

Scaling up the use of fodder shrubs in central Kenya

Charles Wambugu, Steven Franzel, Paul Tuwei, and George Karanja

The low quality and quantity of feed resources is the greatest constraint to improving the productivity of livestock in sub-Saharan Africa (Winrock International 1992). Milk demand and production are concentrated around towns and cities where marketing costs are relatively low. Furthermore, farm sizes are also smaller in these peri-urban areas, which exacerbates feed constraints. Fast-growing leguminous trees or shrubs (the terms ‘tree’ and ‘shrub’ are used synonymously in this paper) have the potential to alleviate farmers’ feed problems. Leguminous trees and shrubs have root nodules that can often fix nitrogen from the atmosphere, making it available to plants. Fodder from these shrubs is rich in protein and, unlike grasses, the shrub leaves maintain their levels of protein even during the dry season. Moreover, farmers can use the shrubs for many other purposes – for hedges along boundaries and around the homestead, for prevention of soil erosion along contours, and for fuelwood.

Since the early 1990s, the National Agroforestry Research Project (NAFRP), based at the Kenya Agricultural Research Institute (KARI) Regional Research Centre, Embu, has been actively testing *Calliandra calothyrsus* fodder shrubs around Embu. The project is jointly managed by the Kenya Forestry Research Institute (KEFRI), and the International Centre for Research in Agroforestry (ICRAF). By 1997, about 1000 farmers in surrounding on-farm trial sites had planted *Calliandra*, but the project lacked the staff and resources required to extend the planting to other areas of the Kenyan highlands. This paper reviews the efforts of a project financed by the Systemwide Livestock Programme (SLP) of the Consultative Group on International Agricultural Research (CGIAR) involving ICRAF, KARI, and the International Livestock Research Institute (ILRI) in facilitating the dissemination of fodder shrubs in the highlands of central Kenya.

Description of study area

The coffee-based land-use system of central Kenya, ranging in altitude from 1300–1800 m, is located on the slopes of Mount Kenya. Rainfall occurs in two seasons, March–June and October–December, and averages 1200–1500 mm annually. Soils, primarily nitosols, are deep and of moderate to high fertility. Population density is high, ranging from 450 to 700 persons/km². In the Embu area, farm size averages 1–2 ha. Most farmers have title to their land, and thus their tenure is relatively secure. The main crops are coffee, produced for cash, and maize and bean, produced for consumption. Most farmers also grow Napier grass (*Pennisetum purpureum*) for feeding their dairy cows and crop their fields continuously because of the shortage of land. About 80 per cent have improved dairy cows, 1.7 cows per family, kept in zero- or minimum-grazing systems. Milk is produced both for home consumption and sale. Forty per cent of the farmers also have goats, averaging 3.2 per family (Minae and Nyamai 1988; Murithi 1998).

The main feed source for dairy cows is Napier grass, supplemented during the dry season with crop residues, such as maize and bean stover, banana leaves and pseudostems, and indigenous fodder shrubs. Forty-five per cent of the farmers buy commercial dairy meal (nominally 16 per cent crude protein) to supplement their cows' diet (Murithi 1998). Farmers complain that the price ratio between dairy meal and milk is not favourable, that they lack cash for buying dairy meal, that its nutritive value is suspect and highly variable, and that it is difficult for them to transport dairy meal from the market to the homestead (Franzel *et al.* 1999).

Research on fodder shrubs

Research on *Calliandra* began in Kenya in the 1980s, by ILRI and KARI. In the early 1990s, NAFRP began conducting on-farm trials with farmers to find out which niches they preferred for planting the shrubs. Farmers did not plant shrubs in pure-stand plots, because of the limited size of their farms, but they found ample space for hundreds of shrubs in hedges around the homestead, external and internal farm boundaries, along contour bunds, or intercropped between rows of Napier grass. Researchers and farmers found that when shrubs are cut at a height of 0.6–1.0 m, biomass yield is substantial and there is little competition with adjacent crops. A farmer managing the shrubs in this way would need about 500 to feed a cow

throughout the year at a rate of 2 kg dry matter (equivalent to 6 kg fresh weight) per day, providing about 0.6 kg crude protein (Paterson *et al.* 1996b). The shrubs are first pruned for fodder 9–12 months after planting, and pruning continues at the rate of four or five times per year (Roothaert *et al.* 1998).

Calliandra seedlings are raised in nurseries and transplanted following the onset of the rains. Experiments on seedling production have confirmed that plants may be grown in raised seedbeds rather than by the more expensive, laborious method of planting in polythene bags (O'Neill *et al.* 1997). On-farm feeding trials have also confirmed the effectiveness of *Calliandra* both as a supplement to the cow's diet and as a substitute for dairy meal. The trials found that 1 kg of dry *Calliandra* had about the same amount of digestible protein as 1 kg of dairy meal; both increased milk production by roughly 0.75 kg under farm conditions, but the response varied depending on such factors as the cow's health and the quality of its basal diet (O'Neill *et al.* 1995; Paterson *et al.* 1996a). Researchers are also conducting studies on other shrub species, exotic and indigenous, to help farmers further diversify their feed sources. These species include *Leucaena trichandra*, *Morus alba* (mulberry), and *Sapium ellipticum*.

Scaling up fodder shrub use: achievements and impact

The NAFRP helped farmer groups in the Embu area to set up 14 *Calliandra* nurseries in 1997, 26 in 1998, and 12 in 1999. But extension work was outside the project mandate; therefore, a new project financed by SLP recruited a dissemination facilitator in 1999 to scale up the use of fodder shrubs in central Kenya (ILRI 2000). The scaling-up task was not exclusively to transfer knowledge of fodder shrub technologies and seed to new areas but, equally important and more time-consuming, it was intended to:

- build partnerships with a range of stakeholders in new areas;
- assess whether feed shortage was perceived to be a problem among farmers, gauge their interest in planting fodder shrubs, and determine whether the shrubs were appropriate in their environment;
- assist farmer groups and communities to be effective in mobilising local and external resources for establishing *Calliandra* nurseries; and

- ensure the effective participation of farmer groups and stakeholders in testing, disseminating, monitoring, and evaluating the practice. These tasks were considered vital to ensuring that scaling up would be sustainable once the project was implemented.

Initially, project staff reviewed secondary information and results of farmer surveys to assess appropriate areas for fodder shrubs. Potential collaborating organisations across seven districts (a district comprises roughly 2000–4000 km² and 200,000–500,000 people) were identified, including government departments, NGOs, churches, and community-based organisations (CBOs). Fortunately, most were already using participatory research and development methods and confirmed that many of the farmers they worked with had critical problems feeding their dairy cows and were interested in planting fodder shrubs. Farmers in some areas, such as those focusing on irrigated vegetable production, were not interested in planting fodder trees.

Project activities extended across seven districts but were focused in clusters within each district to reduce costs and to facilitate monitoring and the exchange of information among groups. Meetings were held with farmers to discuss the problems they had in feeding their cows and to explain to them the costs, benefits, and risks of planting fodder shrubs. Farmer visits were arranged to see farmers in the Embu area who had already had several years of experience in growing and feeding *Calliandra* to their dairy cows. Most of the farmer groups paid for their own transport and subsistence costs on these visits. Seeing and discussing *Calliandra* with experienced farmers was an effective means to promote *Calliandra* planting and to provide a forum for farmers to learn about its growth, management, and use. The tours involved 420 farmers from 25 groups and 20 extension staff.

For areas where farmers were interested in fodder trees, project staff and partners discussed the terms of collaboration and each party's role was made explicit: SLP staff would initially provide the training and seed but after two to three years the partner organisation would take over these functions. Joint workplans were then developed, which clearly indicated a schedule of training events and follow-up activities.

Needs assessments were undertaken to determine farmers' knowledge and skills and to ensure that training would build on farmers' indigenous knowledge. Once farmers were trained to establish nurseries, they, in turn, trained their neighbours. Farmers in the clusters were also trained in seed production so they could provide seed to neighbouring farmers and to extension staff for distribution in other areas.

In 1999–2000, the project assisted staff of the following organisations to help farmers establish nurseries: the provincial administration in two provinces, three departments of the Ministry of Agriculture and Rural Development, one international NGO, four local NGOs, one extension service of a private company, two church extension services, ten CBOs, and 150 farmer groups. Farmer groups ranged in size from four to 50 members, and averaged about 17. Most of the groups were already in existence before the project, promoting such activities as dairy goats, handicrafts, domestic water tanks, soil conservation, organic farming, and shrub nurseries. Most (76 per cent) of the groups included both men and women; 15 per cent were women’s groups, and 9 per cent were men’s groups (see Table 1). Women accounted for 60 per cent of all group members. Most groups had more than one nursery. Nurseries were located on the farm of a member who had access to water during the dry season, which was essential for successful nurseries. Group members divided the labour amongst themselves and shared the seedlings produced. Ten nurseries were also established in school or church compounds and served as demonstration sites for farmers in the area.

By the end of 2000, the 150 groups had developed 250 nurseries involving over 2600 farmers (see Table 2). On average, farmers each transplanted about 400 *Calliandra* seedlings, of which about 240 (60 per cent) survived. Drought was the main cause of the high mortality.

Table 1: Types of farmers and groups establishing fodder shrub nurseries in the central highlands of Kenya

Type of farmer	No.	%	Type of group	No.	%
Female	1560	60	Mixed groups	115	76
Male	1040	40	Women’s groups	22	15
Total	2600	100	Men’s groups	13	9
			Total	150	100

Table 2: Expansion in numbers of farmer groups planting fodder shrub nurseries in the central highlands of Kenya

Season and year	No. of districts	No. of farmer groups	No. of nurseries	No. of farmers
1999 long rains	2	12	12	220
1999 short rains	6	117	180	2037
2000 long rains	7	150	250	2600

Rainfall was lower than normal during three consecutive seasons: the short rains of 1999, and both the long and the short rains of 2000.

Selected group members were trained in how to produce and distribute seeds. *Calliandra* begins producing seed in its second year but unfortunately the shrubs produce relatively little seed, and collecting it is laborious. Some farmers and private nurseries have begun selling *Calliandra* seed and seedlings, and the numbers doing so are likely to increase as production and demand for the shrubs increases.

Dependence on a single fodder shrub species is risky. Diversification reduces the risk of pest and disease attack, improves feed quality, and increases biodiversity. Therefore, the project has started disseminating other fodder shrub species; farmers in 80 groups have planted *L. trichandra*, 70 groups have planted *M. alba*, and 13 have planted a herbaceous legume, *Desmodium intortum*.

Impact assessment of this initiative has not yet been carried out, but an economic analysis was conducted of farmers' *Calliandra* fodder banks in the farmer-managed on-farm trials around Embu (Franzel *et al.* 1999). The analysis indicated that beginning in the second year after planting, a farmer with 500 shrubs would earn an extra US\$130 per year, either through increased milk production or through reduced purchase of dairy meal. If 50 per cent of Kenya's estimated 625,000 smallholder farmers owning dairy cows each planted 500 fodder shrubs, the net benefits per year would reach US\$81 million (Franzel *et al.* 1999).

The impact can also be important for farmers with dairy goats, an enterprise that is particularly well suited for farmers lacking the resources to buy and feed a dairy cow. Dairy goat production is growing rapidly in Kenya, and about 1300 dairy goat farmers in the highlands of central Kenya have planted *Calliandra*. Their feedback has confirmed the results of experiments at KARI-Embu, which found that *Calliandra* is an excellent feed for dairy goats (ILRI 2000).

Monitoring, farmer innovation, and feedback

Informal monitoring takes place in which farmers and extension staff provide feedback to project staff and researchers on their progress and problems. In one case, feedback on a farmer innovation has resulted in a change in recommendations made by extension services. Farmers in Kandara Division, Maragua District, conducted experiments on soaking *Calliandra* seeds before planting and found that seeds soaked

for 48–60 hours had higher germination rates than those soaked for the recommended 24 hours. Researchers at KARI-Embu confirmed the farmers' findings and extension staff now recommend the longer soaking time.

Farmers' problems with pests and their innovations in controlling them have also led to the design of new on-farm trials. For example, in 2001, researchers and farmers are comparing the effectiveness of using netting and local measures (spraying solutions made from tobacco, marigold, neem, hot pepper, or *Tephrosia vogelii*) to control crickets, hoppers, and aphids damaging seedlings in nurseries. These findings demonstrate the importance of monitoring farmers' innovations and feeding them back to research and extension.

Formal questionnaire surveys began in 2000 to assess farmers' experiences with *Calliandra*, problems encountered, and factors explaining adoption and successful group and nursery performance. The surveys are conducted with funding from the CGIAR Systemwide Programme on Collective Action and Property Rights. Results are not yet available, but because researchers from KARI-Embu are involved in conducting the surveys they are expecting considerable feedback from the field.

Problems encountered

Severe drought and poor distribution of rainfall increased the mortality of seedlings in the nurseries and shrubs in the field. Unlike in many areas of Africa, severe drought during the long rains season is extremely rare in central Kenya. Nevertheless, there is a high demand in 2001 for seed for nurseries, and farmers are being urged to locate nurseries near permanent sources of water. Infestation by crickets, hoppers, and aphids, as mentioned above, has also led to a significant loss of seedlings. These pests are particularly damaging during dry periods. The high turnover among staff of the Ministry of Agriculture, poor morale, and lack of resources such as transportation have also constrained success. The SLP project occasionally assists ministry staff with transportation and subsistence allowances, which greatly increases staff motivation.

Factors contributing to success

Several factors have contributed to the achievements thus far:

- The demand among farmers for fodder shrubs was huge, mainly because the shrubs save cash, farmers' scarcest resource, and require only small amounts of land and labour.

- The project area is noted for the dynamism of its farmers, and access to markets is fairly high, both of which enhance the adoption of new practices.
- Because the project works through partner organisations instead of directly with farmers it is able to build on local organisational skills and knowledge and reach far more farmers than would otherwise be possible.
- Dissemination through farmer groups instead of individual farmers economises on scarce training skills and transport facilities. In addition, working with groups ensures greater farmer-to-farmer dissemination and exchange of information.
- The strong partnership between researchers, extensionists, and farmers in the project facilitates the flow of information among the three.

Remaining challenges

Nevertheless, several critical challenges remain:

- While the project has successfully expanded the use of fodder shrubs across seven districts, it is still reaching only a small percentage of dairy farmers in these districts and less than 1 per cent of Kenya's smallholder dairy farmers. Further scaling up is required, focusing on institutions working in areas of the country where smallholder dairy farmers predominate. ICRAF, the Oxford Forestry Institute in the UK, and other partners are planning a project that will help the Ministry of Agriculture and Rural Development, NGOs, and farmer organisations throughout East Africa to assist farmers to plant *Calliandra* for fodder.
- Commercial seed production and distribution are slowly emerging in project areas, but it is not clear if seed production will continue to grow and meet local demand. Greater emphasis is needed on promoting community-based seed production and distribution through a range of partners: farmer groups, individual seed producers, and private nurseries. The SLP project is beginning work in this area.
- Greater diversification of fodder shrubs is needed to reduce the risk of pest and disease attacks, improve feed quality, and increase biodiversity. KARI-Embu has a strong programme for evaluating fodder trees and is increasing its emphasis on indigenous species.

- A consortium of partners needs to be established for promoting fodder shrubs. While the project is currently the hub of the informal network, providing seed and training, other organisations need to take over these functions in future years. Setting up periodic meetings of partners, including farmers, can help promote the exchange of skills, seed, and information, enhancing the spread of fodder shrubs and increasing household income from dairy. The first such meeting of the consortium is scheduled for 2001.
- Extension materials need to be developed to promote *Calliandra*. Videos and simplified brochures for farmers, such as that by Wambugu (2001), are among the tools that will be most useful.

Finally, experience confirms that successful scaling up of a new practice requires much more than transferring seed and knowledge about it. Rather, facilitators need to build partnerships with and among a range of stakeholders, ensure farmers' interest in the practice and its appropriateness to their conditions, assist farmer groups and communities to mobilise local and external resources effectively, and ensure the effective participation of farmer groups and stakeholders in the processes of testing, dissemination, and monitoring and evaluation.

Acknowledgements

The authors are grateful to Peter Cooper and Chin Ong for reviewing earlier versions of this paper.

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