Adoption of planted forages by smallholder dairy farmers in coastal lowland Kenya

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Abstract

Smallholder dairy development in coastal lowland Kenya is mainly constrained by inadequate nutrition. Since the early 1960s, high quality forages have been introduced to improve feeding of dairy cattle in the region. A study was conducted to assess the contribution made by these forages to dairy cattle feeding and factors that influence their adoption. The study revealed that introduced forages contributed less than 40% and 25% of dairy cattle feeding during the rainy and dry seasons, respectively. Natural pasture grasses and broad-leaved weeds were the main feeds. However, farmers indicated that the natural forages were of poorer quality than the introduced ones. A major factor affecting adoption of the planted forages was the allocation of farm resources. Farmers gave preference to growing maize because it is the staple food crop in the region. Other factors farmers considered were: seasonal availability of natural forages; access to extension advice; availability of planting materials; profitability of farm enterprises; and availability and affordability of supplementary feeds.

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Introduction

Despite the large potential for dairy development in coastal lowland Kenya (Mullins 1992), milk production in the region is seriously hampered by poor nutrition of dairy cows (Muinga 1992). The feed resources available in the smallholder mixed farms are inadequate in quantity and quality and rarely meet the nutrient demands of a lactating cow (Reynolds *et al.* 1993). As sown grasses and legumes have potential to contribute significantly to improved feeding of dairy cows (McIntire *et al.* 1992), efforts were taken to identify suitable species and introduce them to farmers. In 1974, an FAO-supported project was initiated to evaluate forage species suitable for the region. Local and introduced collections were evaluated (CARS Annual Report 1974–1980). Napier grass (*Pennisetum purpureum*) was identified as a promising fodder grass and was bulked on government demonstration farms to provide planting material (CARS Annual Report 1979). The promising herbaceous legumes included *Centrosema pubescens* (centro), *Macroptilium atropurpureum* (siratro), *Stylosanthes guianensis* (stylo), *Macrotyloma axillare* (macrotyloma) and *Clitoria ternatea* (clitoria). Leucaena (*Leucaena leucocephala*) was identified as a suitable "multi-purpose tree" species for livestock feeding, soil conservation, supply of building material and wood fuel (Bashir and Getahun 1986).

The National Dairy Development Project (NDDP), initiated in 1980, promoted the zero-grazing dairy production system where animals are fed in confinement. The project recommended Napier grass for dairy cattle feeding and advised farmers to plant 0.4 ha of Napier grass per cow (Stotz 1983). In 1987, the project encouraged planting of fodder trees to bridge the protein gap identified in dairy production (Gelder 1988). Leucaena and *Gliricidia sepium* (gliricidia) were the main fodder trees recommended for the region. A collaborative dairy research project between Kenya Agricultural Research Institute (KARI) and the International Livestock Centre for Africa

(now International Livestock Research Institute), initiated in 1988 (Thorpe and Mureithi 1990), confirmed the good productivity of leucaena, Napier grass and clitoria in the region. Fodder production systems based on these forages were developed (Mureithi 1992; Mureithi and Thorpe 1996). Dairy cattle feeding strategies based on Napier grass as basal feed and leucaena as a protein supplement were also developed (Muinga 1992). The project undertook systematic efforts to introduce these forages to the farmers in 1992 and, by the end of 2 years, about 60% adoption rates were reported (Njunie *et al.* 1994).

However, during regular joint farm visits conducted by researchers and local dairy extension officers, it became evident that the introduced forages were not contributing significantly to the feeding of the dairy cows. The forages fed to the cows were predominantly composed of local grasses and broad-leaved weeds growing naturally, confirming earlier reports by Maarse *et al.* (1990) and Reynolds *et al.* (1993). This study was, therefore, conducted to assess the factors that influence adoption of forages in smallholder dairy farms. The specific objectives of the study were to assess contributions made by planted forages to dairy cattle feeding and to identify the major factors influencing their adoption and utilisation.

Methodology

The study was carried out in 4 locations in the Kilifi district: Tezo, Ngerenya, Gede and Ganda (Figure 1) by researchers of KARI's Regional Research Centre at Mtwapa and dairy extension officers of the Ministry of Agriculture, Livestock Development and Marketing. The study area covered 2 agro-ecological zones: coastal lowland 3 (CL 3) which receives an annual rainfall of about 1200 mm and has an average growing period of 165 days in the first rains; and coastal lowland 4 (CL 4) which receives an annual rainfall of about 1000 mm and has an average growing period of 145 days in the first rains (Jaetzold and Schmidt 1983). The Participatory Rural Appraisal (PRA) methods (PRA Handbook 1991) were used in the study. PRA exercises were held with 6 farmer groups (Table 1), each composed of some farmers receiving specialised dairy extension advice from the NDDP and others receiving advice from general livestock extension officers. Farmers with a history of adopting forages were interviewed as key informants. Issues discussed with farmers during the exercise included the following:

- Forage technologies
  - — forages introduced
  - — management package
  - — utilisation and management
- Extension advice
- Institutions promoting multi-purpose forages, *e.g.* for
  - — soil conservation, mulching
  - — agroforestry/alley farming
  - — hedges for fence
  - — fuel wood etc.
- Land ownership/rights
- Land size, soil types
- Allocation of land among farm enterprises
- Capital availability, *e.g.* for
  - — dairy cattle sheds, houses, zero grazing units
  - — fencing to protect planted forages
- Farm enterprises and perceived uses and profitability
- Labour availability, seasonal labour demand, profile
  - — allocation among various farm enterprises/activities
- Dairy cattle production systems
- Seasonal feeds availability

The PRA exercises were carried out in 3 days (Table 1). Two teams of facilitators were involved in the exercises and each held discussions with one farmer group and later interviewed a key informant. After the PRA exercises, a feedback session was organised where summarised results of the PRA exercises were presented to farmers. During the feedback session, issues that were not clear were probed. The PRA tools used in the PRA exercises included: semi-structured interviews; key informant interviews; historical profiles; seasonal calendars (rainfall, feeds, labour, etc.) and scoring and ranking methods.

Results

The forages introduced

Forages introduced were mainly for feeding dairy cattle (Table 2). Napier grass was introduced as a high quality basal feed while the legumes were introduced as protein supplements. Although centro and siratro were introduced first in 1978,

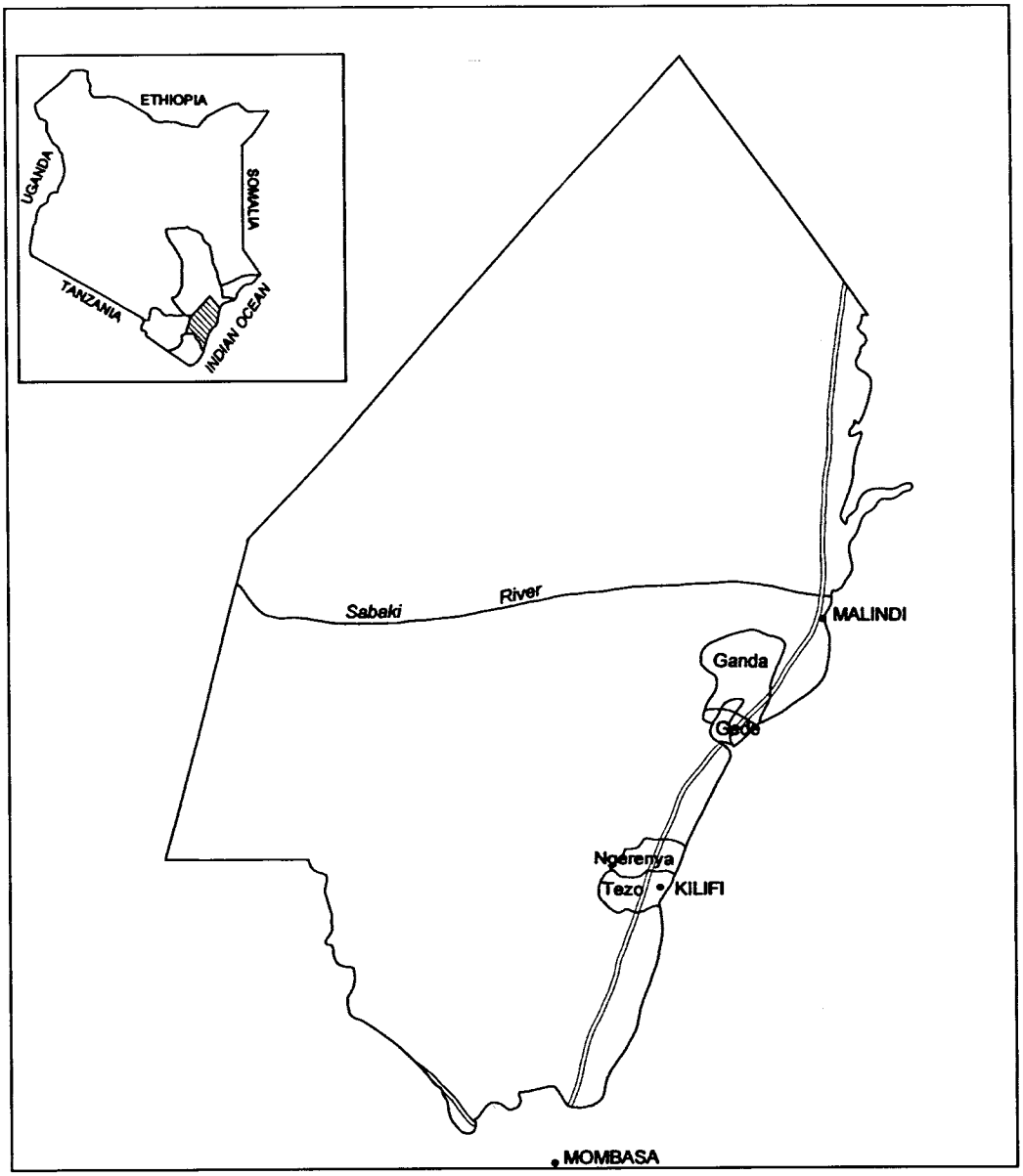

Figure 1. Location of study sites, Kilifi District, Coast Province, Kenya.

they were not familiar to most farmers. Some centrosema plants had persisted in a few farms and one farmer brought their pods and leaves for others to see. Farmers were more familiar with clitoria but most had not planted a big area due to the problem of seed availability. The only source of clitoria seed was the Research Centre and farmers had been given small amounts to multiply and expand their plots. Leucaena was the main fodder tree used in the region. It was planted along plot boundaries as hedges, intercropped with Napier grass or in pure stands. Farmers said that it was very palatable and reported increased milk yields when fed as a supplementary feed to grass forages. Gliricidia was not popular among farmers because its forage was less acceptable to dairy cattle and its wood was of poorer quality.

Table 1. Details of sites selected for the PRA exercises, farmer groups and key informants interviewed.

Date	Site	AEZ[1]	Farm venue[2]	Farmer group			Key informant
				Men	Women	Total	
Team 1 — Tezo Roka							
21.3.95	Tezo Kwa Chokwe	CL3	Elen Gibson	4	3	7	Mwango Rajab
22.3.95	—	CL3	Lazaro Chilumo	8	4	12	Shalumani
23.3.95	Ngerenya	CL3/CL4	Grace Lugho	3	3	6	Mugumu Farm
Team 2 — Malindi							
21.3.95	Gede	CL3	Johnstone Kalume	7	0	7	Prof. Said
22.3.95	Mbaraka Chembe	CL4	Elijah Sayo	35	12	47	Seif Said
23.3.95	Kakuyuni	CL4	Charo Bikanga	11	5	16	Samuel Tzandzi

[1]Agro-ecological Zone.
[2]Owners of the farms where PRA exercises were held.

Table 2. Forages introduced in lowland coastal Kenya.

Forage species	When introduced	By whom
Pennisetum purpureum	• Early 1960s	Ministry of Agriculture
	• 1978–79	Ministry of Lands and Settlement
	• 1979–80	KARI[1]-Mtwapa and Ministry of Livestock Development
	• 1981	NDDP[2]
Centrosema pubescens	• 1978–79	Ministry of Lands and Settlement
Macroptilium atropurpureum	• 1978–79	Ministry of Lands and Settlement
	• 1990	NDDP, KARI/ILCA[3] Dairy Project
Leucaena leucocephala	• 1983–84	Mtwapa Agroforestry Centre
	• 1987–88	NDDP
	• 1990 and 1992	NDDP, KARI/ILCA Dairy Project
Gliricidia sepium	• 1987–88	NDDP
Clitoria ternatea	• 1990 and 1992	NDDP, KARI/ILCA Dairy Project

[1]Kenya Agricultural Research Institute.
[2]National Dairy Development Project.
[3]International Livestock Centre for Africa.

Contribution made by planted forages to feeding dairy cows

The major forages available for feeding during the rainy and dry seasons were listed (Table 3). Farmers scored their contribution to feeding and the percentage contribution was calculated. The main planted forages grown by farmers were Napier grass, leucaena and clitoria. Although maize bran is not a forage, it was included in the list because it was an important feed resource available and used locally.

The combined contribution of Napier grass and leucaena in CL 3 was 32% and 14% during the rainy and dry seasons, respectively. In CL 4, the contribution was 22.5% and 10% in the 2 seasons, respectively. Local forages generally contributed more than 60% during the wet season and more than 75% during the dry season. The feeding of local maize bran increased during the dry season in CL 3, while it was fed at the same level in both seasons in CL 4. It was evident from these results that planted forages made a significant contribution (more than 25%) to feeding only during the wet season, and even then only in the CL 3 agro-ecological zone.

Factors likely to affect adoption of planted forage

Land ownership/rights. Land in the study areas has been demarcated and adjudicated and most

Table 3. Percentage contribution of planted and local forages to feeding of dairy cows in two agro-ecological zones (CL 3 and CL 4).

Type of forages/feed		Season and agro-ecological zone			
		Rainy season		Dry season	
Common name	Botanical name	CL 3 Gede	CL 4 Kakuyuni	CL 3 Gede	CL 4 Kakuyuni
Local panicum grass (ondo)	*Panicum maximum*	32	20	18	17.5
Napier grass	*Pennisetum purpureum*	20	12.5	6	2.5
Double thorned weed (Kimbiri)	*Oxygonium sinuatum*	16	—	14	—
Leucaena	*Leucaena leucocephala*	12	5	8	5
Local maize bran (Wishwa)[1]	—	10	15	14	15
Wandering Jew (Dzadaza)	*Comelina benghalensis*	6	20	18	17.5
Star grass (Ukoka)	*Cynodon plectostaychus*	4	20	14	35
Mdele Mwaka		0	2.5	8	5
Clitoria	*Clitoria ternatea*	—	5	—	2.5
Total		100	100	100	100

[1]Not a forage but an important feed resource in the region. It is available after local grinding and sifting of maize.

farmers have been issued with title deeds. Farmers could rent or borrow land for planting forages but fodder trees could not be planted in these lands because of the permanent nature of trees. In the local Mijikenda society, male children could be allocated land for cultivation but they could not inherit land until their father died. In Muslim society, land could be inherited when the father was still alive and both male and female children were eligible for the inheritance. Since the majority of the dairy farmers in the area legally owned land, issues of land ownership did not appear important in the adoption of forages.

Land size. The land size was quite variable. In settlement scheme areas *e.g.* Gede and Ngerenya, farms were about 5 ha, whereas in the old (ancestral) settlement areas, farm sizes averaged 3 ha. Farmers indicated that they had enough land to plant forages. The average herd size was about 3 animals and given the recommendations of 0.4 ha of Napier grass per cow, farmers potentially had enough land for planting the fodder.

Allocation of land among different cropping activities. The main factors farmers considered before allocating land to specific crops were soil fertility and the distance from the homestead. Dominant in the study area are free-draining sandy soils that are generally low in plant nutrients, particularly nitrogen and organic matter. The land is generally flat. Maize and horticultural crops (mainly tomato) are always planted on the fertile part of the farm because maize is the main staple food crop and horticultural crops earn them cash. In CL 3, tree crops particularly coconut trees (cashewnut in CL 4) and fruit trees (mangoes and citrus) are planted all over the farms without any discernable pattern. Grain legumes, cowpea and green grams, are usually intercropped with maize. Some farmers own a second plot of land in an area called Ngamani that is dominated by fertile clay soils where they grow maize. Some farmers planted Napier grass near the homestead where the zero-grazing unit is located while others planted it anywhere on the farm. A few farmers preferred planting cassava near the homestead to minimise theft of cassava tubers that is common in the area.

Seasonal forage availability. As expected, seasonal forage availability followed the rainfall pattern of the area which is uni-modal with a peak in May (Figure 2). June to August is when forage is plentiful and a few farmers conserved some as silage. Acute shortages of forages are experienced from January to March and farmers have difficulties in feeding their animals. Forages commonly fed to dairy cows in both dry and wet seasons were natural pasture grasses and weeds (Table 3). Most farmers indicated that the availability of these forages on their farms was low but they could access the forages along roadsides and riverbeds. The farms of neighbours who did not keep cattle were also sources of natural forages. In the past, these neighbours allowed harvesting of the forages without payment, but some have started asking for payment, either in cash or kind (milk).

Labour allocation. The main source of labour was household members but hired labour was also available. Farmers developed a seasonal labour profile showing monthly labour demand (Figure 3). Early in the year, January–March,

labour was required to prepare fallow land for planting food crops (maize, cassava, cowpea) and Napier grass. Highest labour demand was in April and May when it was required for planting of the food crops and weeding. Harvesting began in August and land was prepared for a second maize crop in September. Farmers allocated labour first to growing food crops, particularly maize. Little labour was spent in the management of tree crops.

Labour demand for mixed farmers is high throughout the year but increases in the dry period when forage is scarce (Figure 2). Farmers practising zero-grazing walk for long distances in search of forage. Due to labour shortage, farmers were unable to manage Napier grass as recommended. Most planted less than the recommended 0.4 ha per cow and did not weed in time and few returned slurry to the Napier plots. As a result, productivity of Napier grass was low and some Napier stools died during the dry season.

Capital availability. Dairying is an expensive enterprise and requires capital for purchase of dairy cows, construction of cattle sheds, fencing etc. Because many farmers are resource poor, the main source of capital is credit. Discussions were held on the availability of credit to farmers and, surprisingly, they indicated that it was readily available from Kenya's Agricultural Finance Corporation (AFC) so long as one had a title deed to use as collateral. However, many farmers were not keen to apply for it because they did not want to risk their land being sold for defaulting. When

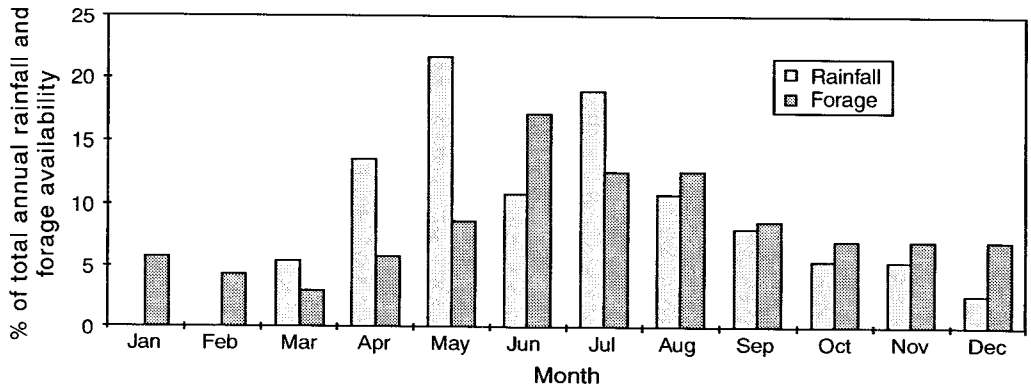

Figure 2. Relative monthly rainfall and forage availability.

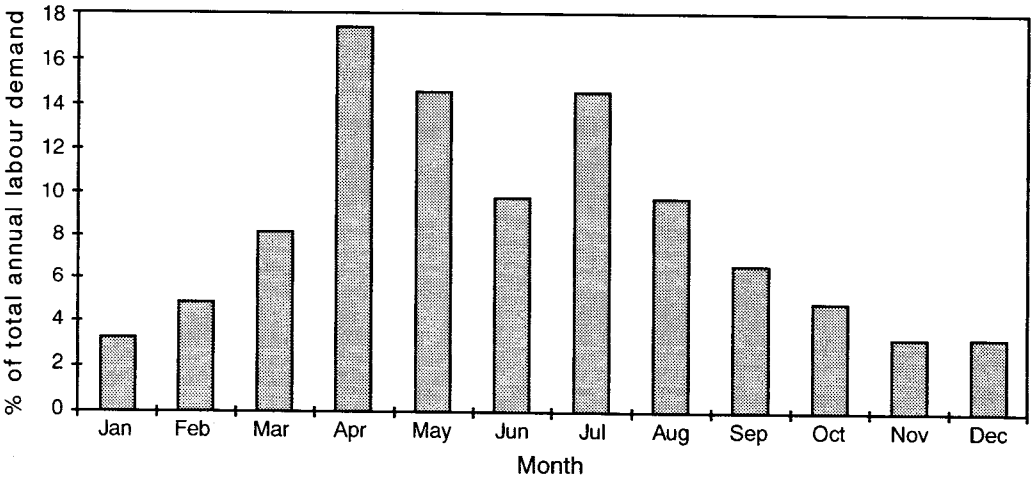

Figure 3. Relative monthly labour demand.

asked whether any land had been sold for non-payment they said none had been sold, but they were discouraged by the harsh letters normally sent to defaulters. Another problem cited was that, culturally, land belonged to all household members despite the title deed bearing the name of the head of the household. For the land to be used as collateral, all members have to agree, a condition which is difficult to satisfy in most cases.

Profitability of the different farm enterprises. Farmers developed an historical profile of the most important farm enterprises from the 1960s and ranked them according to their perceived profitability (Table 4). Maize, the main food crop, was among the first 3 most profitable enterprises since the 1960s. Coconut trees were also among the top 3 enterprises because virtually every product from the tree can be sold. Farmers who tapped coconut wine from the trees ranked them as the highest income earner. They explained that, during the peak season (dry season), a tree could yield as much as 8 litres of wine per day and, with a market price of about US$ 0.30 per litre, one tree could give a daily income of US$ 2.40. They further argued that, once the trees were established, the management required was low and few inputs were required. The land between trees was normally planted with food crops (maize, cassava and grain legumes) and the productivity of the trees was not affected. Cashewnut trees were ranked second in the first 2 decades (Table 4) but, from the 1980s onwards, they decreased in profitability and were ranked fifth. Farmers attributed this to poor prices of raw nuts and declining yields as the trees grew old and became susceptible to diseases. Dairying was ranked third because of the daily income earned from milk sales and income from sale of progeny. However, it was not practised by many farmers because of the high initial capital required to start and the continuous attention required to keep the animals alive and productive.

From the discussions, it was clear that farmers were aware of the profitability of the different enterprises and to some extent they were using profitability as a criterion in resource allocation. For example, maize, one of the first 3 most profitable enterprises, and the main staple food crop, is given first priority in allocation of labour and fertile land.

Extension advice. The way forage technologies were delivered to the farmers appeared to affect the adoption of the forages. For example, farmers attributed the poor adoption of Napier grass, introduced before the NDDP was initiated, to a lack of training and regular extension advice. They associated the popularity of Napier grass and its current level of adoption with the training and the sustained extension advice provided by the NDDP.

Table 4. Historical profile of the main farm enterprises and ranking of their profitability.

Enterprise	Periods		
	1960–1969	1970–1979	1980–1990s
Maize	1	3	2
Cashewnut trees	2	2	5
Coconut trees	3	1	1
Cassava	4	4	6
Fruit trees	5	6	4
Banana	6	5	7
Dairy	—	—	3
Tomato	—	7	8

Availability of other feeds. Farmers gave a list of other feeds they use, which included copra cake, cottonseed cake, commercial maize bran and maize germ. These feeds were available throughout the year from local urban markets but their use was limited by a shortage of cash. Availability of these feeds did not appear to have an influence on planted forages as they were used mainly as energy and protein supplements.

Availability of planting materials. This factor was not reported as important mainly because institutions involved in the introduction of forages also made the materials available in sufficient quantities (with the exception of clitoria). Napier bulking fields were established by the Ministry of Agriculture and Livestock and KARI. The Agroforestry Centre at Mtwapa produced seedlings of leuceana and gliricidia and initially supplied them free. Napier planting materials were also available from neighbours and rooted splits from existing/surviving Napier stools could be used to expand Napier plots or to replace dead stools.

Discussion

The forages mostly planted by farmers for dairy cattle feeding were Napier grass, clitoria and leucaena, *i.e.* those introduced by recent publicly-funded development projects. Farmers had

limited experience in feeding clitoria because they had not planted enough area, but the study by Njunie *et al.* (1994) of introducing legumes on-farm highlights the value of clitoria; 88% of farmers who fed clitoria forage to their dairy cows reported increased milk production. Since August 1992 when the leucaena psyllid arrived on the coast (Reynolds and Bimbuzi 1993), the productivity of leucaena trees has been severely reduced. Gliricidia was introduced as an alternative but farmers reported that it was less palatable. A similar observation was made at the Research Centre where it was shown that cattle require at least 3 days of continuous offer to get used to the forage (R.W. Muinga, unpublished data). Gliricidia is well suited to the region and is being recommended by extension officers and researchers in the region as an alternative to leucaena.

The contribution of these forages to feeding of dairy cows was quite low. Reynolds *et al.* (1993) made similar observations and reported that planted forages contributed only 15% of the available fodder in smallholder dairy farms. This was probably because dairy farmers gave less priority in allocation of resources to growing of the forages. For example, Napier grass was usually planted in the less fertile part of the farm and maize planted in the most fertile part. Instead of planting 0.4 ha of Napier grass per cow as recommended by NDDP, farmers planted less. A farm survey by NDDP (1994) in the region revealed that farmers planted an average of only 0.17 ha per cow. There was little labour for management of Napier grass. Napier plots were not weeded in time and most farmers were unable to return slurry to Napier plots. According to the NDDP survey, only 37% of farmers had their plots well weeded and 36% applied slurry to Napier grass. The low priority farmers gave in the allocation of resources to planted forages is not unique to coastal Kenya, but is a common phenomenon in Sub-Saharan Africa where competition for resources (land and labour) in smallholder farms favours food crops (McIntire *et al.* 1992).

Despite dairying being ranked the third most profitable enterprise since its introduction to smallholder farms in 1980, farmers were not giving it any special attention. This was not surprising because even the most profitable enterprises, coconut trees and maize, were not given any special attention to improve their yields. Most farmers did not use purchased inputs (certified seeds, fertilisers, pesticides etc.) or follow recommended agronomic practices to improve maize yields. As a result, farmers' maize yields average 1.2 t/ha for the crop planted at the onset of the main wet season (April–May) and about half that for the short rains crop (October–December) (Muturi 1981; Boxem *et al.* 1987). The coconut trees were not weeded or fertilised except incidentally when they were grown with food crops. Most coconut trees were old and there were no newly established ones to replace the old ones. It was apparent that growing coconut trees was considered as a 'low input high output' enterprise.

Extension advice appeared crucial in the adoption of forages. More farmers appear to have adopted forages, particularly Napier grass, after the initiation of the NDDP which extended a zero-grazing package that included the establishment and management of Napier grass. Initially, the project assisted farmers to secure credit from AFC. However, although the extension staff did a good job of extending the package to farmers, it appears they did not emphasise adequately the high workload involved and the inputs required to manage dairy cows and to maintain the Napier grass plot. As a result, many new dairy farmers started off very enthusiastically, but after a few years, their enthusiasm waned. This resulted in low production with which farmers appeared satisfied.

Summary and recommendations

This study has shown that sown forages popular among smallholder dairy farmers in coastal lowland Kenya were Napier grass, leucaena and clitoria but their contribution to feeding was low. Farmers depended more on natural pastures and broad-leaved weeds which contributed over 60% of dairy cattle feeding. Maize was given preference in the allocation of farm resources, labour and fertile land, because it was the main staple crop. Although extension advice was critical in the adoption of the planted forage, it appears that target clients for the forage technologies were not properly identified.

Two main recommendations resulted from this study:

- Since the local forages appear to be the main source of dairy feeds in the region, it is important to assess their seasonal availability and quality.

- As the extension advice influences the adoption of forage technologies, it is recommended that both researchers and extension officers re-examine the dissemination of forage technologies with a view to extending those forages that are compatible with specific agro-ecological zones, production systems and the levels of farmers' resources.

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