

Constraints to adoption of forage and browse legumes by smallholder dairy farmers in Zimbabwe

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Abstract

A survey was conducted to determine the level of adoption of forage and browse legumes and to identify the major constraints limiting their adoption in the smallholder dairy sector of Zimbabwe. Sixty households were selected using stratified random sampling from a sampling frame of 174 registered farmers in Nharira-Lancashire Dairy Scheme in Chikomba District of Zimbabwe.

The majority of households were aware (94.7 %) and 87.9 % adopted forage/browse legume technologies. Results showed that most of the farmers were full-adopters based on the type of species used (66.7 %) and area under forage (47.8 %) criteria. The most commonly adopted species were *Mucuna pruriens* (60.6 %) and *Leucaena leucocephala* (53.5 %). The size of household, land size and number of dairy cattle significantly affected adoption of forage/browse legume technologies. Lack of inputs, low yields and lack of persistence of legumes and lack of fencing material were identified as core factors limiting adoption of forage/browse legume technologies.

Stakeholders' support in smallholder dairying should continue to be extended to resource-poor farmers as well as to the more receptive targets with access to resources for investment. This should be executed through participatory approaches to achieve widespread and long-term benefits of adopting forage/browse legume technologies for sustainable smallholder dairy production in Zimbabwe.

Key words: Adoption, browse legumes, constraints, dairy, forage, smallholder farmers

Introduction

Forage and browse legumes play an important role in sustaining livelihoods of small- and medium-scale farmers in the tropics, mainly as a result of their contribution to economic and environmental sustainability (Peters and Lascano 2003). Legumes play a vital role in the improvement of tropical pastures, largely due to their ability to fix atmospheric nitrogen. Apart from the direct contribution to livestock production, particularly in intensive systems such as dairy, through the provision of protein-rich fodder, legumes can improve the productivity of rangelands by increasing the amount of nitrogen available for uptake by associated grasses (Giller 2001). Despite the overwhelming evidence of the suitability of several legume species for pasture improvement in Zimbabwe and many regions of the tropics, their potential for sustainable development is largely untapped and their adoption in particular has been limited (Mapiye et al 2006; Pengelly et al 2004; Kumwenda and Ngwira 2003). Major limitations to the adoption of forage legume based technologies include the scarcity and high cost of seed and inoculants; poor identification of entry points and target groups; difficulties associated with establishment and maintenance of legumes; limited exploitation of the multipurpose nature of many types of forage legumes; isolated efforts in feed and soil improvement; and often difficult socio-economic environments

(Mapiye et al 2006; Kumwenda and Ngwira 2003; Mupangwa 1994).

The smallholder dairy industry in Zimbabwe is facing viability problems since it was introduced in 1983 (Ngongoni et al 2006; Hanyani-Mlambo et al 1998; Dairy Marketing Board (DMB) 1992). The variability of quantity and quality of feed resources; particularly protein during the dry season is one of the main factors limiting smallholder dairy production in Zimbabwe (Francis and Sibanda 2001). The problems of the unavailability and high cost of nitrogen fertilisers and purchased protein concentrates for dairy livestock feeding in Zimbabwe have continued to rise due to inflation and recurrent droughts leading to a continued decline of the smallholder dairy industry. Smallholder dairy has the potential to increase milk production base of the country, improve household nutrition, and empower women and youth in income generation ventures. It can assist farmers to diversify, spread farming risks and create opportunity for idling forage and browse legume resources to enter the human food chain thereby utilising marginal farm resources (Ngongoni et al 2006).

Forage legumes offer a lower-cost alternative to nitrogen fertilisers and purchased protein supplements for improving dairy cattle feed resources in the tropics (Mapiye et al 2006). Therefore, the major challenge for improving smallholder dairy production in Zimbabwe is to gain long-term and widespread adoption of the more appropriate legume-based technologies by farmers. The objective of this study was to determine the level of adoption of forage and browse legumes and to identify the major constraints limiting their adoption in the smallholder dairy sector of Zimbabwe.

Materials and methods

Study site

The study was conducted at Nharira Lancashire Dairy Scheme in Chikomba District, in Mashonaland East Province of Zimbabwe. The district has an area of 340 000 ha with approximately 30 000 households and 65 small-scale commercial farms. The Scheme comprises of small-scale and communal farmers with 174 as registered members. It is located in agro-ecological zone III, characterised by low-medium rainfall (650-800 mm annually) and high temperatures (15-30 °C). The agro-ecological zone experiences severe mid-season dry spells making it marginal for enterprises based on crop production alone, and the maximum amount of rainfall is received between November-April. The area has characteristic patches of vleis, low hills and light textured sandy-loam soils derived from granitic soils. The farming systems are mainly based on livestock production and cultivation of drought resistant food and fodder crops. Dairy breeds used in the area include Red-Dane, Friesland, Jersey, Crossbreeds and Indigenous (Mashona). The most common crops grown in the area are maize, sunflower, groundnuts, finger millet and sorghum. The natural vegetation is of sparsely scattered trees [mainly *Brachystegia spiciformis*, (Msasa), *Julbernardia globiflora* (Munondo) and *Combretum molle* (Mupembere) species] and abundant tall tufted grasses such as *Heteropogon species* and *Hyparrhenia species*.

Sampling procedure

Sixty households were selected using stratified random sampling from a sampling frame of 174 registered farmers in the Scheme. The stratification was based on the type of farmer [small-scale (20 farmers) or communal (40 farmers)] and participation of the farmer [active (34 farmers) or non-active (26 farmers)]. An active participant was a farmer who supplied milk at Nharira Lancashire Dairy Scheme Milk Collection Centre every month throughout the year (January-December 2005).

Data collection

Structured questionnaires (pre-tested) through interviews were used for data collection. The data were collected in February 2006. The data collected included: socio-demographic characteristics (age, gender, household size, employment and educational background), landholding sizes (arable, grazing and fallow land, and yields of crops), livestock (types, numbers and uses) and adoption of forage legumes technologies. Levels of adoption were categorised based on hecterage under forage legumes [0-0.25 ha (non adopted), 0.26-1.0 ha (partly adopted) and >1 ha (fully adopted)], type of legumes used [None (non adopted), forage legumes for veld improvement plus improved grasses (partly adopted), ley legumes and browse legumes (fully adopted)] and feeding system (grazing, (non adopted) cut and carry (partly adopted) and conserved legume fodder (fully adopted)].

Data analysis

The data were analysed using the Statistical Package for Social Scientists (SPSS) 11.0 for Windows (SPSS 2001). Data analysis was carried out in two stages. The first stage involved the descriptive statistics and cross tabulation to get an indication of the relationship between the variables in the analysis. The second stage entailed the use of Cluster analysis to determine the farmer and farm characteristics associated with the adoption of different legume technologies.

Results and discussion

Socio-demographic characteristics

The overall mean age of the household heads was 49 (56.1 % of the households). This is comparable to reports by Mutisi et al (1994) and Ngongoni et al (2006) who recorded the overall mean age of 50 and 51 in Chinamhora communal area and eight dairy schemes in Zimbabwe, respectively. On average, each household had a size of 7 ± 3 (mean \pm standard deviation) members. Ngongoni et al (2006) reported a range of 8-12 members (with a mean of 9 ± 0.6 members/family). Family size has been asserted as the most important determinant of labour investment for family farms (Hanyani-Mlambo et al 1998). In this study, household size was considered important because in addition to being a source of labour, the size of the family may also influence the need for improving adoption of forage and browse legume technologies. Most of the households (65.8 %) were male-headed and 34.2 % were female-headed. The findings are similar to results obtained by Francis and Sibanda (2001), which showed that more than 60 % of the households in smallholder areas were male-headed and 40 % were female-headed.

All the households were literate, with the majority (93 %) having completed primary school education and 89.5 % having received some agricultural training. This is comparable to earlier studies by Francis and Sibanda (2001) and Ngongoni et al (2006), which showed that all the households were literate, with 54 % having completed primary school education. The majority of the farmers (80.6 %) cited farming as their full-time occupation. About 65 % of the households were communal farmers, while 35 % were small-scale farmers. Fifty-eight per cent of the farmers were non-active and 42 % were active.

Landholdings

There were differences in the size of landholding between the Nharira and Lancashire. The mean total land size for each household in Nharira was 6.5 ± 0.8 ha. This was more than the average national communal land size of 3.0 ha. However, this agrees with Hanyani-Mlambo et al (1998) and Ngongoni et al (2006) who recorded a range of 6-7 ha in Chikwaka, Guruve and Nharira communal areas. Rohrbach (1989) showed variation in land held in communal areas, Hurungwe (3.3-5.3 ha), Mangwende (2.1-3.8 ha) Bushu (1.3-2.4 ha) and Chibi (1.8-3.4). The average land size in Lancashire was 93.5 ha and this is comparable to results obtained in Lancashire (95.8 ha) by Ngongoni et al (2006).

Most of the households in Nharira cultivated 2-4 ha and grazing land size of 10 to 20 ha/household were recorded. The average land size for arable land in Lancashire was 8 ± 3 ha. The size of fallow land ranged from 0.1-4.5 ha. These figures are similar to those recorded by Francis and Sibanda (2001) and Ngongoni et al (2006), arable land (2-6 ha and 6-12 ha), grazing land (11-16 ha and > 15 ha) and fallow land (0.5-2.5 ha and 1.5-4.5 ha) for communal and small-scale areas, respectively.

Crops grown

The main crops cultivated by farmers in Nharira-Lancashire Dairy Scheme were maize (100 % of the households), groundnuts (68.4 %), sunflower (44.7 %), soybean (33.3 %), sugar bean (21.9 %), paprika (22.2 %), finger millet (20.2 %) and sorghum (15.8 %). The average area put under major crops was as follows: maize, 4 ± 3.5 ha; groundnuts, 1 ± 0.8 ha; finger millet, 1 ± 0.7 ha; sunflower, 0.9 ± 0.6 ha; sorghum, 0.9 ± 0.4 ha; soybean, 0.6 ± 0.3 ha and roundnuts, 0.3 ± 0.1 ha. These crops were mainly used as sources of cash, livestock feed and/or human food by most households. In support of these findings Ngongoni et al (2006) recorded maize, groundnuts and sunflower as major crops grown in most dairy schemes in Zimbabwe, and stated that maize and groundnuts were grown for cash and home consumption, while sunflower was grown specifically as a cash crop.

Forage and browse legumes grown

About 47 % of the households in Lancashire grew an average of 1 ± 0.6 ha of fodder whilst 58 % of the households grew between 0.1-0.5 ha of fodder in Nharira. This might indicate that land to grow fodder for dairy cattle is insufficient, since food and cash crops are granted first priority of the available land. According to Ngongoni et al (2006), about 14 % of the households in the small-scale commercial dairy schemes grew more than one hectare of fodder and over 63 % of the households in the communal areas grew between 0.2-0.4 ha of fodder.

Most (94 %) of the households in Nharira-Lancashire grew forage and browse legumes. Forage and browse legumes such as *Mucuna pruriens*, *Lablab purpureus*, *Vigna unguiculata*, *Macroptilium atropurpureum*, *Stylosathes guianensis*, *Leucaena leucocephala*, *Acacia spp.*, *Calliandra calothyrsus*, *Cajanus cajan* and *Sesbania sesban* were established for purposes of dairy cattle feeding by about 80 % of the households in Nharira-Lancashire dairy scheme. The most common cultivated grasses were *Pennisetum spp.* (45 % of the households) and *Cynodon nlemfuensis* (10 %). This outcome is comparable to studies done on eight dairy schemes in Zimbabwe, which showed that the majority of the households grew fodder, though on small areas and the most common cultivated species were *Macroptilium atropurpureum*, *S. guianensis*, *Pennisetum spp.*, and *Cynodon nlemfuensis* (Ngongoni et al 2006; Hanyani-Mlambo et al 1998).

Livestock ownership

Ninety-three per cent of the households owned dairy breeds of cattle and 94.7 % owned indigenous breeds with average herd sizes of 6 ± 5 and 12 ± 11 , respectively. Similar results were reported in Lancashire, where 43 % of the households kept six or more dairy cattle (Ngongoni et al 2006; Hanyani-Mlambo et al 1998). About 83 % of those who kept dairy cattle used them for milk production for both home consumption and for sale. Indigenous breeds were mainly used for draught power and as a source of income (94 % of the households). Ninety-one per cent of the households owned chickens, 54.4 % goats, 6 % sheep and 2.6 % donkeys. On average, each household had a flock size of 24 ± 24 with a range of 1 to 130 chickens. The mean flock/herd sizes for goats, sheep and donkeys were 5 ± 2 , 7 ± 1 , 6.9 ± 0.3 , respectively. Chickens, goats and sheep were mainly kept for home consumption and as a source of income, whilst donkeys were solely kept for draught power purposes. Ngongoni et al (2006) obtained similar findings where indigenous and dairy breeds of cattle and chickens were the dominant

livestock in the smallholder sector, while small number of goats, sheep and donkeys were present.

Ownership of implements

All the farmers owned at least one plough and one wheelbarrow. The other important implements owned by farmers were scotch cart (97.0 %), cultivator (94.7 %), harrow (44.7 %), ridger (31.6 %), engine pump (4.4 %) and a grinding mill (4.4 %).

Level of adoption of forage/browse legume technologies

The majority of the farmers (94.7 %) were aware of forage and browse legumes technologies. About 54 % of the farmers obtained information on forage and browse legumes from Agricultural Research and Extension (AREX) officers. Other sources of information were Agricultural Rural Development Authority (ARDA) (10 %), Nharira-Lancashire Dairy Association (8 %), Universities (7 %), International Centre for Agro-forestry Research (ICRAF) (5%) and a combination of one or more of these sources with AREX (25.6 %). About 87.9 % of the households were adopters whilst 12.1 % were non-adopters. Researchers attributed this to excellent information dissemination by AREX officers and other stakeholders. It can also be ascribed to farmers' participation in legumes research conducted by various stakeholders in the area over the past fifteen years. These researchers and extension specialists placed emphasis on on-farm research and farmer-to-farmer extension to provide evidence to farmers of the economic benefits and costs of legume forages (Ngongoni et al 2006; Hanyani-Mlambo et al 1998). In order to ensure sustainable dairy farming, potentially effective technologies and management strategies were promoted through participatory action research (PAR) involving farmers, researchers and extension workers (Francis and Sibanda 2001; Hanyani-Mlambo et al 1998). Among the adopters 51.5 % were communal farmers and 48.5 % were small-scale farmers. All the non-adopters were communal farmers. Male-headed households (64.6 %) adopted more than female-headed households (35.4 %).

The majority of the farmers were full-adopters based on the following criteria; hecterage under forage (47.8 % of the households) and type of species used (66.7 %) (Table 1).

Table 1. Adoption level of forage/browse legume technologies by smallholder farmers in Nharira-Lancashire Dairy Scheme

Adoption criteria	Adoption level		
	Not adopted	Partly adopted	Fully adopted
Area under forage/browse, ha	11.5	40.7	47.8
Type of species used	4.6	28.7	66.7
Feeding system	16.5	62.4	21.1

This might indicate that farmers in Nharira-Lancashire recognized the short-medium term financial benefits of using forage/browse legumes. Forage and browse legumes have high protein content that promotes live weight and milk yield increase in dairy cows, and consequently lead to high profits (Hanyani-Mlambo et al 1998). Most of the farmers (62.4 %) were partly adopters based on feeding system criterion (Table 1). This can be attributed to lack of appropriate machinery to conserve fodder and lack of knowledge on fodder conservation. These findings support Hanyani-Mlambo et al (1998) who observed that where fodder production has been attempted or is in progress, the situation is characterized by a great disparity between the herd size and fodder base and, in all cases, fodder banks were never enough to feed dairy animals throughout the dry season.

Table 2 shows the proportion of households that adopted a particular forage/browse species. These

results indicate that farmers adopted high yielding ley and browse species as opposed to findings by Francis and Sibanda (2001) where most farmers used low-medium yielding legume species, mainly suitable for rangeland improvement.

Table 2. Proportion of farmers (%) who adopted legume species in Nharira-Lancashire Dairy Scheme

Species	Proportion, %
<i>Acaccia spp.</i>	17.5
<i>Calliandra calothyrsus</i>	18.4
<i>Lablab purpureus</i>	7.9
<i>Leucaena leucocephala</i>	53.5
<i>Macroptilium atropurpureum</i>	23.7
<i>Mucuna pruriens</i>	60.6
<i>Sesbania sesban</i>	2.6
<i>Stylosathes guianensis</i>	11.4
<i>Vigna unguiculata</i>	12.1

Table 3 shows factors associated with adoption of forage/browse technologies. The factors that significantly affected adoption of forage and browse legumes in Nharira-Lancashire Dairy Scheme included the type of farmer, level of participation, size of household, total land size and number of dairy cattle ($P < 0.05$). Full adopters had large family sizes, owned large pieces of land and large herds of dairy cattle ($P < 0.05$).

Table 3. K-Means Cluster Analysis for factors associated with adoption of forage and browse legume technologies at Nharira-Lancashire Dairy Scheme

Factor	Cluster		
	1	2	3
Area under forages	Fully adopted	Fully adopted	Partly adopted
Type of forage used	Partly adopted	Fully adopted	Partly adopted
Feeding system	Partly adopted	Fully adopted	Partly adopted
Farmer participation	Not active	Active	Active
Type of the farmer	Small-scale	Communal	Communal
Gender	Male	Female	Male
Age of household head	40-55 years	>55 years	40-55 years
Agricultural training	Master farmer	Master farmer	Diploma
Education level	Secondary	Secondary	Diploma
Size of household	7 people	15 people	6 people
Total land size	101.06 ha	370.0 ha	5.93 ha
Number of dairy cattle	7	24	5
Number of beef cattle	12	35	11

Adoption constraints

The major constraints to adoption of forage and browse legumes were shortage of inputs (27.2 % of the households), low yield and lack of persistence of legumes (24.0 %) and lack of fencing material (18.6 %). Other constraints mentioned were lack of capital (10.0 %), lack of knowledge (7.1 %), shortage of labour (5.7 %), shortage of land (4.3 %) and 2.9 % of the households had no constraints. The constraints mentioned above affected communal and small-scale farmers' differently. The majority of communal farmers mentioned labour (100 % of the households), inputs (95.5 %), lack of fencing material (91.5 %), drought (87 %) lack of capital (84.7 %) and land (66.7 %) as their main problems. About 80 % of the households that indicated knowledge as a constraint were small-scale farmers. Comparable to findings of this study, several studies (Mapiye et al 2006; Kabirizi et al 2004; Gerrits 2000) cited high cost of resources, low yield and lack of persistence of legumes, lack of capital, land shortage and shortage of labour as major constraints to adoption of forage legumes. Constraints on any of the factors of production: land, labour and capital can inhibit uptake of forage technologies (Kabirizi et al 2004). Such constraints are severe among the resource-poor smallholder dairy cattle farmers (Kumwenda and Ngwira 2003) for whom forage legume technologies are most needed.

Table 4 shows constraints [number of households (%)] associated with different levels of adoption. In terms of hecterage under forage and type of legume species used; full adopters were the most affected by shortage of inputs, capital, land and labour, whilst lack of fencing material, drought and knowledge affected both part- and full-adopters. Shortage of inputs, fencing material, lack of knowledge, shortage of land and labour, and drought mostly affected partly-adopters under feeding system criterion.

Table 4. Percentage households for constraints associated with different levels of adoption

Constraint	Adoption criteria								
	Area under forage			Type of forage used			Feeding method		
	None	Partly	Fully	None	Partly	Fully	None	Partly	Fully
Inputs	0.0	31.3	68.8	0.0	15.4	84.6	18.8	68.8	12.5
Drought	13.3	40.0	46.7	18.2	36.4	45.4	20.0	53.3	26.7
Fencing	8.3	50.0	41.7	9.1	18.2	72.8	7.7	69.2	23.2
Capital	0.0	42.9	57.1	25.0	25.0	50.0	57.1	42.9	0.0
Land	0.0	33.3	66.7	0.0	66.7	33.3	0.0	100	0.0
Knowledge	0.0	60.0	40.0	25.0	25.0	50.0	20.0	60.0	20.0
Labour	25.0	25.0	50.0	0.0	0.0	100	0.0	75.0	25.0
No constraint	50.0	0.0	50.0	0.0	50.0	50.0	0.0	100	0.0

Lack of inputs

The key inputs limiting adoption were shortage of planting material, inoculants, implements, fertilisers and chemicals. In agreement to results of this survey, Mapiye et al (2006) and Mupangwa (1994) asserted that adoption of legumes in Zimbabwe is hampered by high cost and low availability of seed for the recommended varieties. Farmers rarely collect or use seeds from their own farms or from their neighbours, as they still expect the forage/tree seedlings or seeds from projects, government and non-governmental organisations (Franzel et al 1999). Efforts should be made to overcome this constraint by training farmers and farmer groups on seed collection and propagation, and encouraging them to produce and use their own seeds. Developing local-level seed supply systems or encourage farmers, either in groups or as individuals to establish seed multiplication plots/orchards can be a lower-cost option for improving the availability of seed to smallholder farmers (Hove et al 2003). This can enable farmers to produce seed commercially to meet their requirements as well as that of external markets. To this end forage legume seed production and distribution networks have to be established with a system for the production and extension of rhizobial inoculants (Mapiye et al 2006).

Low yields and lack of persistence of legumes

Low yields and lack of persistence was mentioned as one of the factors limiting adoption of forage legumes in this study. This was mainly attributed to low rainfall especially during the dry season. Poor agronomic performance was reported as a constraint for adoption of some browse species in Chikwaka communal area (Hove et al 2003). In Uganda, Kabirizi et al (2004) indicated that forage legumes were not the best option for solving dry season feeding because of the low yield and lack of persistence during the dry season. Persistence is an important attribute of forage legumes that determines their use as permanent pastures. Climate, management, pests and their interrelations in a given environment influence persistence (Mapiye et al 2006).

Persistence of forage and browse legumes can be improved by use of careful grazing management and moderated fertiliser inputs (Lungu et al 1997). High yields can be achieved by planting forage/browse species in the early growing season or by use of short-season or drought tolerant varieties. Cutting and conserving excess forage/browse material during the peak-growing season for utilisation in the dry season can be another coping mechanism to increase feed supply during periods of scarcity. Where farmers can afford, or have access to credit they are encouraged to acquire irrigation equipment so that they can supply water to their forage/browse species during periods of water stress to improve their yields. Some farmers mentioned prevalence of termites as a problem during the early establishment phase of browse species and an integrated approach using a combination of different methods to control pests (termites) is recommended.

Lack of fencing material

Similar to output of this research, Hove et al (2003) reported damage of forage/browse seedlings/plants by free grazing livestock as a constraint in Chikwaka dairy scheme in Zimbabwe. Fencing leguminous pastures is essential to prevent trespassing and uncontrolled grazing. Farmers used barbed wire to protect their fodder plots/orchards but this did not prevent goats from gaining access. While live fences may play a role, farmers suggested that local leaders should review the by-laws governing the movement of livestock during the dry season, when most of the uncontrolled browsing occurs (Hove et al 2003). Fencing is costly and can act as a key deterrent to the adoption of the technology in terms of capital outlay (Tarawali and Ikwuegbu 1993). Therefore, farmer organizations, government and other stakeholders are recommended to provide credit to smallholder dairy farmers to meet fencing costs.

Lack of capital

The majority of the farmers could not afford to raise enough capital to purchase the required inputs (such as planting material, fence, machinery, implements, fertiliser, chemicals, etc.) and later meet the labour costs required to manage the forages. Mureithi and Thorpe (1993) reported that capital availability was a major factor affecting adoption of improved forages in Kenya. Access to credit for purchasing inputs plays a crucial role in the development and adoption of new technologies and improved feed resources especially in low-income households (Kabirizi et al 2004) such as those found in Nharira-Lancashire. The main source of capital would be credit (obtainable from the Agricultural Finance Corporation, Agri-bank, commercial banks, local savings clubs and other stakeholders in Zimbabwe) but many farmers are not keen to apply for it because they either lack collateral or do not want to risk their assets (cattle, land, etc.) being sold for defaulting (Hanyani-Mlambo et al 1998; Mureithi and Thorpe 1993). Therefore, there is also need to redefine the target group from all resource poor farmers many of whom are usually risk-averse, own small pieces of land and have little cash reserves for new initiatives, to the more receptive targets in the group, who have access to resources for investment and are able to take risks (Pengelly et al 2004).

Lack of knowledge

Lack of knowledge was amongst constraints acknowledged by smallholder dairy farmers in Nharira-Lancashire. After forage/browse legumes are given to farmers they do not know what is best to do with them or how to use them efficiently. Smallholder farmers lack knowledge on suitable cultivars for their area, establishment, management, conservation and utilisation of forage/browse legumes (Mupangwa 1994). Establishment of effective training-research-extension-farmer and stakeholder linkages can alleviate this constraint. Marketing and promotion of legume-based technologies through the print and electronic media can also be useful. Field days, competitions, on-farm research, demonstrations, educational tours and training workshops can improve knowledge of farmers on legume-based technologies. Expansion of agricultural shows to Ward level or rotation of venues at District level may go a long way in improving the awareness and adoption of legume pasture technologies (Mapiye et al 2006).

Shortage of labour

Labour shortages also play a role in whether farmers adopt forages or not, and household size was shown to influence adoption of forage/browse legumes in this study. The times when labour is required for forages/browses, it is often already occupied by other crop activities. Hence, labour constraints may continue to be a factor influencing adoption of improved forages. Farmers rely on hired labour for farm operations such as weeding and fodder conservation while family labour is used for land preparation, planting and harvesting (Francis and Sibanda 2001). Researchers and development workers are challenged to introduce labour-saving husbandry practices in legume-based technologies. For instance, the under-sowing method of establishing leguminous pastures in cropped areas is a much less labour-demanding approach as the legume will benefit from land preparation and the fertiliser originally meant for the crop. Also, ridging post-leguminous soils has been found to be easier because of the lower bulk density than after a natural fallow. Weeding crops once at the most critical stage (first 30 days) as opposed to twice has been recommended in forage legume-based cropping systems. Finally, in managing leguminous pastures for higher productivity, beneficiaries are advised to control fast-growing grasses by grazing instead of applying expensive and labour-demanding herbicides or employing manual weed control (Tarawali and Ikwuegbu 1993).

Non-availability of land

Land shortage was identified as one of the factors affecting adoption of forage/browse legumes in Nharira-Lancashire. This can be attributed to the fact that forage/browse legume production competes with food crop production and farmers may not want to take land away from food production for other uses. Accordingly, forage/browse legumes compete with crop residues, which can be grazed at low labour input (Anderson 1985). Use of one of the intercropping techniques or using fallow areas would not affect the cereal crops. On the other hand intensification of crop production, such as use of modern soil fertility management techniques, encourages adoption. This implies that the development and use by farmers of high yielding crop varieties and intensive crop management practices can significantly enhance adoption of forage/browse legumes by releasing land for forage production (Gebremedhin et al 2003). Land tenure is another constraint to farmers wanting to adopt long-term technologies for pasture and livestock improvement in Zimbabwe (Mapiye et al 2006) and this warrants further investigation.

Conclusions and recommendations

- The majority of households were aware (94.7 %) and 87.9 % adopted forage/browse legume

technologies in Nharira-Lancashire, Zimbabwe.

- Most of the farmers were full-adopters based on the type of species used (66.7 %) and area under forage (47.8 %) criteria.
- The most commonly adopted species were high yielding ley and browse species such as *Mucuna pruriens* (60.6 %) and *Leucaena leucocephala* (53.5 %).
- However, basing on feeding system most farmers (62.4 %) were partly adopters.
- The type of farmer, level of participation, size of household, total land size and number of dairy cattle significantly affected adoption of forage/browse legume technologies. Lack of inputs, low yields and lack of persistence of legumes and lack of fencing material were identified as core factors limiting adoption of forage/browse legume technologies in Nharira-Lancashire smallholder dairy scheme.
- Since the application of forage and browse legume technologies is the key to intensification and increase to output of smallholder dairy cattle production systems, government and other stakeholders support in smallholder dairying should continue to be extended to resource poor farmers as well as to the more receptive targets with access to resources for investment. This should be executed through participatory approaches to achieve widespread and long-term benefits of adopting forage/browse legume technologies for sustainable smallholder dairy production in Zimbabwe.
- Research efforts should also be directed towards promoting adoption of improved grasses and homegrown feed technologies as they also play an important role in smallholder dairy production systems.

Acknowledgements

The authors are grateful to Grasslands Research Station in Marondera for financially supporting this research.

References

- Anderson F M 1985** Farmer Circumstances in Ethiopia and the Improvement of Animal Feed Resources. Paper presented at the PANESA Workshop on Animal Feed Resources for Small-Scale Livestock Producers, Nairobi, Kenya, November 11-15, 1985.
- Dairy Marketing Board (DMB) 1992** Annual Report 1992.
- Francis J and Sibanda S 2001** Participatory action research experiences in smallholder dairy farming in Zimbabwe: Livestock Research for Rural Development. 13 (3): 1-6: <http://www.cipav.org.co/lrrd/lrrd13/3/fran133.htm>
- Franzel S, Wambugu C, Tuwe P and Karanja J 2003** Adoption and scaling up of the use of fodder shrubs in central Kenya. Tropical grasslands 37: 239-250.
- Gebremedhin B, Amhed M M and Ehui S K 2003** Determinants of adoption of improved forage technologies in crop-livestock systems: evidence from highlands of Ethiopia. Tropical grasslands 37: 262-273.
- Gerrits A 2000** Dissemination of fodder materials in the Central Highlands of Kenya. In: Calliandra calothyrsus and other fodder trees: Moving forward in research and development. Oxford Forestry Institute, Oxford, UK and ICRAF (International Centre for Research in Agro-forestry), Nairobi, Kenya. pp. 12-14.

- Giller K E 2001** Nitrogen fixation in the Tropical Systems. 2nd Edition CABI: Wallingford, UK. pp. 150-300.
- Hanyani-Mlambo B T, Sibanda S and Østergaard V 1998** Socio-economic aspects of smallholder dairying in Zimbabwe. *Livestock Research for Rural Development*. 10 (2): 1-20: <http://www.cipav.org.co/lrrd/lrrd10/2/zimb102.htm>
- Hove L, Franzel S and Moyo P S 2003** Farmer experiences in the production and utilisation of fodder trees in Zimbabwe: constraints and opportunities for increased adoption. *Tropical Grasslands* 37: 279-283.
- Kabirizi J, Mpairwe D and Mutetikka D 2004** Testing forage legume technologies with smallholder dairy farmers: a case study of Masaka district, Uganda. *Uganda Journal of Agricultural Sciences* 9: 914-921.
- Kumwenda M and Ngwira A 2003** Forage demand and constraints to adoption by livestock keepers in Malawi. *Tropical grasslands* 37: 274-278.
- Lungu L, Matizha W and Gasha S 1997** Legume persistence and productivity of legume reinforced range on the high altitude sand veld of Zimbabwe under continuous grazing applied in wet season. *Journal of Zimbabwe Society for Animal Production* 8: 131-136.
- Mapiye C, Mupangwa J F, Mugabe P H, Chikumba N, Poshiwa X and Foti R 2006** A review of forage legumes research for rangeland improvement in Zimbabwe. *Tropical Grasslands* 40 in press.
- Mupangwa J F 1994** Fodder production in small-scale and communal sectors of Zimbabwe. In: Mutisi C, Madsen J, Hvelplund T and Gomez M (eds) *Proceedings of the Workshop on Integrated Livestock/Crop Production in the Small-Scale and Communal Farming Systems in Zimbabwe*. Held at Faculty of Agriculture Hall, University of Zimbabwe. 26-28 January 1994.
- Mureithi J G and Thorpe W 1993** The effects of herbaceous legume intercropping and mulching on the productivity of Napier grass (*Pennisetum purpureum*) and total forage yield in coastal lowland Kenya. In: Ndikumana J and de Leeuw P. *Sustainable feed production and utilization for smallholder livestock enterprises in Sub-Saharan Africa*. Feed Resources Network (AFRNET), Harare, Zimbabwe, 6-19 December 1993. AFRNET (African Feed Resources Network), Nairobi, Kenya.
- Mutisi C, Nyamangara M, Madsen J, Hvelplund T and Gomez M 1994** A study of crop-livestock system in Chinamhora communal area with emphasis on cattle nutrition. In: Mutisi C, Madsen J, Hvelplund T and Gomez M. (editors). *Proceedings of the workshop on integrated livestock/crop production in the small-scale and communal farming systems in Zimbabwe*. University of Zimbabwe. 26-28 January 1994. pp 148-161.
- Ngongoni N, T Mapiye C, Mwale M and Mupeta B 2006** Factors affecting milk production in the smallholder dairy sector in Zimbabwe. *Livestock Research for Rural Development*. Volume 18. Retrieved July 28, 2006, from <http://www.cipav.org.co/lrrd/lrrd18/5/ngon18072.htm>
- Pengelly B C, Whitbread A, Mazaiwana P R and Mukombe N 2004** Tropical Research for Future-Better Use of Research Resources to Deliver Adoption and Benefits to Farmers. *Tropical grasslands* 37: 207-216.
- Peters M and Lascano C E 2003** Forage technology adoption: linking on-station research with participatory methods. *Tropical grasslands* 37:197-203.
- Rohrbach D D 1989** The economics of smallholder maize production in Zimbabwe: implications for food security, Michigan State University (MSU) International development paper number 11 (East Lansing), Department of agricultural economics, MSU, U.S.A.
- Statistical Package for Social Scientists (SPSS) 11.0 for Windows 2001** SPSS AnswerNet. Retrieved from the World Wide Web from <http://www.spss.com/tech/answer/>.
- Tarawali G and Ikwuegbu O A 1993** The potential of forage legumes in soil management for sustainable livestock and crop production in the subhumid zone of central Nigeria. *Proceedings of the third Wye International Conference on Sustainable Agriculture* held at Wye College, UK, 31st August - 4th September 1993.

Received 24 August 2006; Accepted 16 September 2006; Published 6 December 2006

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