World Agroforestry Centre
TRANSFORMING LIVES AND LANDSCAPES

09

Policybrief

Fodder trees and milk production in East Africa

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Improving the income of smallholder dairy farmers

Key points

1. An estimated 205,000 smallholder dairy farmers in East Africa had adopted fodder trees by 2005, up from just a couple thousand a decade earlier.
2. Broad uptake owes much to the technology being low cost, relatively easy to use, effective in raising milk yields, and available for use as a substitute for expensive dairy feed concentrates.
3. As the technology requires some training, its spread is facilitated by group training provided by projects, non-governmental organizations and extension staff, as well as by volunteer farmer-to-farmer dissemination.
4. Women are active in planting trees, accounting for almost half of planters when reached directly by NGOs or extension, but are less likely to be reached through farmer to farmer processes.
5. Feeding trials found that 1 kilogram of calliandra increased milk production by 0.6–0.8 kilograms; a new survey of farmers in Kenya that examined the effect of calliandra over a wide variety of actual feeding patterns found an effect about half as large but still highly advantageous.
6. The net benefits accruing to adopters of fodder trees in Kenya from 1993 to 2008 is estimated at between $18.7 million and $29.6 million.

Background

Milk production grew steadily in East Africa in the 1980s and 1990s. The pace of growth has since accelerated with recent high rates of income growth and urbanization. Much of market demand has been met by smallholder dairy farmers, typically with 1–3 cows on farms measuring 0.5–1.5 hectares.

Milk productivity per cow remains very low. In intensive production systems with improved cattle, average milk yields per cow are just 7–8 litres per day, despite the potential of farmers' breeds to produce at least three times that much (Reynolds et al. 1996). The scarcity and low quantity of feed resources are major constraints on improving the productivity of dairy animals in sub-Saharan Africa (Mapiye et al. 2006).

Fodder trees and shrubs were rarely used in the intensive dairy systems of the East African highlands until the late 1980s, when several fodder tree species were introduced. However, little was known about good management practices of the species for growth and sustainability, best feeding guidelines for different tree fodders, niches and competition of the trees with other enterprises on smallholder farms, and best methods for seed multiplication and establishment of trees on farms.

To address these knowledge gaps, the World Agroforestry Centre developed in 1991 a fodder research programme in collaboration with the Kenya Agricultural Research Institute (KARI) and the Kenya Forestry Research Institute (KEFRI). The World Agroforestry Centre and its partners, including national agricultural research and forestry institutes in Burundi, Kenya, Rwanda, Tanzania and Uganda, played a clear role in developing fodder trees as a viable technology in East Africa and a further catalytic action-research role in its scaling up.

Overview and analysis of results

The World Agroforestry Centre and its partners were active in several areas of research on fodder trees:

1. **Species identification and characterization.** Among fodder trees, *Calliandra calothyrsus* was a key species screened across many locations in East Africa. Since the mid-1990s *Leucaena trichandra*, an exotic species; *Morus alba* (mulberry), a naturalized species; and sesbania, an indigenous species, were widely tested. Farmers in the region have preferred calliandra to other species and thus it is the most commonly found in smallholder dairy farms.

2. **Nursery and tree establishment research.** All priority fodder species become established and grow better when sprouted in a nursery and transplanted as seedlings. Seeds are planted in nurseries and, after 3 months, transplanted on the farm with the onset of the rains. Methods were developed to avoid the use of polythene bags, which greatly increases the cost of nursery production.

3. **On-farm management of fodder trees.** Trials designed by researchers but managed by farmers assessed three promising species—*Calliandra calothyrsus*, *Sesbania sesban* and *Leucaena leucocephala*. Because of the limited size of the farms, research focused on integrating the trees into existing cropping systems rather than on planting them in monoculture fodder banks. Farmers preferred planting trees in hedges around the farm compound, in hedges along contour bunds.

4. **Animal feeding research.** On-farm feeding trials have confirmed the effectiveness of calliandra as a supplement to a basal diet, with 1 kg of dried calliandra about matching the digestible protein of 1 kg of dairy meal (Paterson et al. 1998). While feeding trials found that 1 kilogram of calliandra increased milk production by 0.6–0.8 kilograms, a new survey of farmers in Kenya found an effect about half as large under current farm and feeding practices .

As technology-development research matured and positive results were obtained, the World Agroforestry Centre and its partners focused more research on scaling-up processes, technology adoption and impact to identify constraints and improve dissemination strategies.

Three general dissemination phases can be distinguished in East Africa: (1) local scaling up from the research site at Embu, Kenya, and a few other sites in Kenya and Uganda (1995–1999); (2) wider awareness creation and pilot site extension in Kenya, Rwanda, Tanzania and Uganda (1999–2004); and (3) the System-wide Collaborative Action for Livelihoods and the Environment (SCALE™) approach in Kenya, with a focus on central Kenya (2005–2007). A more recent dissemination project, East Africa Dairy Development, was launched in Kenya, Rwanda and Uganda in late 2008.

Fodder trees require little or no cash investment or land taken away from producing food or other crops. The only inputs required are seed and minimal amounts of labour, which farmers are usually willing to provide. But, like many agroforestry and natural resource management practices, growing fodder trees requires farmers to become familiar with raising seedlings in a nursery, pruning trees on farm and feeding the leaves to livestock (Franzel and Wambugu 2007). In recognition of these potential constraints, the dissemination process entailed three components: awareness creation, technology management training and access to germplasm.

Dissemination evolved from highly localized processes, in which researchers played a strong catalytic role, into one in which a number of intermediaries, including private sector actors and civil society organizations, played larger roles. This marked transition in approaches was evident with respect to access to seed. In the early days, the World Agroforestry Centre and NGOs acted as intermediaries, buying seed from a few producers or dealers in western Kenya and making it available to new communities. As a complement to this, small exchanges and sales emerged within communities. Eventually, the demand for seed grew to the point that a more organized, formal and private sector effort was needed. The private seed sector became more independent and empowered with the formation of the private Kenya Association of Tree Seed and Nursery Operators. With improved communications, this network was better able to respond to germplasm demand arising from many quarters.

Also improving seed access was group training on nursery production, using group nurseries as training sites (Wambugu et al. 2001). This was found to be more cost effective in terms of knowledge diffusion and effective in generating seedlings that could be planted by farmers, as the tree species did not exist in private nurseries.

In terms of methods of farmer training, various projects have funded field technicians to help train farmers, farmer groups, NGOs and extension agents. The cadre of trained staff has been able to train others in their mandated regions. Likewise, farmers themselves are active trainers and seed providers and have greatly multiplied the number of farmers adopting fodder trees. These two methods have worked well to expand the number of trained farmers in areas where the trainers reside. But they have not been effective in bridging geographical distances and reaching new communities.

In terms of what has worked well and why in the region as a whole, a few lessons have been learned. Five elements appear to be critical for the successful dissemination of the practice, according to Franzel and Wambugu (2007):

1. **Large NGO promoters.** In Rwanda and Uganda, a few large international NGOs facilitated the dissemination of fodder trees to many thousands of farmers, accounting for over half of farmers planting in the two countries. Large NGOs were also important in facilitating the spread of the practice in Kenya and Tanzania. An advantage of NGO promoters is that they often have sufficient resources to follow through. It was found in central Kenya, for example, that farmers visited by NGOs received an average of 8.5 visits per year (Wambugu 2006).

2. **Civil society campaigns.** The System-wide Collaborative Action for Livelihoods and the Environment (SCALE™) methodology brings civil society stakeholders together to plan and implement campaigns to promote new practices (AED 2004). Engaging with a wide range of stakeholders representing all aspects of a given system, SCALE™ generated a great increase in the demand for and supply of tree fodder germplasm in central Kenya.

3. **Facilitated seed flows.** Poor seed availability was a key constraint in many areas. As calliandra, the main species, produces relatively little seed, farmers need to be trained to collect, maintain and treat it before planting. The World

Gender dimensions of impact

Nearly half of tree planters are women, as confirmed by development partner records and selected studies.

Major dissemination efforts through projects or non-governmental organizations have purposefully targeted women. A study by Mawanda (2004) in Uganda showed that, in most households, women were the ones who planted and managed calliandra on the farm. This was also found in Kenya, although planting rates among divorced or widowed women were lower as compared to males.

However, there are signs that farmer-to-farmer dissemination processes have been biased towards men. This requires further monitoring and evaluation.

Women have benefitted from their involvement in increasing the feed resources available on the farm and reducing the time required to forage for feed, especially in the dry season, as they are key suppliers of labour for the dairy enterprise. On the other hand, there is evidence that women are not able to fully benefit from the income generated in dairying and from fodder trees in particular in married households.

Agroforestry Centre and its partners helped seed vendors in central Kenya form an association to forge links with seed providers in western Kenya and make seeds available in small packets for sale to farmers in central Kenya. Over 8 months in 2006, 43 seed vendors sold over 1 tonne of seed, which is sufficient for about 33,000 farmers and a quantity much greater than they had sold previously.

4. **Dissemination facilitators.** Dissemination facilitators are extension specialists who are knowledgeable about fodder trees and whose principal function is to promote their use among extension providers and support them with training, information and access to seed. They proved to be highly effective. In central Kenya, for example, over a 2-year period a dissemination facilitator helped 22 organizations and 150 farmer groups comprising 2,600 farmers establish 250 nurseries and plant over a million fodder trees (Wambugu et al. 2001).

5. **Farmer-to-farmer dissemination.** Survey results showed that farmers played a critical role in disseminating seed and information to other farmers. A survey of 94 farmers in central Kenya randomly selected from among farmers who had planted fodder trees 3 years before the study revealed that 57% had given out both planting material (seeds or seedlings) and information to other farmers.

The uptake of fodder trees has been substantial. By 2005, about 10 years after dissemination began in earnest, 224 organizations were counted across Kenya, Rwanda, northern Tanzania and Uganda promoting fodder trees. Through their efforts and farmer to farmer dissemination, about 205,000 farmers had established fodder trees in the region(Table 1).

Adoption opportunities for fodder trees are not narrowly defined by ecological zone, market access or household characteristics. Rather, there seems to be interest in planting fodder trees in a range of conditions.

Cumulative fodder research benefits

Cumulative fodder research benefits. The benefits accruing to farmers in the region from increased and/or cheaper milk production are estimated to be about $27.72 annually for each adopting household in Kenya during the 2004-2008 period. Multiplying by the number of fodder tree users in each year between 1993 and 2008 yields a nominal (undiscounted) benefit of between $18.7 and $29.6 million dollars for Kenya alone (the range reflects different estimates of the yield effect of fodder shrubs).

Not all 205,000 adopters of leguminous trees use them primarily for fodder, but most do, including almost all 86,000 adopters in Kenya in 2005. Other uses and benefits of calliandra cited by farmers include increasing the butterfat content of milk and therefore creaminess (Paterson et al. 1998); its usefulness as a supplement to improve cow health and shorten the calving interval; and the provision of firewood, fencing, stakes, boundary markings and erosion control (Kabarizi et al. 2004).

Maina (2009) reports that farmers mentioned their growing interest in using tree fodder for dairy goat production, which is a rapidly growing enterprise in East Africa. They described using tree fodder to feed rabbits and fish, as well as calliandra as an important source of pollen for honey production. For all types of animals, tree fodder was especially important during the dry season, when other sources of fresh feeds were unavailable.

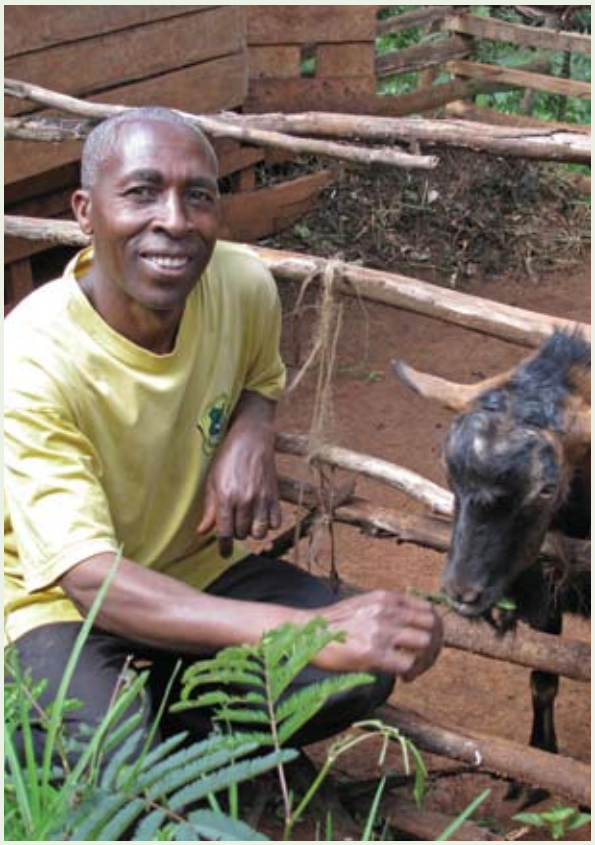
As dairy production enterprises expand in peri-urban or other densely populated areas, markets for tree fodder are likely to develop, creating further employment for growers, collectors, transporters and traders.

Table 1: Farmers planting fodder trees in Kenya, Rwanda, northern Tanzania and Uganda by 2005

Country	Number of organizations promoting fodder trees	Our record of the number of farmers planting	Rough estimate of additional farmers planting*	Total
Kenya	60	51,645	30,000	81,645
Uganda	80	77,369	5,000	82,369
Northern Tanzania	15	17,519	10,000	27,519
Rwanda	69	9,590	4,400	13,990
Total	224	156,123	49,400	205,523

Source: Franzel and Wambugu 2007.

**The estimate of additional farmers planting is based on studies of farmer to farmer dissemination patterns in selected study sites.*



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Research priorities

As fodder trees have only been recently scaled up across large areas of East Africa, farmers are still learning how to use them in combination with other feeds. It is critical for researchers to monitor and evaluate farmer experiences across the different sites in order to identify constraints to impact and opportunities to enhance the impact of the fodder trees. The issue of how women have benefitted from the technology is not fully settled, and qualitative research undertaken in this study indicated that a quantitative follow-up study would be valuable. Finally, several previous studies have identified other benefits from fodder trees worth investigating, such as the feeding of the tree fodder to other animals including dairy goats, rabbits and chickens, as well as the marketing of tree fodder as an enterprise in itself.

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