cut-and-carry’ system.

However, it wasn’t until the 1980s that research and development organizations began to encourage dairy farmers to plant fodder trees as a crop. The International Livestock Research Institute (ILRI) and the Kenya Agricultural Research Institute (KARI) first tested the use of fodder trees at sites on the Kenyan coast. They provided several species to farmers, but little research was done on how best to establish them on farms, how to manage them, and their relative merits under different conditions.

“The idea of promoting fodder trees could easily have petered out,” says Frank Place, “but we decided they had real potential and we galvanized the research effort.” In 1991, scientists from the World Agroforestry Centre, KARI and the Kenya Forestry Research Institute (KEFRI) began their first on-farm trials around Embu, on the southern flanks of Mount Kenya, initially focusing on three promising species, *Calliandra calothyrsus*, *Sesbania sesban* and *Leucaena leucocephala*.



▲ Julius Kangee harvests the seeds of *trichandra* to sell to other farmers.

Two performed poorly. *Leucocephala* produced excellent fodder, but suffered from heavy predation by a leaf-eating insect, the psyllid *Heteropsylla cubana*. *Sesbania* was unable to withstand regular pruning. However, calliandra performed well and remains the most popular – and thoroughly researched – fodder tree throughout East Africa. Patulul provenance was found to be of significantly higher nutritional value than San Ramón provenance, and of similar quality to the Embu land race. It had previously been thought that drying calliandra reduced its quality and digestibility, but research showed that this was not the case. Cutting every 6 weeks or every 12 weeks produces a similar amount of leaf biomass, but the longer cutting interval has the added advantage of providing farmers with small-diameter wood that can be used as fuel. The research also established that the quality of the fodder is reduced when calliandra is grown on acid, infertile soils. Most of this research was conducted under partnerships between ICRAF, KARI, KEFRI and the Oxford Forestry Institute in the UK.

Since then, research has been conducted on over 20 other species, some of which have been widely adopted. Mulberry (*Morus alba*) and trichandra (*Leucaena trichandra*) are popular among farmers in Kenya, and diversifolia (*Leucaena diversifolia*) is favoured, together with calliandra, by farmers in Rwanda and Uganda. Calliandra is popular in Tanzania, together with *leucocephala*, despite the latter's susceptibility to insect attacks.



▲ Besides providing Macharia Mugachia's livestock with protein, fodder trees stabilize his soils and yield significant quantities of firewood.

“The ideal fodder trees are fast-growing species that provide high-quality feed and withstand regular pruning,” explains Franzel. “They should be easy to propagate in farmers’ nurseries and unlikely to become a weed.”

At first sight, Juma Gichohi is a typical highland farmer. He owns less than a hectare of land and milks just two cows. However, he has planted many more fodder trees than most of his neighbours – he has over 2000 calliandra, trichandra and mulberry – and he is an authority on how to grow and use them, which is why he is one of the most influential farmer trainers in his area. “Nearly all my fodder trees are planted in hedges, either along my boundaries, or beside footpaths on my farm,” he explains, “and that way they’re not taking up space that could be used for other crops.”

Macharia Mugachia, an 86 year-old farmer who lives nearby, has found fodder trees particularly useful for soil conservation and this has influenced his planting strategy. “As my land is very steep, I’ve planted calliandra and other trees along the edge of my terraces, so that helps me to keep the soil in place,” he says. “In fact, because of the fodder trees, I’ve completely changed the way I manage my farm.”

Many farmers intercrop fodder trees with napier grass, used as a bulk feed for cattle, and some have found they work well as small



▲ Pruning fodder trees.

hedges between large trees, such as *Grevillea robusta*, a popular source of timber and firewood. Some farmers – Gill Kamau being one – take full advantage of the nitrogen-fixing properties of many species of fodder tree by planting them between rows of maize and other food crops. “Calliandra and trichandra are providing me with a natural fertilizer, as well as fodder for my animals,” he says.

Fodder trees have also worked well for dairy farmers in more arid parts of East Africa. For example, around 70 women who belong to Saphina Njema, a farmers’ group in Tanzania’s Shinyanga District, have increased their milk yields from 3–5 litres to over 10 litres a day. The increase can be partly attributed to using improved breeds, and partly to using fodder trees, which were promoted by the Shinyanga Soil Conservation Programme – known by its Swahili acronym, HASHI – in the mid-1990s.

The farms here tend to be larger than those in Central Kenya and many of the women grow their fodder crops in blocks, rather than as hedges. Some have even used fodder crops to restore degraded land. “I planted fodder trees on one plot of land that was completely bare and rocky,” explains Maria Manyangu. “They broke up



▲ Mary Tenga is one of many women in Shinyanga, Tanzania, whose milk yields have increased dramatically – thanks, in part, to the use of fodder trees.

the hard pan and I've recently been able to plough the land. This year I'm expecting to plant maize there."

Besides studying where farmers chose to plant their fodder trees, the early research at Embu examined the best ways to raise seedlings in nurseries and how to establish and manage them on farms. As a general rule, farmers prune their trees for the first time some nine to 12 months after transplanting them, and four to six times a year thereafter. This yields approximately 1.5 kg of dry matter per tree per year, with the prunings of 500 trees being sufficient to feed a cow throughout the year at a rate of 2 kg of dry matter a day. 1 kg of dried calliandra provides roughly the same amount of digestible protein as 1 kg of dairy meal, and both increase milk production by around 0.75 litres, although this varies from farm to farm, depending on the breed of the cow, its health and the quality of the feed. These were among the findings of various research projects undertaken by KARI, KEFRI, the World Agroforestry Centre and the UK Natural Resources Institute.



▲ *Mixing dried fodder. Dried calliandra provides roughly the same amount of digestible protein as dairy meal.*

FRESH MILK, YOGHURT
& LALA AVAILABLE.

FRESH MILK
YOGHURT
& LALA



Making the most of markets. The Kagundi-ini Dairy Goat Farmers' Group has set up its own retail outlet.

2. MONEY IN THEIR POCKETS, AND MUCH MORE

“We’re trying to help the farmer to spend less money from his pocket, and make more money at the same time,” says Esther Karanja, a dissemination facilitator who trains organizations working with farmers. Fodder trees can do both these things: they can provide farmers with a substitute for expensive dairy meal and they can increase milk yields, thus providing farmers with more to sell.

An analysis of results from four different locations in Kenya and Uganda, carried out in 2002 and 2003, provides some figures for the impact of fodder trees on farmers’ incomes. A farmer with one cow and 500 fodder trees who uses calliandra as a substitute for dairy meal will increase his net annual income by between US\$101 and US\$122. A farmer with one cow and 500 fodder trees who decides to use calliandra as an additional supplement to whatever else he uses as feed, which may or may not include dairy meal, will increase his net annual income by between US\$62 and US\$115. Either way, this is a considerable sum of money, bearing in mind that the gross per capita national income in Kenya is around US\$300 a year.

If you visit dairy farmers in a developed country, you’ll find that most are getting roughly the same amount of



▲ Good breeding and good management can help farmers to achieve high yields. Friesian crosses in the Kenyan highlands.

milk from their cows – around 25 litres a day, for example, in the US. This isn't the case in East Africa, where milk yields vary, often by a considerable amount, from one farm to another. Take, for example, some of the farmers we met during the course of research for this booklet. Juma Gichohi now gets around 15 litres of milk a day from his cows, and two other members of his farmers' group, Prisca Njeri Wanyinyi and Macharia Mugachia, get 12 litres from theirs. However, not far away, Julius Kangee regularly gets 25 litres from his Friesian cows. Gill Kamau, in contrast, gets just 5 litres from his.

Despite the variations, these farmers have all increased their milk yields during recent years. They find it hard to say precisely how much of the increase has come from upgrading their livestock, and how much from using fodder trees, but none of them doubt that fodder trees have made a significant contribution. Farmers who use fodder trees also confirm that a diet rich in protein improves animal health – “My cows always look better when they eat fodder trees,” says Mrs Wanyinyi – and ensures that cows calve once every 12 months, rather than less frequently, which tends to be the case for cows on a subsistence diet.

Calliandra also increases the butterfat content of milk, and although farmers don't receive a better price for creamier milk, they say they need less in their tea to get the desired taste and consistency, this being a matter of considerable importance on Kenya. There is, however, one problem with calliandra. Despite its popularity, it is not a particularly high-quality feed. It is high in tannins, which have the effect of



▲ A mixed pile of fresh fodder on an upland farm.

binding proteins, a significant portion of which are then excreted by the cow, rather than digested. However, as Mrs Wanyinyi points out, this does make excellent manure.

In fact, manure is an important by-product for dairy farmers, providing them with a free source of natural fertilizer. Of course, cows will produce manure without being fed fodder crops, but fodder crops help to improve the quality of the manure. In Kenya, Uganda and Tanzania, farmers keep cows, first and foremost, to provide milk and an income. This is not the case in Rwanda. “If you ask farmers in Rwanda what the main purpose of keeping a cow is, many will tell you it’s for manure,” explains Franzel. “They’ve got very acidic soils, and the farmers report that manure not only provides nutrients and improves soil structure, it also reduces soil acidity.”

It’s good for goats too

Shortly before Rev. Stephen Kimani Kagacha retired from the Anglican Church in 1998, he got in touch with Gill Kamau. “I was looking for something to do in my retirement and I told Gill I’d seen a good enterprise with dairy goats,” he recounts. “I suggested we could begin something like that here, and we called a public meeting.” Around 35 smallholders turned up. A few weeks later, the Kagundi-ini Dairy Goat Farmers’ Group was registered with the Dairy Goat Association of Kenya (DGAK). The local group now has 27 members; the national association has over 12,000 and the number is swiftly rising, reflecting the burgeoning interest in dairy goats.



▲ A vicar with a mission. Rev Kagacha helped to establish the Kagundi-ini Dairy Goat Farmers’ Group.

“Around half our members don’t have enough land to keep a cow, so goats are a good substitute,” says Kamau. Goats require less fodder and space than cows, and owning several goats represents less of a risk than owning one cow. Lose a goat and you still have others to provide milk and manure; lose your cow, on the other hand, and you are in serious trouble. Goats also make very efficient use of low-quality fodder and their milk can fetch up to four times as much as cow’s milk. It is particularly suitable for children and the sick, as it is easier to digest than cow’s milk.

When the Kagundi-ini group was first established, farmers bought their goats from the local market. These local breeds yielded relatively small quantities of milk, so over the past decade Kamau and his neighbours have put their does – the females – to German Alpine bucks. Their upgraded goats, fed on a diet that includes fodder trees, are now providing farmers with more milk. The Kagundi-ini Dairy Goat Farmers’ Group has also set up a profitable enterprise selling milk products. (See box: Making the most of milk, page 20)

“When I began keeping goats, I used to get about half a litre a day from a goat,” explains Mercy Nyoike, who has eight goats and one cow. “Now I often get 2 litres.” Some of the milk is consumed by her family; some is sold. Mrs Nyoike is also making an income from the sale of her kids,



▲ Wilson Wanyoike with the Kagundi-ini group's buck.

which fetch between 5000 Ksh (US\$66) and 9000 Ksh (US\$120) each, depending on their age. “Before I kept goats, I made very little money and I struggled to educate my children,” she says. “But with the goats, I’ve been able to pay school fees, and we’ve also earned enough to build a new house.”

To avoid inbreeding, the DGAK manages a programme that enables its member organizations, of which there are over 1000, to change their bucks every 15 months. Gikonyo, the Kagundi-ini group’s current buck, is looked after by Wilson Wanyoike. Gikonyo serves around 70 does a year, with members of the group paying 75 Ksh (US\$1) a session and non-members 150 Ksh (US\$2). “It used to be a real struggle providing food and clothes for my family, but the goats have changed all that,” says Wanyoike. Three of his five children are still at school, and he is now able to pay annual fees, which amounts to 18,000 Ksh (US\$240). “Everybody in our group is now better off than they were in the past,” says Kamau, “and we’re all growing fodder trees.”

FARM-Africa is one of several international NGOs that are encouraging goat farmers to use fodder trees. So far, around 10,000 families in Kenya have benefited from its goat improvement strategy, which has involved crossing exotic high-yielding goats with local goats. This has helped to raise farmers’ incomes by up to US\$995 a year, primarily by increasing the value of the goats and their milk production. In Meru Central and Meru South districts, farmers upgraded their local Galla goats by crossing them with Toggenburgs. This enabled them to increase milk yields from a meagre 0.4 litres to 2.4–2.9 litres a day.

“We have strongly promoted fodder trees as part of our dairy goat programme,” explains Christie Peacock, chief executive officer of FARM-Africa. “Leguminous trees can do a lot to improve the diet of goats that have been fed on standard fodder such as Napier grass and maize stalks.” However, she cautions against overstating the impact of fodder trees on goat milk yields. “In many parts of the tropics, the big constraints for tropical ruminants are a

lack of energy and water, and farmers who want to get really high yields will need to feed their goats with high-quality supplements, such as dairy meal and fish meal, not just fodder trees.”

In fact, a significant number of dairy farmers feed their livestock with supplements as well as the leaves of fodder trees. For example, most members of the Saphina Njema farmers’ group in Shinyanga, Tanzania, mix supplements such as maize bran, which they buy, and their own protein-rich crop by-products with fodder trees like gliricidia. The environment in Shinyanga is much drier than the climate in the Kenyan Highlands, but you hear much the same story from the smallholders who grow fodder trees.

“After I began using fodder trees, I increased my cow’s milk yield from 7 litres a day to 11 litres,” explains Julianna Mwandu. “Before, I didn’t earn enough money to pay for my three oldest children to go to secondary school, but now I’m earning enough to pay for my youngest two children to attend the school. I’ve also been able to purchase timber and iron sheets to re-roof my house.”

KAGUUBU - INTI S.F.O			
SAPHINA (KAGUUBU)			
BUSKET (SAPHINA)			
3.5lt6 Cows Milk	-17/04/09	100	350 =
28 Lt6 "	-28/04/09	100	280 =
30 Lt6 "	-15/04/09	100	300 =
1 Lt6 "	-17/04/09	100	100 =
30 Lt6 "	-22/04/09	100	300 =
35 Lt6 "	-25/04/09	100	350 =
26 Lt6 "	-28/04/09	100	260 =
50 Lt6 "	-29/04/09	100	300 =
50 Lt6 "			
			KSH 2240.00
			<i>Paid on 24/09/09</i>
			2240 =

▲ There is good money in goats' milk, which was selling for 100 shillings (US\$1.30) a litre in 2009.

And that's not all

So are there any disadvantages to using fodder trees? Absolutely none, says Rev. Kagacha emphatically. He and other members of the Kagundi-ini Dairy Goat Farmers' Group reel off their many virtues besides increasing milk yields. They help to improve soil fertility; they provide nectar for bees; they provide a year-round harvest of firewood, an important consideration for women; and prunings can be used as stakes to support beans, tomatoes and peas. Fodder trees also improve the health and performance of rabbits and hens. One of the trees, mulberry, even provides farming families with a delicious fruit as well as livestock fodder. "And then there are the seeds," says Rev Kagacha, who sold some 100 kg of fodder tree seeds last year at 2000 Ksh (US\$27) a kg.

The World Agroforestry Centre and its partners have encouraged farmer trainers to take advantage of the growing market for seeds and fodder trees seedlings. "We don't pay farmers to train other farmers, but we've encouraged them to set up businesses, which provide them with a financial incentive to give training sessions," explains Esther Karanja.

A few years after farmers began to use fodder trees in and around Kagundi-ini, Gill Kamau realized that there was a good market for seeds and he began to harvest more than he needed for his own small nursery. He gave some away and he sold some. Then, under a programme that is described in the next section, he received training from the Kenya Forestry Research Institute (KEFRI) on how to harvest, store and package seeds.



▲ Gill Kamau made 60,000 shillings (US\$800) from the sale of fodder tree seeds in 2009.

Last year, Kamau sold 30 kg of seeds for 60,000 Kenyan shillings (US\$800), a considerable sum of money in rural Kenya. Juma Gichohi, who is known locally as Juma Mutambia – ‘Juma the Disseminator’ – sold even more: 84 kilos of calliandra seeds and 27 kilos of trichandra seeds, as well 8600 fodder trees seedlings. Farmer trainers like these are now running serious businesses that are providing tens of thousands of dairy farmers with the seeds they need to establish fodder trees.

Making the most of milk



On market days, at least 70 people visit a small shop run by the Kagundi-ini Goat Farmers' Group to buy milk and yoghurt. It's busy on other days too. Established by a group of relatively poor farmers – half don't own a large enough plot of land

to keep a cow – the shop sells around 35 litres of milk or yoghurt a day and provides full-time employment for three people.

Goat's milk costs four times as much as cow's milk, but it's not easy to sell when farmers have small quantities, especially if they live far from the main points of demand, such as hospitals and maternity wards. "Most of the members who have both goats and cows keep the goat milk for home consumption, which leaves them with an excess of cow's milk to sell," explains Francis Wamithi, the group's chairman. "That's what prompted us to set up the shop in 2004."

Each household invested 5000 Ksh (US\$66) to buy a deep freeze and other equipment. This was a considerable sum of capital, but worth every cent. "We divide the profits among ourselves at the end of each year," says Wamithi with satisfaction, "and each household gets around 2000 Ksh (US\$26)." That still leaves enough to pay for the group's Christmas dinner, which is attended by 50 or more people.

When the shop was established, it was the first of its kind in Kagundi-ini. Since then, four other milk shops have appeared on the scene, creating intense competition. Wamithi and his colleagues are confident that their shop will continue to do business, but they are also thinking of setting up another outlet, some distance away, to sell yoghurt made from their milk.



Sarah Kawere (in pink) training farmers in Namulaba village, Uganda, how to grow better fodder crops.

3. SPREADING THE MESSAGE

Of all the agroforestry technologies promoted in Africa, fodder trees have been the quickest to spread. There are several reasons for this. “For one thing, fodder trees don’t cost much and they’re reasonably easy to establish,” says Frank Place. “Another factor that’s encouraged the spread of fodder trees is the profitability of the dairy sector. Everybody along the value chain, from farmers to processors, benefits when milk yields increase.”

There have been four phases of dissemination. The first, between 1995 and 1999, involved the modest scaling up of fodder tree activities at Embu and a few other sites in Kenya and Uganda. This was followed by a more ambitious programme to create awareness in Kenya, Rwanda, Tanzania and Uganda. By the time this came to an end, in 2005, an estimated 205,000 farmers had planted some 11 million fodder trees, thanks to the activities of over 220 different organizations.

Over 40% of the planters were women. “Adoption rates for women are generally much lower than for men and we celebrate if we can get rates like 40%!” says Steve Franzel. Adoption



▲ Over 40% of farmers who plant fodder trees are women.

rates for new practices tend to be much higher among men, as they have better access to land, labour, cash and extension services. It seems that two factors encouraged large numbers of women to plant fodder trees. First, many organizations targeted women's group; second, planting fodder trees costs little money. However, women tend to plant fewer trees than men, perhaps because they have less access to land and labour than men.

Prior to 2006, the researchers had worked closely with farmers in relatively small areas, and here they had considerable success promoting the use of fodder trees. "But there was the big problem of how to tell our story beyond these places," says Franzel. "We needed to spread the use of these practices across very large areas if they were to have a significant impact."

That is precisely what the third phase of dissemination, known as SCALE[®] (System-Wide Collaborative Action for Livelihoods and the Environment), achieved in 2006 and 2007. SCALE[®] is a communication and management process developed by the US-based Academy for Educational Development (AED), with the support of the United States Agency for International Development (USAID). In East Africa it revolutionized the way fodder trees were promoted. "The process taught us how to work with the media, how to work with a wide range of organizations, many of which we'd never worked with before, and how to organize meetings, which was something we thought we knew about, but maybe didn't," says Franzel.

"In typical development projects, the contractors do all the work and make all the decisions," explains Roberta Hilbruner of USAID. "SCALE[®] is completely different, and flips this top-down approach on its head. The process is driven by the people who are going to benefit, right from the very start."

Just as importantly, SCALE[®] takes a 'systems-wide' approach. "It looks at the whole forest, instead of just a tree," says Hilbruner, "and in Kenya we managed to get the entire dairy

industry involved. That's what made it work so well." A three-day workshop brought together over 120 individuals representing a range of different organizations, from research institutes to government agencies, farmers' groups to feed companies and environmentalists. Many had never met or collaborated, but together they analysed the problems facing farmers and identified a set of goals they could achieve. Hilbruner and her colleagues were astonished by the level of enthusiasm. "People were jumping up and shouting out what they were willing to do to reach their vision," she recalls. "It was inspiring to see their energy and excitement."

During the course of the next year, SCALE® led to a dramatic increase in awareness about the benefits of using fodder trees. Before SCALE® began, around 45,000 farmers in Central Kenya were using fodder trees. Within a year, SCALE® had helped the World Agroforestry Centre and its partners to reach three times that many again. SCALE® helped to establish a new seed dealers' association and there was extensive unpaid coverage about fodder trees in the national media.

The current phase of dissemination began in 2008. Funded by the Gates Foundation and managed by Heifer International, the East Africa Dairy Development (EADD) project aims to transform the lives of 179,000 families – over 1 million people – in Kenya, Rwanda and Uganda by doubling dairy incomes over a ten-year period. The World Agroforestry Centre is responsible for ensuring that farmers have access to high-quality feeds, including fodder trees.



▲ Wilson Wanyoike and Mercy Nyoike are among many farmers in Kagundi-ini to benefit from planting fodder trees.

The pathways to success

From a farmer's point of view, fodder trees have many attractions. They cost relatively little to establish – US\$6–8 is all it needs to establish 500 trees, enough to feed a cow, year after year – and they can be planted in areas where they won't compete with other crops. However, like many agroforestry technologies, they are 'knowledge intensive.' Farmers have to learn new skills, such as how to raise seedlings in nurseries and manage the trees. This takes time, effort and money.

In Rwanda and Uganda, international NGOs have been particularly influential when it comes to promoting fodder trees, accounting for over half the farmers adopting the new technology. International NGOs have also had an influence in Kenya and Tanzania. Some, like FARM-Africa, have been involved in the promotion of high-yielding dairy goats for smallholders; others have encouraged farmers to plant trees for a range of purposes, fodder being just one of them. Civil society campaigns, such as those catalysed by SCALE[®], have also had a significant impact, as have efforts to improve the availability of seeds. Then there had been the crucial role played by dissemination facilitators and the farmer trainers.

Dissemination facilitators like Esther Karanja provide training and advice to the organizations who



▲ Dissemination facilitators like Esther Karanja train organizations who work with farmers.

work with farmers. In other words, they train the trainers. They are invariably employed by international agencies or national agricultural research institutes. At present, the EADD project uses seven dissemination facilitators. It is a measure of how effective they can be that one dissemination facilitator in Kenya provided training, during a two-year period, to 22 organizations and 150 farm groups comprising 2600 farmers. Between them, they established 250 nurseries and planted over 1 million fodder trees.

There are now some 400 farmer trainers promoting fodder trees and other high-quality feeds at EADD project sites in East Africa. Farmer trainer programmes are not uncommon, but farmer trainers are generally selected on the basis of their technical expertise, hence the terms ‘expert farmers’, ‘model farmers’ and ‘master farmers’. Things are being done differently with the EADD project. “Our research shows that farmers who are good networkers and communicators are the best trainers, and these may not be the farmers with most expertise,” explains Franzel. Under the EADD project, trainees are chosen by their peers, not on the basis of their expertise, but their ability to communicate with fellow farmers. (See box: Is this the future? on page 30)

Thirty-four per cent of farmer trainers are women, and Sarah Kawere tells a story that could be told by many others. A smallholder in the Ugandan village of Namulaba, she was recruited as a volunteer farmer trainer by Jane Kugonza, a dissemination facilitator with the World Agroforestry Centre. In just two months, Mrs Kawere, a widow with four children, trained 20 local farmers to grow better fodder crops and improve the nutrition of their dairy cattle. By using high-quality feed on her own farm, she also increased her own production by 2 litres per cow per day.

A number of factors motivate the trainers. They learn about the best farming practices, and therefore increase their chance of getting better milk yields. They are also provided with seeds and planting material for setting up demonstrations. The seeds and seedlings

produced in the demonstration plots are provided free of charge to farmers in their own group, but trainers can also sell them to outsiders. Many have noticed that their role as teachers improves their social status within their villages.

Farmer trainers receive no pay, but the possibility of selling seeds at training sessions is a significant incentive. “When I travel to give a training session, the farmers might refund my bus fare, and I might sell some packets of seeds,” explains Gill Kamau, “but even if I don’t, I’m happy to do it.” This is partly because he has a passion for teaching farmers how to improve their livelihoods, but he also believes that the more farmers he trains, the larger the market for fodder tree seeds. If he doesn’t benefit now, he will later.



▲ Farmer trainers frequently make an additional income by selling fodder tree seeds to trainees.

A survey of 94 farmers in central Kenya, randomly selected from those who had planted fodder trees three years earlier, found that 57% had given planting materials and information about fodder trees to other farmers, with just 5% accounting for 66% of all dissemination. Farmers were most likely to give planting materials to their friends, but relatives and neighbours also benefited. However, farmers who receive information and seeds from other farmers generally have fewer trees than those who are in direct contact

with the staff of extension agencies, research institutes and specific projects. According to one survey published in 2006, three-quarters of 'second-generation adopters' in Kenya had planted fewer than 100 trees. This compared to a national average of 165 trees, which is still far below the number of trees needed to provide sufficient protein-rich feed for one cow.

Is this the future?

Before he retired as a school teacher in 2006, Julius Kangee used to attend to affairs on his small farm in the evenings. Now he is a full-time farmer and he runs a thriving business that trains between 150–200 farmers a week.

As soon as the trainee farmers arrive at Ndoka Dairies, near Sagana in Kirinyaga West District, Kangee and his wife take them on a tour of their farm. The visitors are bound to be impressed: his 15 dairy cows yield up to 25 litres of milk a day each, and his German Alpine goats – fluctuating in number between 30 and 50 – are also very productive. The Kangees use livestock manure as fertilizer and to generate biogas, which provides them with both light and heat for cooking.

After the tour, the farmers receive training on a range of topics, including how to grow and prune



▲ Innovative farmers like the Kangees are generating biogas from manure.

fodder trees and how to make leaf meal. The trainees are provided with a 17-page booklet on dairy farming. For all this, and lunch, they pay 200 Ksh (US\$2.60), and before they leave they can buy seeds grown and harvested at Ndoka Dairies. During the past year, Kangee sold 500 100-gram packets of fodder tree seeds, enough for about 1,500 farmers.

Kangee first learned about fodder trees in 2004. "I realized that if they helped me to save money on dairy feed, that would be good for my business," he recalls. Now, he promotes fodder trees not just in his training sessions, but as chairman of the Dairy Goat Association of Kenya, which has over 12,000 members.

"If you want healthy goats, you need a balanced diet that includes fodder trees," says Kangee. "I frequently see goats that belong to farmers who don't use fodder trees, and I can tell you they don't grow as fast as mine, and they're not as healthy. Fodder trees lead to better health, better growth and more milk."

"It's very unusual to find an individual conducting training on this scale," says Steve Franzel of the World Agroforestry Centre, "but I think this is where extension is going. We will see more and more training enterprises like this."



Out of sight, but not out of mind. Stall-fed dairy cows provide a significant income in Kenya's densely populated Central Province.

4. SO FAR SO GOOD

Over 16 years, between 1993 and 2008, the World Agroforestry Centre spent US\$4.71 million on research into the use and dissemination of fodder trees. Other organizations have also invested in fodder tree research, but this represents the lion's share of expenditure, and it is dwarfed by the benefits that have accrued to farmers who have adopted the new technology. One calculation suggests that the benefits for each adopting household have amounted to US\$29.29 a year; another study came up with US\$44. If we take the first figure, the benefits of the research for Kenya alone come to US\$19.7 million; if we take the second, to US\$29.6 million. The actual figure, suggests an impact assessment conducted by Frank Place and his colleagues, may well lie between the two. Either way, this is an excellent return on investment.

However, much needs to be done still. Charles Wambugu, a former World Agroforestry Centre extension specialist who has been involved in fodder research for many years, believes that the spread of fodder trees has been restricted by the fact that many farmers are unaware of their economic and environmental potential. Indeed, by 2006, less than 10% of smallholder dairy farmers in East Africa were using fodder trees. "Established farm input outlets frequently lack information on their potential to increase milk quality and quantity," says Wambugu. "This means they are not actively disseminating information about fodder trees or distributing planting materials."

Wambugu suggests that more research needs to be done to develop fodder trees for use at high altitudes and in drier parts of East Africa. Areas above 2200m often suffer from frequent frosts, which species like calliandra, leucaena and mulberry are unable to withstand, and on-farm trials conducted in drier parts of central Kenya failed to identify fodder tree species that can survive the harsh climate.

Over the coming years, the World Agroforestry Centre will continue to conduct research on fodder trees in partnerships with national research institutes in the countries where it works and research institutes from developed countries. One of the aims will be to increase the diversity of fodder trees available to farmers, with priority being given to assessing the potential value of indigenous species. Researchers will also investigate different models of seed production and distribution, the aim being to ensure that sustainable supplies are made available for dairy farmers. Research will also address the important issue of leaf meal production. Leaf meal, processed from fodder shrub leaves, is widely marketed in South and Southeast Asia, and is likely to become more important for African farmers. Research will focus on how to promote leaf meal enterprises in order to benefit smallholders and women in particular.

Dissemination will remain a key issue. The World Agroforestry Centre will continue to provide technical assistance by training trainers, helping its partners to establish demonstration plots, and by developing and distributing extension materials for a range of collaborators. At the same time, the Centre will continue to encourage policymakers to promote fodder trees in rural areas, especially at the local level. Participatory monitoring and evaluation will ensure that farmer innovations are incorporated into research and extension programmes. They will also help researchers to measure the effectiveness of different fodder shrub management options and approaches to dissemination.

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