

A study to understand fodder markets and fodder trading patterns in MoreMilkIT sites and other selected regions in Tanzania



More Milk in Tanzania (MoreMilkIT) Project

MAZIWA ZAIDI



Research
Program on
Livestock
and Fish

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Preamble

Smallholder dairy farmers often do not meet their all year round feed demand from on-farm production due to a number of reasons among them, limited land to grow forages, maintaining too many stock for the available forage supplies, and low yields from available forage due to effects of seasonality of rainfall and/or poor fodder production practices. Furthermore landless dairy farming is gaining popularity whereby a farmer keeps one or two dairy cows exclusively under zero-grazing and maintains them on forage harvested from common property lands or purchased from farms and/or markets. Farmers' strategies for coping with feed deficit include purchasing forages off farm, feeding less forage to the animals and feeding excessive levels of concentrates, a strategy that is too costly to most smallholder farmers. Anecdotal evidence has shown that fodder trading around urban and peri-urban areas is increasingly becoming an important source of fodder in many developing countries. Fodder markets offer several benefits to the dairy value chain among them:

- It offers an opportunity for dairying to the landless and urban and peri-urban farmers with very limited ability to produce their own fodder.
- Smallholder dairy farmers can access quality fodder at reasonable prices to be able to produce milk economically and at competitive cost.
- Fodder trading offers a business opportunity to the unemployed who have limited ability to undertake high capital investments.

Most fodder trading in Tanzania happens in towns and in peri-urban areas and it is envisaged that fodder markets can address low feed supply for the dairy sector in the country. However, there is paucity of information on the market arrangement, consumption of fodder by dairy producers, quality of different types of fodder, challenges facing the value chain actors' and the economic viability of the business. Such information is important in assessing how far businesses engaged in fodder markets can serve areas beyond urban and peri-urban areas and therefore how to extend fodder markets into dry areas to help alleviate feed shortages, especially in the dry season.

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Executive summary

Fodder markets are an important source of forage to smallholder dairy farmers particularly around urban and peri-urban areas of many developing countries. In order to understand fodder markets and fodder trading patterns in Tanzania, focus group discussions with various actors (producers, traders and consumers) in the fodder value chain and discussions with key informant held in MoreMilkiT sites and other selected regions in Tanzania. In addition, samples of forages were analysed for nutrient content in order to assess the quality of fodder traded in the market. The largest (57%) proportion of fodder market actors comprised consumers, with about a third of them depending entirely on purchased fodder. Majority of fodder traders were males, 26 to 35 years old who sold fodder as a business and depended mainly on fodder gathered from open/public land.

Producers comprised only 7% of the fodder market actors, and the majority were small scale farmers who produced fodder in excess of their requirement. Fodder trading took place throughout the year but the fodder types and volume varied according to seasons. The major fodder types traded (in terms of volumes and availability) across all the sites were grasses from natural unimproved pastures and dry maize stover.

The price of fodder was determined mainly by availability and quality, the main quality indicators used being maturity and leafiness. The nutritive value of marketed fodder was relatively similar across the sites although the crude protein content (CP) content of natural grass appeared to be higher in Mwanza and Morooro.

Generally, CP content ranged from 2.0% in hay (*Cenchrus spp*) to 33.5% in leucaena leaf meal and metabolizable energy (ME from 5.9 MJ/kg DM in rice straw to 9.3 MJ/kg DM in leucaena leaf meal. Most of the fodder was traded in its fresh form and little or no conservation was done at market or farm level. This therefore had implications on price. Fodder quality, insufficient supply (due to scarcity of land for production and effect of seasonality), lack of technical knowledge and lack of capital were major challenges across all sites and fodder market actors.

The study conclude that there is opportunity for improving the livelihoods of rural and urban poor through fodder marketing and suggested areas of intervention, the major ones being dissemination of improved technologies to enhance fodder production, utilization and conservation, provision of market information and establishment of policy, institutional and social structures to support fodder marketing.

Introduction

Smallholder dairy farming is important in sustaining livelihoods of poor rural farmers particularly in Sub-Saharan Africa. However, the availability of sufficient high quality feed is a key constraint to improving milk yields and this curtails dairy income for smallholders through intensification of smallholder dairy systems. The rising demand for dairy products (Delgado et al., 1999; Gerosa and Skoet, 2012), coupled with continuously shrinking land sizes and deteriorating soil fertility present a dilemma to smallholder farmers. Studies have shown that whereas smallholder dairy farmers experience insufficient supply of feed all-year round, an apparent contradiction is a rapid expansion of large breed types with genetic potential for high milk production, which is associated with high feed requirement. This apparent contradiction may be a consequence of farmers' effort to produce more milk for sale in a market where payment is based on volume sold.

In East Africa where there is rapid growth of smallholder dairy farming, availability and access to feed resources is an important constraint to livestock productivity. Feed scarcity has two main dimensions- temporal or seasonal and spatial, and both are to some extent mitigated through conservation, storage and marketing of feeds. With the rapid growth of smallholder dairy farming against a backdrop of shrinking land sizes due to increasing human population and hence pressure on land for food and feed production, fodder markets will become increasingly important for smallholder systems. This will be even more pronounced as producers shift towards more intensive systems of dairy production, increase the population of improved dairy cattle, become more market oriented and focus on the need to be competitive in the livestock product market by higher production per animal and unit of land with better feeds (Manyawu et al., 2013). Studies show that fodder marketing takes place at different levels (e.g. village and district), and involves different actors: (wholesalers, rural retailers, input sellers, producers) and fodder types (Rhodes grass, maize stovers, oat straws and Lucerne hay) (Nangole *et al.*, 2011).

Provision of market information to producers and buyers is important to enhance and improve feed marketing systems. In addition, there is a need to promote feed marketing alongside feed conservation and feed processing as well as creating platforms for linkages amongst actors (Nangole *et al.*, 2013). Market information is needed to enhance feed marketing systems. However, the most available information is about manufactured feed rather than about roughages (Jabbar, 2008). This has created an information gap in a very important segment particularly of smallholder dairy production.

In Tanzania, smallholder dairying is an important income earning enterprise for crop-livestock farmers in mixed farming systems. Smallholder dairy production system is commonly practised in the Southern Highlands, Northern highlands and Kagera regions. This system is gradually expanding to the sub humid coastal and sub urban areas of Tanga, Morogoro, around Dar es Salaam and other coast regions with diverse climatic conditions. In some of these areas, there is an emerging trend of the urban/ peri-urban dairy farming that is mainly motivated by availability of milk market, need for creation of employment opportunities and ease of integration with other agro-economic activities. Farm holdings in these areas are relatively small in size with 1 – 5 cows per household often under confinement (Njombe et al., 2011). In these systems, one of the key constraints to dairy production is inadequate supply of fodder and poor nutritive quality of animal feed, resulting in low levels of productivity and lack of a marketable surplus of milk.

While farmers strive to produce their own forages, they often do not meet their feed demand due to a number of reasons, including limited land to grow forages, too much stock for the available forage supplies, strong effects of seasonality of rainfall on available forage amongst others. Consequently farmers are either pushed to purchase forages off farm, underfeed cows with less forage, or feed excessive levels of concentrates, a strategy that is costly to most smallholder farmers (Moran, 2009). Anecdotal evidence has shown that there exists fodder trading around peri-urban and urban towns

in Tanzania. Fodder trading also involved youth who harvested natural grass in crop fields, roadsides and in wetlands areas along rivers. Fodder markets are particularly important for the landless and urban and peri-urban dairy farmers that have very limited ability to produce enough fodder, and need access to quality fodder at reasonable prices to be able to produce milk economically and at competitive cost. It is also unclear how far businesses engaged in fodder markets can serve beyond urban and peri-urban areas where they are observed currently. Gender issues are believed to be particularly pertinent in this context given that women in Tanzania often have a disadvantaged access to both land and formal markets while playing key roles in livestock and dairy production. Fodder trading is also important for those farmers who do not have livestock but engage in producing fodder for farmers who own livestock. These fodder producers are thus employed in the fodder value chain. Literature review indicates that there is very scanty information about fodder markets and trading in Tanzania. Limited work has been done about production and marketing of *Leucaena leucocephala* leaf meal in Tanga (Franzel et al., 2007) and other forages (Massawe, 2008). No effort has been made to improve fodder markets either. In addition, gender issues have been little explored in relation to fodder production and market access.

Objective of the study

The overall objective of this study was to understand fodder markets and fodder trading patterns in Tanzania.

The specific objectives:

1. To develop a systematic understanding of fodder markets and interactions among various players along the fodder value chain. This included:
 - a. Mapping the fodder value chains i.e. identifying the main fodder products and the market actors: producers, intermediaries and consumers.
 - b. Profiling the fodder value chain actors including their socio-economic and gender characteristics as well as their roles, needs and opportunities to access the fodder value chain, and the modalities of interaction among them.
 - c. Establishing and characterizing the market chain linkages between production and consumption ends of the fodder value chains.
 - d. Determining the distribution of margin among actors along the fodder value chain.
 - e. Determining how far fodder markets can serve beyond urban and peri-urban areas

Methodology

Study sites

The study was carried out in six sites in the sub-humid and highland areas of Tanzania (Figure 1).



Figure 1. Map of Tanzania showing sites of the study

Data collection

The study applied both qualitative and quantitative methods to address the following key issues:

- The types, form and quality of feed traded and hence identify the factors leading to the use or non-use of local forage materials by ruminant livestock keepers;
- The types of fodder traders in the market and their linkages (encompassing production, transportation, trade and use) and hence assess the performance of forage markets in terms of linking supply with demand, constraints and opportunities;
- Forage and fodder price variation by quality, space and time, hence determine the ability of markets and producers to differentiate and reward forage quality, and the barriers to that;
- The costs and margins obtained in the forage and fodder trade.

The actual field work included:

Focus group discussions (FGD)

Focus group discussions (FGDs) were held with producers, traders and consumers. Different checklists were prepared to guide the discussions (Appendix I, II, and III). The discussions entailed participatory assessment of producer forage options, exchange mechanisms for fodder, suppliers and buyers, value addition and costs, quality/price relationships, gender issues in fodder marketing, seasonality and criteria used by farmers in deciding when and what type of feed to be purchased and the constraints and opportunities at each market node. Extension staff, local leaders and traders themselves assisted in identifying potential participants, to form groups of between 12 and 15 participants.

Individual interviews

Before the start of the FGD, information from individual participants was collected using a short structured questionnaire (Appendix IV). This questionnaire aimed to collect information on individual attributes of the participants.

Key Informant Discussions

Informal discussions were held with representative feed market actors i.e. individuals considered to have wealth of knowledge and/or experience in fodder markets (including fodder producers, traders, consumers, extension staff, and representatives of dairy companies). The aim was to obtain an overall picture of fodder marketing, policy, economic and social cultural issues surrounding and the general constraints and opportunities. A checklist (Appendix V) was used to guide the discussions.

Feed quality assessment

Samples of the three most commonly marketed fodder were collected (Appendix VI) at every node of the market and analysed using near infrared reflectance spectroscopy (NIRS) for Dry Matter (DM), Crude Protein (CP) acid-detergent fiber (ADF) and neutral-detergent fiber (NDF) and digestible organic matter (DOM) and metabolizable energy (ME). The objective was to elucidate feed quality along the fodder value chain and the relationship between quality and price and explore applicability of a feed quality index in pricing.



Plate 1. Forage /feed sampling for chemical composition determination

Nutritional quality assessment was done using point sampling (sampling of fodder types available at that particular point); hence it was not possible to achieve the sampling frame envisaged for each site (i.e. three replicates of at least three most common fodders types per fodder market actor); majority of feed types were represented by a total of up to five samples . This is because some of the fodders were either out of season or not available at the sampling venue at that particular time. Summary statistics were presented for feed types represented by at least three samples.

Stakeholders' Workshop

A stakeholders' workshop was held thereafter to share the preliminary findings of the FGDs and to identify potential interventions for improved market performance, and improved utilization of quality forage. Participants included fodder market actors, representatives of different institutions. The report of the stakeholders' workshop is presented in Appendix VII.

Data management and analysis

Taped discussions and written notes of the focus groups were transcribed, uploaded onto NVivo qualitative analysis software and organized into different themes/nodes. Importance of specific variables/attributes was assessed using the word frequency query. The scores of feed quantities were used to generate weighted percent volume of fodder traded (all fodder types consolidated) in each month using the following formula:

$$\text{Weighted (\%) volume} = \frac{\sum(ab)}{S} \times 100 \quad \text{where:}$$

- a = score of the fodder quantity using a scale of 1 to 10
- b = frequency of the score in terms of % coverage
- S = Total for all the months

Data on nutrient content of feeds was summarized in MS Excel using simple descriptive statistics.

Results and discussion

The actors

Actor types

The fodder market value chain involved the three broad categories of actors: producers, traders and consumers but within these categories were sub-groups as shown below:

1. Producers:
 - Institutions (Private, public)
 - Large-scale farmers
 - Small-scale farmers
2. Traders:
 - Gatherers
 - Retailers
 - Wholesale traders
3. Consumers
 - Buy to supplement
 - Depend on purchased fodder only

The majority of producers were small-scale farmers with less than five acres of land allocated to fodder production. Institutions comprised public and private institutional farms such as university, prison and company farms. These farms mainly produced Rhodes grass hay. Large scale-farms comprised farmers producing grass hay for sale and crop (mainly rice and maize) farmers who baled and sold crop residues after harvest. Most of the producers were also dairy farmers and hence sold only what was in excess of their own requirements and hence this may suggest that the quantity of fodder from individual farms that is found in market may be relatively low. On the other hand, this presents an opportunity for disseminating fodder production technologies.

Traders were dominated by gatherers who, more often than not, cut free of charge fodder from open unutilized public or private land and sold it on wholesale or retail. This may have implications on quality of fodder traded. Wholesale traders were the least (Figure 2). Most of the traders were not engaged in dairy farming and hence engaged in fodder selling as a business, which may be indicative of the importance of fodder marketing as a source of livelihood.

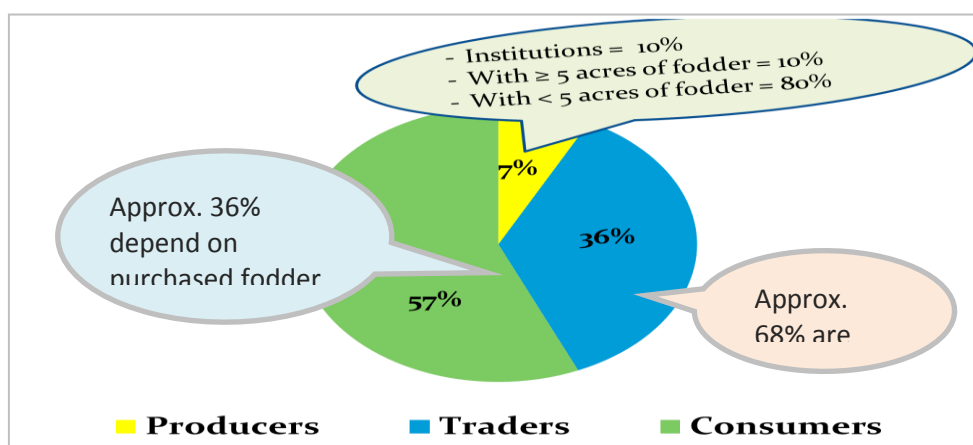


Figure 2: Overall proportion of all fodder market actors in all study sites

The participants

Although the number of participants differed across both actors and sites, the highest number of any category was of consumers and the lowest, producers (Table 1), with some of the sites having no producers all i.e. those producing and selling. Although the sampling method and/or other external factors which can influence attendance may have affected the numbers, the results may be an indication of high fodder demand from traders and consumers and low supply by producers.

Table 1 - Distribution of participants by category of actors

	Producers	Traders	Consumers	Total
Site				
Arusha	2	4	15	21
Dar es Salaam	0	32	60	92
Morogoro	10	20	7	37
Moshi	0	15	26	41
Mwanza	0	10	19	29
Tanga	6	10	15	31
Total	18	90	143	251

Gender distribution

Majority of producers in Morogoro and Arusha were male but in Tanga, the number of males was about the same as that of females. Majority of traders in all sites except Moshi and Tanga were males. In Moshi, fodder trading was viewed as a menial job, which men did not wish to be associated with. A livestock officer working with farmers in Moshi observed that *'Women are mostly involved in fodder marketing since they are the main family care givers while men are mostly engaged in non-profitable social activities'*.

In Tanga, the main fodder traded was dried leucaena leaves and men viewed the process of drying and threshing as a woman's job. Tanga area has been cited as the only area in sub-Saharan Africa where leucaena leaf meal is widely marketed (Franzel et al., 2007). In Dar es Salaam and Morogoro, participants said "*the work is too difficult for women.*" Women consumers were the majority except in Moshi. In most sites, it was reported that women were responsible for managing the dairy enterprise, hence this may explain their high number as consumers. The gender distribution of participants is presented in Figure 3.

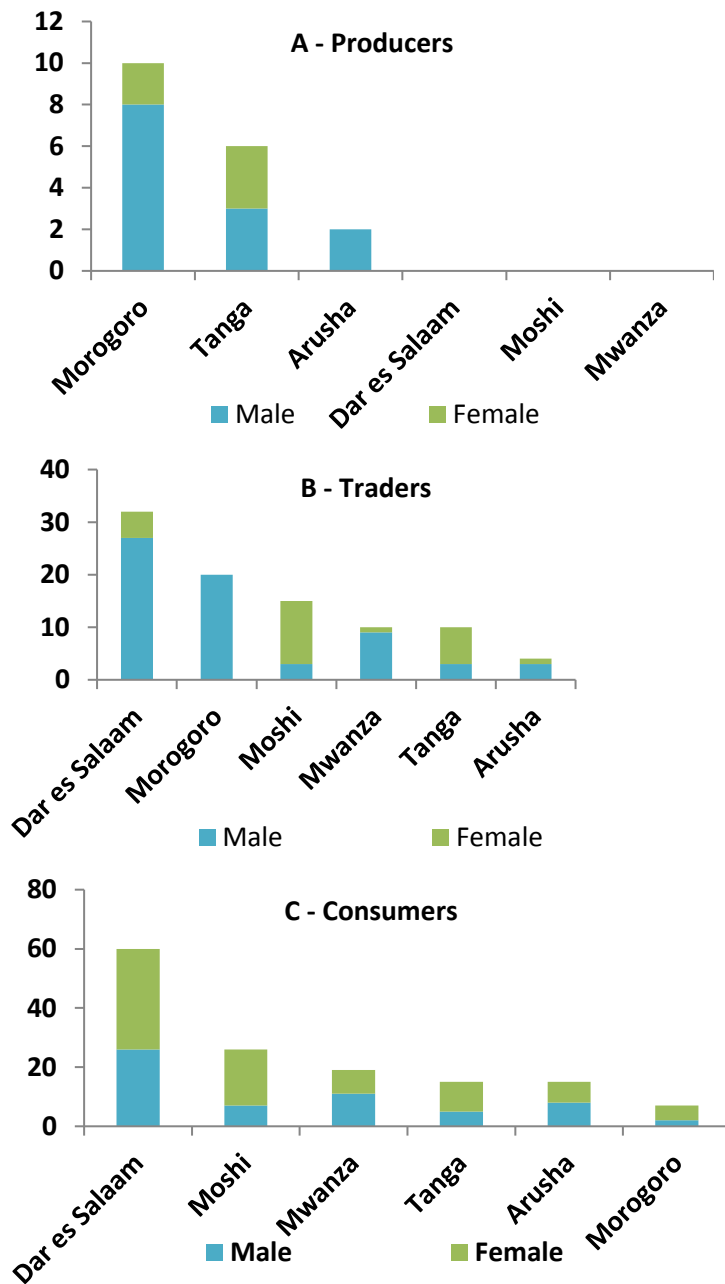


Figure 3 - Distribution of fodder market actors by gender across all study sites

Age distribution

Although overall majority of participants were over 45 years old, there were differences among the different actor categories. Majority of producers and consumers were over 45 years old while traders were 26 to 35 years old (Table 2). This is indication that the fodder trading is attractive to the youth who may not have adequate resources such as land and start-up capital. Most of the traders reported that they did not need any capital to start the business, “only a sickle and you.”

Table 2 - Distribution in % of fodder market actors by age group across all study sites

Actor type	Below 18 yrs.		18 to 25 yrs		26 to 35 yrs.		36 to 45 yrs.		Above 45 yrs.	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Producers	0	0	0.4 (1)	0	1 (2)	0.4 (1)	1 (3)	0.4 (1)	4 (9)	1 (3)
Traders	0	0	4 (9)	0.4 (1)	12 (30)	4 (9)	4 (9)	1 (3)	7 (17)	5 (12)
Consumers	0.4 (1)	0	2 (4)	0.4 (1)	3 (8)	5 (13)	6 (15)	8 (20)	12 (31)	19 (49)
Total	0 (1)	0	6 (14)	1 (2)	16 (40)	9 (23)	11 (27)	9 (24)	23 (57)	25 (64)

*Values in parenthesis represent numbers.

Education level

All participants with an exception of five traders had gone through formal education. However, majority (60%) had gone up to only primary level. Majority of the participants who had secondary and tertiary education were consumers (Table 3). This has implications in tailoring and dissemination of innovations and technical messages. It shows the potential of fodder marketing as an alternative form of employment to the less educated.

Table 3 – Distribution in % of fodder market actors by education level across all study sites

Actor type	None		Primary		Secondary		Tertiary	
	Male	Female	Male	Female	Male	Female	Male	Female
Producers	0	0	3 (8)	0.4 (1)	1 (3)	1 (3)	2 (4)	0.4 (1)
Traders	2 (5)*	0	17 (43)	7 (18)	5 (12)	2 (6)	2 (5)	0.4 (1)
Consumers	0	0.4 (1)	12 (31)	19 (49)	6 (16)	10 (26)	5 (12)	3 (7)
Total	2 (5)	0.4 (1)	33 (82)	27 (68)	12 (31)	14 (35)	8 (21)	4 (9)

*Values in parenthesis represent numbers.

Dairy farming

As expected, all the consumers (99%) (except one who had recently lost his animal) had dairy cattle. About three quarters (75%) of the producers had dairy cattle and it is likely that this is what initially motivated them to plant fodder (Table 4). The producers who did not have dairy cows were mainly crop farmers who sold crop residues after harvest and a few farmers who planted fodder for sale. About three quarters (72%) of the traders did not have dairy cattle and carried out fodder trading purely as a business.

Table 4 - Proportion of farmers with dairy cattle among the different actors in all study sites

Actor type	% with dairy cattle	% without dairy cattle	n
Producers	75	25	20
Traders	28	72	90
Consumers	99	1	142

Production systems

Majority of farmers in all the sites except Tanga predominantly reared their dairy cattle under the zero-grazing system. In Tanga, majority of farmers practiced semi-zero grazing since there was open land where they could graze. Whereas there were some farmers practicing free grazing in Morogoro (about 14%) and semi-zero grazing in Dar es Salaam (about 27%), more than 90% of farmers in Moshi, Arusha and Mwanza practiced zero-grazing throughout the year.

Fodder trading

Mapping the value chain

Due to its informal nature, fodder market is complex with all the actors somehow interrelated (Figure 4). Fodder generally moves from the source to the consumer through any available channel and in some cases directly. This has serious implications on efficiency, cost and benefits. The actors purchase or gather fodder from anywhere and sell to anyone willing to buy. Availability of fodder is the main factor influencing the market. During the rainy season when fodder is in plenty, gatherers mainly harvest free fodder from open areas and may sell to retail traders or directly to consumers. During this time, wholesale traders purchase fodder – mainly grass hay - from large-scale farms and institutions and store or sell to retail traders. Retail traders purchase fodder from gatherers, small and large-scale farms and even from wholesale traders. During the rainy season, some of the consumers do not purchase fodder because “*it is available on farm and in open areas nearby and even some farmers who have excess may just give you free of charge.*” Those who purchase do it mainly from gatherers since it is cheaper.

During the dry season when there is scarcity of fodder, the consumers said “*we run around everywhere looking for fodder*”; hence they purchase fodder from all the traders and even from producers. The gatherers at this time obtain most of their fodder by purchasing from small-scale farms. In addition, they harvest from open or uncultivated public areas free of charge but from private land at a fee. Other traders purchase fodder from small and large-scale farms even outside their district.

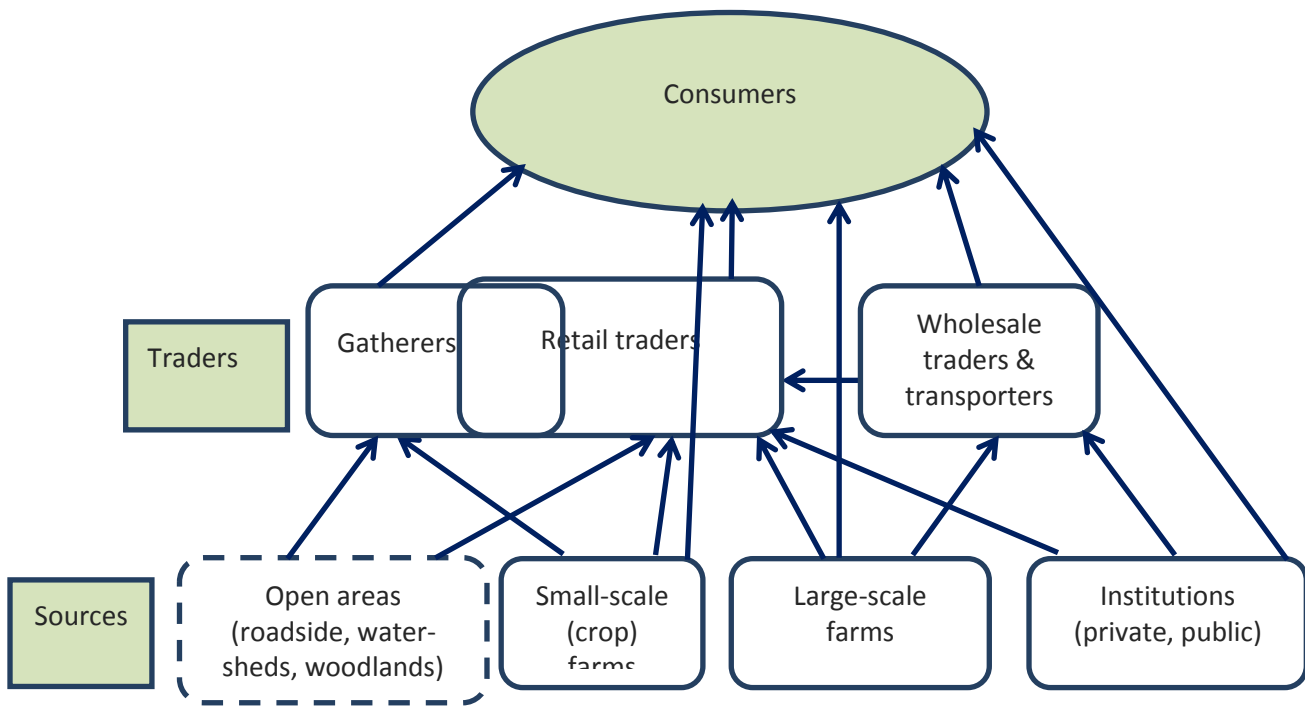


Figure 4. The fodder value chain actors and their linkages

Fodder traded

There was a wide variety of fodder traded (Table 5) but the most common fodder in the market across all the sites based on the frequency of mentions was grass which was sold fresh dry or as a mixture with legumes or weeds, followed by dry maize stover (Figure 5). Most of it was obtained from naturally growing pastures. Other important forages were Rhodes grass hay, rice straw, bean haulms, Napier grass and leucaena. Natural grass comprised a mixture of grasses, whose species varied widely both across and within the sites but the most common was *Cynodon dactylon*, *Cynodon spp* and *Boithlocloa spp*. In some cases the grass contained legumes in the mixture. The common herbaceous legumes found in mixture were *Stylosanthes spp*, *Macroptlium spp*, *Neonotonia spp* and Natural lablab. In other instances, the gatherers could not identify some of the wild plants and argued that as long as they were green and non-poisonous they were considered fit for the market. This variability has serious implications on quality. Natural grass mixture and Rhodes grass hay were the only fodder types available throughout the year. Crop residues were available during the harvest period of each specific crop. Napier grass fodder trading was mentioned by consumers and producers only, which may indicate that consumers purchase it directly from the farm. This may also suggest that the available volumes are not enough to attract traders. Napier grass may also be difficult to trade due to its bulkiness and short shelf life unless it is conserved as silage. Adoption of silage-making by smallholder farmers was low and among the factors attributed to the low adoption was lack of technical knowledge.

Table 5 - Fodder types traded (✓) across all the study sites

Fodder type	Moshi	Arusha	Tanga	Morogoro	Dar es Salaam	Mwanza
Natural grass mixture	✓	✓	✓	✓	✓	✓
Rhodes grass (hay)	✓	✓	✓	✓	✓	
Rice straw	✓	✓	✓		✓	✓
Bean haulms	✓	✓		✓		
Dry Maize stover	✓	✓	✓	✓	✓	✓
Napier grass		✓	✓	✓		
Leucaeauna			✓	✓		
Natural Elephant grass (magugu)				✓	✓	✓
Matembele pori (vines)				✓		✓
Mlonge (moringa)				✓		✓
Vegetable waste				✓		✓
Banana leaves/stems					✓	



Figure 5. Common fodder types across all the sites based on the frequency of mentions



Plate 2. Natural grass mixture delivered by handcart to a farm in Tanga



Plate 3 . A roadside fodder market in Moshi: Some of the bundles contain grass only, others grass mixed with other wild plants

Reasons for selling/buying

The reasons for buying or selling fodder differed between actor types but they were relatively similar across all sites.

Producers:

The producers gave the following reasons:

- When fodder produced exceeds requirements. This was the case particularly with the producers who kept dairy cattle. The main objective for establishing fodder was to feed their animals; hence fodder sales were made only when there was excess. This has implications on supply of fodder to the market since during the dry season small-scale farmers are unlikely source of fodder for the market. Large-scale farmers and institutions however, produced enough fodder for their animals and extra for sale. However, being a small minority (20%), their contribution of fodder to the market requires further investigation.
- To generate cash in order to offset the cost of bailing forages. It is common practice for large-scale crop farmers (rice, barley, maize and beans) to bale crop residues after harvest to clear the land in preparation for the following crop. Most farmers hire the machinery to do so and hence, sell the baled residue in order to offset the cost of hiring the machinery.
- Due to high demand of crop residues after harvest. Owing to the great demand for fodder, crop farmers offer the residue after harvest for sale to livestock farmers. This has created an opportunity for the farmers to get more income from the crops. One producer remarked *“sometimes we end up making more money from the crop residue than the harvest.”*
- To generate income. Some farmers (mostly large-scale and institutions) deliberately produced fodder for sale and were the main source to wholesale traders. This was also the main source of Rhodes grass hay. A major observation was that these producers were not able to meet the market demand for fodder. This presents an opportunity to establish a reliable source quality fodder.

Traders:

The traders had engaged in fodder trading due to the following reasons:

- As a business (to earn cash/make a living): Majority of traders depended on fodder marketing as a source of livelihood.

- Fodder business requires very low start-up capital. Fodder marketing was attractive particularly to the women and youth who had limited access to capital. A number of them reported that *“you only need a panga to start the business.”*
- Due to lack of any other formal employment. This was common especially among the youth, who formed the majority of traders. Some youths in Morogoro had even gone as far as forming a self-help group through which they assisted one another to purchase equipment. Such a group could also serve as an entry point for disseminating various technologies.
- To supplement family income (especially for women). Owing to the low capital requirement, fodder trading had proved to be an attractive business for women.
- Due to increasing demand for fodder amongst smallholder dairy farmers. This had created a business opportunity especially for the unemployed youth.

Consumers:

The consumers gave the following reasons:

- Insufficient fodder production. This was mainly due to i) scarcity of land and ii) lack of knowledge on fodder production (seed selection and improved husbandry) hence low output from the little land available.
- To overcome seasonal feed scarcity. Even for the smallholder farmers with land set aside for fodder production, majority are not able to meet their year-round fodder requirements by on-farm production. Hence they buy fodder during the dry season when on-farm fodder is insufficient. Some farmers also buy and store crop residues during the period of harvest for use during fodder shortage.
- To bring in a good mix of feed types to improve intake. Some consumers reported that when they offered the same type of fodder to their animals the intake progressively went down due to what they referred to as *“the animals get bored.”* Therefore, they normally purchased other fodder type in order to give the animals an attractive mix.
- To obtain feed types which are not available locally. Where the consumers had knowledge of different fodder types, they would purchase some of the types they were not able to grow.
- To improve quality of fodder available on farms. Although most of the consumers reported that their main objective of feeding their animals was to *“make them satisfied,”* a number of them were also concerned about the quality of fodder. These consumers purchased types of fodder they considered of better quality to feed together with what was available on-farm. One consumer remarked *“I now know that bean haulms are better quality than dry maize stover.”*

Fodder trading patterns

As mentioned earlier, natural grass mixture and Rhodes grass hay were the only forages available in the market throughout the year. However, the volumes traded varied across the sites. Within the sites, volumes traded depended mainly on the seasons (wet, dry, harvest). Crop residues were highly available during the harvest period of each specific crop. Grasses were highly available during the rainy season while leucaena was more readily available during the dry season because it was easier to dry. Natural grass mixture and dry maize stover were mentioned in all the sites but the other fodder types varied. While it was not possible to quantify the volumes of different fodder types traded, weighted scores of all the traded fodder throughout the year indicated that fodder marketing was an all year round business (Figure 6). Further investigation is needed in order to disaggregate this information into fodder types, sites and fodder value chain nodes. Cost of fodder varied mainly between the dry and wet season and this was mainly due to i) availability, ii) demand

and iii) cost of transportation. It would be worthwhile to carry out further investigation on spatial and temporal variability in price of different fodder types across the sites. The average cost (as given by the participants) of the most commonly traded fodder is given in Table 6 below.

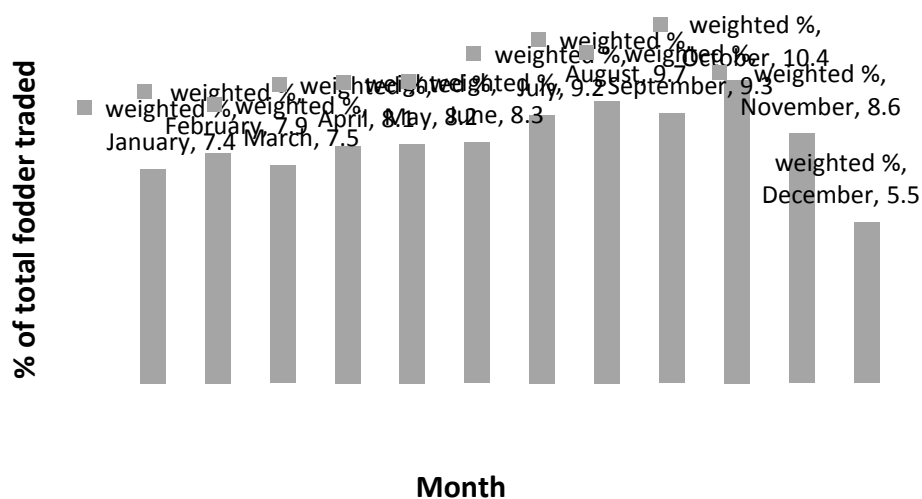


Figure 6 - Weighted volume of fodder traded during the year across all the sites

Table 6 - Average market price of different fodder types across the study sites

Fodder type	Availability (months)		Cost (Tsh)		
	High	Low	Unit	Availability is high	Availability is low
Natural grass mixture	Aug, Sept, Oct	Dec, Jan,	Bundle	7,000	9,000
			Pickup	30,000	40,000
Rhodes grass (hay)	Jan, Feb, Mar	Apr, May	Bale	3,000	4,000
Rice straw	Nov, Dec (at harvest)		Lorry	35,000	-
Bean haulms	July, Oct (at harvest)		Lorry	600,000	-
Dry maize stover	Aug, Sept, Oct (at harvest)		Pickup	30,000	40,000
			Acre	20,000	55,000
Napier grass	Mar, Apr	Dec, Jan	Acre	50,000	70,000
			Load	1,500	3,000
Leucaena	Jan, Feb, Mar	Apr, May, June	Tin (2.5 – 3.0 kg)	7,000	9,000

Fodder quality assessment

Buying good quality, good value feed for dairy cows in the quantities required to maintain high milk production is essential to maintain farm income. A practical assessment for forage or feed quality is based on animal performance. However this may be useful when comparing forages given to growing or lactating animals and it may also mean that the farmer has already incurred the cost of buying feed. It is therefore important to have a way of assessing the quality of feed before purchase. The participants assessed fodder quality mainly from its physical appearance and in some instances from the smell. The fodder characteristics used in quality assessment included:

- Colour: Fodder that is deep green was considered to be of better quality.
- Stage of maturity: The fodder should not be too young or too old.
- Leaf to stem ratio: Better quality fodder should have high amount of leaf compared to stem
- Tenderness of the leaves: The leaves should be tender although not too lush.
- Well preserved: Not rotten or with foul smell
- Lack of undesirable types of plants (e.g. poisonous, unappealing/unpalatable to the animal)
- Fodder type: some types of fodder are more nutritious e.g. bean leaves. Buyers selected fodder to buy based on greenish and presence of leguminous forage species in the bundle.
- Effect on milk yield: for those who had lactating dairy cows, they selected fodder which they had observed resulted in increased milk production.

Checking feed quality is more than simply checking its physical characteristics. It is really the nutritional content that the buyer should be more concerned about i.e. the energy, protein content, etc. These determine the feed's value and necessitate the analysis of the feeds in question. The results of analysis can be used to cost the feed in terms of individual nutrients e.g. cost per unit metabolisable energy (ME) and crude protein (CP) versus alternative feeds (the two major nutrients that determine the milk production potential of a feed) and to develop feed quality indices. Based on nutritional attributes, Relative feed value (RFV) index and Relative Feed Quality (RFQ) have been widely used to determine the quality of forages (Moore and Undersander, 2002) and therefore add some objectivity to determining a market value. In the present study, the most important attribute for quality assessment was stage of maturity, followed by leafiness (Figure 7). Factors determining price were fodder type and quality (based on physical attributes).



Figure 7. Important fodder attributes used in quality assessment across all the sites based on the frequency of mentions

Nutritive value of marketed fodder

The crude protein (CP) content of feeds marketed ranged from 2.0% in hay (*Cenchrus spp*) to 33.5% in leucaena leaf meal. Natural pasture and dry maize stover, the two most common fodders in the market had average CP concentrations of 9.1 ± 3.47 and $6.00 \pm 2.60\%$ respectively while leucaena leaf meal, the common supplementary fodder had an average CP content of $28.0 \pm 4.67\%$. Metabolizable energy (ME) content ranged from 5.9 MJ/kg DM in rice straw to 9.3 MJ/kg DM in leucaena leaf meal but the average for natural grass and dry maize stover was 7.3 ± 0.36 and $7.5 \pm 0.46\%$ respectively ME content of leucaena leaf meal was $8.33 \pm 0.66\%$ (Table 7). The nutrient content of natural grass was relatively similar across the sites except the CP content which appeared higher in Mwanza and Morooro (Table 8). However the number of samples collected per site was highly variable and this may have had an influence on the averages.

Most of the natural grass marketed was collected from open areas and hence there was wide variation in species but on average, it was of medium quality. The soils in the open areas may be relatively fertile since there has not been degradation caused by human cultivation. However, the quality of grass in the market may be influenced by the species, stage at harvest and storage. Most of the FGD participants reported they lacked knowledge on various fodder production, management and utilization. Since natural grass was the fodder that is available in the market all year round, interventions for improving its quality and availability to the consumer would improve their quantity and quality fodder in the smallholder dairy farms. Use of crop residues in smallholder dairy farms is common because they are cheaply available; however, they are low in protein and digestibility. In the present study, the quality of maize stover was relatively high and that of rice straw surprisingly high, compared with that reported elsewhere. The quality of crop residues may vary greatly depending the crop's growing (and may be variety) conditions and the residue's harvesting, processing and storage. Further studies should be carried out to validate these figures and further investigate the temporal and spatial variability.

Table 7 - Nutrient content (mean \pm s.d.) of feed types* commonly marketed across all the study sites

Row Labels	No. of samples	CP(%)	NDF(%)	ADF(%)	IVOMD(%)	Me(MJ/Kg)
Natural Grass	75	9.1 \pm 3.47	73.06 \pm 6.53	46.89 \pm 5.36	52.62 \pm 3.27	7.31 \pm 0.36
Leucaena leaf meal	15	28.0 \pm 4.67	49.21 \pm 6.70	29.17 \pm 7.38	63.11 \pm 4.42	8.33 \pm 0.66
Napier grass	11	12.62 \pm 3.45	68.11 \pm 2.76	42.38 \pm 4.60	55.15 \pm 3.34	7.27 \pm 0.55
Dry maize stover	9	6.00 \pm 2.60	75.51 \pm 6.42	51.00 \pm 8.50	52.65 \pm 3.80	7.49 \pm 0.46
Hay (Cenchrus)	9	3.45 \pm 0.65	83.26 \pm 3.54	58.70 \pm 4.57	47.97 \pm 4.67	7.30 \pm 0.64
Bean haulms	8	6.43 \pm 1.64	62.62 \pm 8.55	53.88 \pm 8.52	54.33 \pm 3.40	7.87 \pm 0.30
Guatemala grass	5	13.66 \pm 2.21	72.65 \pm 4.05	48.75 \pm 2.32	55.70 \pm 1.92	7.36 \pm 0.16
Hay (Rhodes)	5	4.22 \pm 0.56	77.86 \pm 0.82	53.87 \pm 2.07	49.36 \pm 2.96	7.21 \pm 0.39
Grass/Legumes Mixture	4	6.96 \pm 2.20	76.17 \pm 1.52	52.33 \pm 3.09	50.13 \pm 2.67	7.17 \pm 0.32
Banana stems	3	10.90 \pm 6.89	62.96 \pm 5.60	44.99 \pm 10.11	51.91 \pm 1.69	6.67 \pm 0.39
Elephant grass	3	11.17 \pm 3.53	72.48 \pm 4.67	44.45 \pm 4.74	52.52 \pm 3.65	7.10 \pm 0.35
Rice straw	3	9.43 \pm 2.05	66.50 \pm 4.43	49.15 \pm 4.18	48.60 \pm 2.80	6.34 \pm 0.37
Chloris gayana	2	4.72 \pm 0.93	79.55 \pm 0.99	52.80 \pm 1.08	53.12 \pm 4.97	7.78 \pm 0.77
Grass-weeds mixture	2	10.68 \pm 1.60	63.75 \pm 3.92	46.13 \pm 4.44	55.49 \pm 0.76	7.61 \pm 0.49
Napier-weeds mixture	2	10.95 \pm 0.16	70.99 \pm 0.88	44.61 \pm 0.36	53.27 \pm 1.01	6.96 \pm 0.30
Sweet potato vines	2	11.89 \pm 3.54	41.39 \pm 0.03	47.36 \pm 1.61	52.69 \pm 2.49	7.04 \pm 0.26

CP = Crude protein; NDF = Neutral detergent fibre; ADF = Acid detergent fibre; IVOMD = *In vitro* organic matter digestibility;

ME MJ/kg = Metabolizable energy (MJ/kg DM)

*Fodder types represented by only one sample were excluded. The full list is presented in Appendix VIII

Table 8 - Nutrient content (mean \pm s.d.) of natural grass marketed in the different study sites

Site	No. of samples	CP(%)	NDF(%)	ADF(%)	IVOMD(%)	Me(MJ/kg)
Arusha	2	8.4 \pm 6.27	75.9 \pm 11.92	50.0 \pm 12.07	50.9 \pm 8.78	7.1 \pm 0.55
Dar es Salaam	30	7.7 \pm 2.75	73.8 \pm 6.99	47.0 \pm 5.66	52.1 \pm 3.08	7.3 \pm 0.38
Morogoro	11	13.0 \pm 1.90	73.1 \pm 1.54	44.0 \pm 2.35	54.2 \pm 1.77	7.2 \pm 0.20
Moshi	5	7.7 \pm 4.13	69.1 \pm 12.11	46.1 \pm 7.62	53.8 \pm 3.85	7.6 \pm 0.48
Mwanza	18	10.5 \pm 3.15	71.2 \pm 6.05	46.5 \pm 5.14	54.0 \pm 2.47	7.4 \pm 0.26
Tanga	9	6.7 \pm 2.25	75.7 \pm 4.00	50.7 \pm 2.97	49.2 \pm 2.70	7.0 \pm 0.26
Overall		9.1 \pm 3.47	73.1 \pm 6.53	46.9 \pm 5.36	52.6 \pm 3.27	7.3 \pm 0.36
Minimum		2.8	45.7	32.1	44.7	6.4
Maximum		15.4	85.4	59.1	61.6	8.4

CP = Crude protein; NDF = Neutral detergent fibre; ADF = Acid detergent fibre; IVOMD = *In vitro* organic matter digestibility;

ME MJ/kg = Metabolizable energy (MJ/kg DM)

Contractual arrangements

Fodder purchases were normally done on cash basis. However, there were occasions e.g. during times of scarcity when a consumer made reservations with a trader with whom they have developed a working relationship. Traders also made such reservations with producers. In some occasions, the consumer could obtain fodder to pay later. During the wet season, traders were sometimes forced to offer the fodder on credit instead of leaving it to rot. However, this was cited as challenge by the traders due to the fact that there were occasions when some consumers took fodder on credit and refused to pay. There were however no binding contracts and consumers were free to purchase fodder from a trader and traders from a producer of their choice. There were also instances where consumers gave manure to crop farmers in exchange for fodder and/or crop residues.

Transportation

The type of transport used to ferry fodder depended on the buyers' financial capability, quantity of fodder and the distance; the common ones within and across sites being:

- Carrying on the head
- Bicycles
- Vehicles (pick-ups, Lorries)
- Motor cycles
- Hand carts

Carrying on the head was done mostly by women while bicycles and lorries were used mostly by men. It was observed that use of vehicles was unpopular with women and the reason was that loading of fodder was too difficult for women. Another interesting reason given by the men was that women are economical and they do not like to incur heavy expenditure. One male participant said:

“Men focus on time; that is why they look for means that is fast as long as he is going to get what he wants. Women will start bargaining therefore they will look for something that is cheap because they fear expenses but for us men we don't look at that.”

Fodder utilization

The amount of feed an animal consumes is arguably the most important single factor that influences its productivity. It is therefore necessary to ensure that an animal takes in as much of the feed on offer as possible. The consumers in the present study applied various strategies to enhance intake of the purchased fodder. The most common practice was chopping. Chopping particularly in the case of dry maize stover has been found to increase intake (Methu et al., 2001). Most consumers bought fresh fodder daily, once or twice a week. Dry fodder such as hay and crop residues were usually purchased in large quantities and stored in sheds. When feeding dry maize stover and other dry crop residues such as bean haulms and rice straw, a number of participants reportedly chopped and sprinkled with salted water, while few farmers used molasses. When feeding lactating animals, most of the consumers mixed the fodder with commercial concentrates (dairy meal) or brewers' waste. A few farmers in Tanga reported that they also fed cotton seedcake.

Fodder preservation

Majority of consumers purchased fresh fodder at short intervals. No form of conservation of fresh fodder except wilting was reported among them. Dry fodder was stored in barns/stores or heaped under a tree/shade. Most of the traders also purchased fodder in quantities enough to sell out since

they did not practice any form of fodder conservation. Only large scale fodder producers conserved Rhodes grass in form of hay.



Plate 4. Hay stored in raised shed in a farm in Arusha



Plate 5. Dry maize stover stacked under a tree in a farm in Moshi

Policy and institutional issues

Fodder trading was informal and hence there were no policy and/or institutional structures; for instance there was no:

- formal fodder selling points
- formal fodder marketing guidelines
- organized groups/associations among actors
- formal information along the value chain e.g.
 - feed processing and storage to improve shelf life in the market
 - Fodder utilization options
 - Fodder availability and prices
- Fodder trading was not recognized by local or national governments , hence there was no:
 - licencing or registration system
 - regulatory body i.e. fodder quality guidelines

Challenges, coping strategies and possible solutions

Although each actor type had challenges unique to them, a few were similar across all actor types and sites. Among the most important challenges were lack of technical knowledge, insufficient land for fodder production, fodder availability and capital. The challenges, coping strategies and possible solutions cited by each actor type are presented in table 9 below.

Table 9 – Challenges, coping strategies and possible solution cited by the different actors across all study sties

Producers

Constraint	Coping strategy	Suggested solution
Scarcity of land	<ul style="list-style-type: none"> Utilize available land 	<ul style="list-style-type: none"> Rent more land, Government to set aside land for fodder producers, Producers should form cooperatives in order to be heard by government
Lack of capital	<ul style="list-style-type: none"> Produce on a small scale 	<ul style="list-style-type: none"> Form self-help groups Government to set up credit schemes
Inadequate inputs & services	<ol style="list-style-type: none"> Obtain the service wherever it can be found 	<ol style="list-style-type: none"> Government to set up service points for farmers
High cost or lack of farm machinery / equipment for production	<ul style="list-style-type: none"> Produce at a low scale 	<ul style="list-style-type: none"> Government to exempt taxes on farm machinery, Government to set up institutions that give credit, Formation of farmers groups/association for increased joint purchasing power
Lack of technical knowledge	<ul style="list-style-type: none"> Seek information from neighbours/fellow farmers 	<ul style="list-style-type: none"> Research institutions & government to conduct training for farmers Farmers to seek information through other means e.g. agricultural show, media, radios and special TV sessions. There is need to create awareness of available channels
Long duration required to establish planted fodder (e.g. Napier grass)	<ul style="list-style-type: none"> Plant what is available 	<ul style="list-style-type: none"> Research to come up with varieties that take a shorter time
Changing weather patterns	<ul style="list-style-type: none"> Harvest when weather conditions are favourable 	<ul style="list-style-type: none"> Practice irrigation in order to produce fodder year round
Pests and diseases that affect fodder	<ul style="list-style-type: none"> Plant fodder not affected Seek information from experienced farmers, media 	<ul style="list-style-type: none"> Research institutions to come up with new varieties
Cost of transporting fodder from farm to market	<ul style="list-style-type: none"> Meet the cost as they come and try to bargain 	<ul style="list-style-type: none"> Collective action
Low purchasing power of consumers	<ul style="list-style-type: none"> Sell to those who are able to buy Store what one is unable to sell 	<ul style="list-style-type: none"> Buyers should organize themselves in groups

Consumers

Constraint	Coping strategy	Suggested solution
Scarcity of fodder particularly during dry season hence: <ul style="list-style-type: none"> • Move long distance to sources of fodder • High cost of transport 	<ul style="list-style-type: none"> • Feed what is available • Feed rationing so that what is there can last longer • Buy crop residues and store 	<ul style="list-style-type: none"> • Produce sufficient fodder on-farm • Conserve fodder when in plenty
Lack of market for milk	<ul style="list-style-type: none"> • Produce little milk 	<ul style="list-style-type: none"> • Farmers to form cooperative • Government to set up milk plants • Government to invite foreign buyers
Poor milk prices	<ul style="list-style-type: none"> • Produce little milk 	<ul style="list-style-type: none"> • Farmers form cooperatives • Government to set price of milk
Lack of government support to dairy farming	<ul style="list-style-type: none"> • Produce little milk 	<ul style="list-style-type: none"> • Farmers to form cooperatives
Inadequate labor supply	<ul style="list-style-type: none"> • Treat labourers like family members 	<ul style="list-style-type: none"> • Pay high for labour
Too many responsibilities on women	<ul style="list-style-type: none"> • Do what they can 	<ul style="list-style-type: none"> • Sensitize men on importance of sharing responsibilities

Traders

Constraint	Coping strateg	Suggested solution
Lack of recognition for fodder trade	<ul style="list-style-type: none"> • Self-confidence 	<ul style="list-style-type: none"> • Create awareness and provide technical information to help traders carry out the business in a professional way.
Change in weather pattern (supply of fodder)	<ul style="list-style-type: none"> • Plant of draught tolerant varieties?? • Irrigation 	<ul style="list-style-type: none"> • Tree planting • Government to set up policies that prevent environmental degradation
Seasonal variation in fodder availability	<ul style="list-style-type: none"> • Search for fodder far-off 	<ul style="list-style-type: none"> • Avail capital to enable year round fodder availability
Long distance to sources of fodder during dry weather hence high cost of transport	<ul style="list-style-type: none"> • Sell available quantities 	<ul style="list-style-type: none"> • Traders can form groups and use pooled transport
Security of homestead while away searching for fodder	<ul style="list-style-type: none"> • Identify culprits secretly 	<ul style="list-style-type: none"> • Government to improve on security
Risk of being attacked by dangerous animals e.g. snakes	<ul style="list-style-type: none"> • Walk/search for fodder with caution 	
Levies on fodder for sale	<ul style="list-style-type: none"> • Sometimes traders evade the council by getting fodder very early in the morning 	<ul style="list-style-type: none"> • Government should recognize fodder trade and extend services e.g build sheds for traders
Lack of officially designated market place	<ul style="list-style-type: none"> • Sell by the roadside 	<ul style="list-style-type: none"> • Government should set aside market place for fodder
Market fluctuations (buyers and prices)	<ul style="list-style-type: none"> • Try to maintain customers' loyalty • Reduce amount of fodder for sale when there are few customers 	<ul style="list-style-type: none"> • Conserve fodder when in excess
Defaulting customers	<ul style="list-style-type: none"> • Try not to sell on credit 	
Poor quality of fodder especially during the dry season	<ul style="list-style-type: none"> • Search for fodder far away • Sell at low price 	<ul style="list-style-type: none"> • Practice fodder conservation
Lack of knowledge on fodder (type, quality, production and management)	<ul style="list-style-type: none"> • Use experience or indigenous knowledge 	<ul style="list-style-type: none"> • Government should provide training: Extension workers, Institutions e.g. TALIRI, LITA, SUA, etc.
Poor working equipment	<ul style="list-style-type: none"> • Use simple cheap equipment 	<ul style="list-style-type: none"> • Take loans to buy equipment
Lack of efficient means of transport	<ul style="list-style-type: none"> • Make use of cheap means or hire 	<ul style="list-style-type: none"> • Government to provide credit scheme where traders can take loans
Lack of capital	<ul style="list-style-type: none"> • Borrow money informally from each other 	<ul style="list-style-type: none"> • Traders should form groups which can assist in accessing credit

Opportunities in fodder marketing

- The fodder market presents an opportunity for improving the livelihoods of rural and urban poor due to the following observations:
- Rising demand for fodder especially in urban areas
- Presence of actors along the fodder value chain: there is potential to organize the actors and set up structures to grow fodder businesses in rural and urban areas
- There is huge potential for fodder value addition along the fodder market value chain
- There is huge opportunity to streamline policy and institutional support structures and services for fodder businesses in Tanzania
- There is opportunity to build the capacity of all fodder market actors along the value chain in order to grow businesses

Suggested areas of intervention

The following suggested areas of intervention:

1. Dissemination of improved fodder technologies: Improved access to quality forage seeds and technical information on fodder production, management and utilization.
2. Fodder conservation: This should be enhanced both at farm and market level.
3. Utilization options to improve fodder quality and intake; integration of grass-legumes mixtures; .
4. Provision of market and technical information relevant to the whole fodder value chain.
5. Collective action: This can achieve economies of scale, and efficiency in marketing and service acquisition and delivery.
6. Expand fodder production by private and government institutions: Utilize their expansive land optimally to help address the rising fodder demand.
7. Fodder irrigation: As a mitigation strategy to scarcity of fodder during the dry spells

Suggested areas for further research

The following are suggested areas for further research:

1. Identification of forage seeds that are short maturing, drought and disease tolerant
2. Spatial and temporal variability in quality, volumes and price of fodder in the market.
3. Application of Feed Quality Index for pricing fodder along the value chain.
4. Improving the efficiency of fodder market in solving feed shortage in smallholder dairy farms and increasing the incomes of feed value chain actors.

Conclusions

The demand for fodder is rising due to i) increasing number of dairy farmers in urban areas as result of increasing demand for milk and meat ii) the fact that many open areas around towns which in the past have served as sources of grazing fodder are decreasing due to increasing urbanization, hence dairy farmers in these areas will increasingly depend on purchased fodder. The shrinking open areas for grazing around towns means that fodder sources will fall further and further away from demand areas and consequently, there will be an increase in cost of fodder transportation and fodder prices. Since market access has been shown to be a major factor driving smallholder dairy production, profitability will remain higher in the urban and peri-urban areas and hence fodder market will continue to play a role in provision of year round feeds. Improving the efficiency of fodder market will therefore make dairy farming more profitable and provide income generation opportunities particularly for women and the youth.

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Appendix I. Checklist for Focus Group Discussion with fodder producers and Gatherers

Introduction

This tool will mainly focus on collecting data through Focus Group Discussions with farmers/fodder producers to gain an understanding of their role in the fodder value chain. It will address issues to do with production, demand and supply, seasonality, quality, conservation/processing, trading throughout the year, support services, constraints; and gender and policy issues that affect fodder production. Some effort will be put in quantifying some aspects of the consensus reached during the discussions.

1. Production environment

- For those who have livestock, what are the common feeding systems used in the area by season (by show of hand, count the number of participants)?

	Only grazing (free-range or tethered)	Mainly grazing with some stall feeding	Mainly stall feeding with some grazing	Only stall feeding (zero grazing)
Dry season				
Wet season				

- What prompted you to start trading with fodder?
- How common is fodder marketing? How has it been like in the last 10 years or so?
- How is the rainfall pattern in your area? Out of a total possible score of 10, what is the proportion of rain received in each month?

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (score 0-10)												

- Which are the common fodder types produced during the wet and dry season (list)? Why are these types fodder common?
- What is the average fodder acreage? Has this acreage increased or decreased in last five years? Why?
- How far do you travel to gather fodder for sale? How big is the area from which you gather fodder?
- How do you produce the fodder? (selection of seed/planting material, planting, crop management, harvesting).
- What role do you play in the management of fodder in the areas where you gather from?
- How do you maintain/improve the quality of the fodder produce/gather?
- Where do you seek information of fodder production; what type of information do you seek?

- k. Which constraints do you face in fodder production/gathering? What are the possible solutions?
- l. Who between men and women are more involved in production/gathering of fodder for sale? Why?

2. Quality of fodder

- a. How do you assess the quality of fodder? (list the characteristics/attributes)
- b. What factors affect this quality and how do you mitigate these effects?
- c. How does the quality differ in different seasons?
- d. How do you consider quality when pricing fodder; do you set a higher price for fodder perceived to be of higher quality?
- e. What quality attributes justify higher pricing of fodder? Why?
- f. What other factors do you consider when pricing fodder?
- g. How is fodder stored? What are the costs and advantages/disadvantages of storing fodder?

3. Fodder marketing

- h. Where do you sell your fodder? (list geographical locations and distance in Km. with reference to the FGD site. Are there different markets for male and female producers and if so why? Do these locations differ by season?
- i. To whom do you sell fodder? Who are the most important buyers; why?
- j. **How do you source** for market for your fodder?
- k. How do you take/transport your fodder to the market? How much does it cost? (probe on fluctuations in transportation costs).
- l. What if any are your contractual arrangements? (this may be with regard to pricing, payment, quotas etc).
- m. How do the producers and buyers set the selling/buying price of fodder? What factors do they use to bargain?
- n. In what form do you sell the fodders? Why?
- o. If any, what kind of processing is done, why and how is done?
- p. What are the advantages/disadvantages of processing fodder?
- q. Do you practice feed conservation?
- r. What feed conservation methods are used?
- s. What problems are identified/ observed with feed conservation? And what are the potential solutions/interventions?
- t. **How much fodder is sold in each month? Out of a total possible score of 10, what is the proportion of fodder sold in each month?**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sales (score 0-10)												

- u. What challenges do you face when selling fodder? Are there differences between males and female producers? How do you cope with these challenges and what are possible solutions?
- v. Are forages/fodder prices the same throughout the year? Which month(s) is the price highest; which month(s) it lowest? What causes these differences?

4. Constraints

- a. What are the major challenges in producing/gathering fodder for the market? Are they different for male and female producers? What are your coping strategies? What are the possible solutions? (list on the flip chart)

Challenge	Rank	Coping strategies	Suggested solution

- b. Are farmers organized with the aim of solving some of these constraints?
 c. If yes, how are they organized? Groups, Cooperatives, Associations etc.
 d. What support services are available to fodder producers? How accessible are they?
 e. What support services do you need but are not readily available? Who can best address this issue and how?
 f. What do you see as the future of fodder marketing?

Appendix II. Checklist for Focus Group Discussion with Traders

Introduction

This tool will mainly focus on collecting data through Focus Group Discussions with traders (wholesale, retail) to gain an understanding of how fodder markets function, their scope, dynamics and role in fodder value chain. It will address issues to do with demand and supply, seasonality, quality, conservation/processing, trading throughout the year, transaction costs, support services, constraints and opportunities; and gender, institutional and policy issues that affect fodder marketing. Quantitative information will be collected wherever/whenever possible during the discussions.

5. How did you establishment your business?
 - a. What prompted you to start trading with fodder? Why and how did you start?
 - b. How common is fodder marketing? How has it been like in the last 10 or 5 years or so?
 - c. How did you obtain your starting capital? What kind of equipment did you need and how did you obtain it?
 - d. Between males and female traders, who are the majority (wholesalers, retailers, informal) traders? How has this changed over the years? How?

6. Which are the common fodder types that you trade with?
 - a. What are the commonly traded fodder types? (list on flip chart fodders traded during the wet and dry season) Why are these fodder types common?
 - b. In what form are the fodders bought and sold?
 - c. Are the fodders processed while in your possession? If so, what kind of processing takes place? What is the impact of this processing?
 - d. How do you store different types of fodder? What is the impact if any, of storing fodder?
 - e. **What volume/quantity of fodder is traded in different months of the year?** Out of a total possible score of 10, what is the proportion of fodder sold in each month?

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Qunativity (score 0-10)												

7. What are your sources of fodder and how do you go about the purchases?
 - a. How do you source for fodder?
 - b. What are your sources of fodder during the wet and dry season? (list sources and geographical locations on the flip chart)
 - c. How far do you go to source for fodder (during the dry and wet season)?

- d. What factors do you consider when negotiating prices with the suppliers you buy fodder from?
 - e. What are the contractual arrangements?
 - f. How do you transport the fodder? What is the cost and how is it determined?
 - g. How consistent are your fodder sources throughout the year?
 - h. Are there instances when you source for fodder outside the normal sources? When and why?
 - i. Do you experience problems in finding people who sell fodder to you? If yes, why?
 - j. What strategy do you have to make sure you can get supplies when needed?
 - k. What do you consider as good quality fodder?
 - l. How does quality influence your fodder purchases?
 - m. How stable are feed product buying prices?
 - n. How do you cope with price variability?
8. Where do you sell fodder, who are your customers and how do you conduct the business?
- a. Who are your customers? (list on flip chart) Where do they come from?
 - b. Do they always purchase fodder from you? Why?
 - c. What factors do you consider when negotiating prices with customers who buy fodder from you?
 - d. How do the prices vary in different months/seasons of the year?
 - e. What are the fodder price ranges for different fodders traded by season?
 - f. Do you experience problems in finding people to buy fodder from you? If yes, why?
 - g. What strategy you have for attracting customers?
 - h. What do your customers consider as good quality fodder?
 - i. How does quality influence your their purchases?
 - j. What strategy do you have any for trying to get customers to be regular/loyal?
 - k. **What** other products and inputs do you commonly traded in?
9. Which support services are available to you? What kind of support do you give/receive?
- a. Do you offer credit facility to your customers? If so what are they? If not, why?
 - b. Which credit facilities are available to you? If so what are they? If not, why?
 - c. Do you offer technical advice to your customers? If so what kind?
 - d. Have you received any training? If so what kind and from where?
 - e. What skills are you lacking that would help you to run your business? What are the barriers to obtaining these skills?
 - a. **Are you a member of any trading association? If so** yes, which one? What are the benefits of the membership?
 - b. How do you interact with other traders in the market?
10. What challenges do you encounter in your business how can they be overcome?

- a. How do the challenges affect male and female traders?
- b. Do you plan to expand to new markets?
- c. What strategy will you use to expand?
- d. Are there any government policies that affect your business (e.g. local gvt. by-laws, land policies, et. ?
- e. What are the advantages/disadvantages of these policies?
- f. What are your coping strategies?

Challenge	Rank	Coping strategies	Suggested solution

Appendix III. Checklist for Focus Group Discussion with Consumers

Introduction

This tool will mainly focus on collecting data through Focus Group Discussions with consumers (farmers who purchase fodder for the purpose of feeding their animals) to gain an understanding of demand and supply of fodder, access to and the role of fodder markets in meeting fodder demands (in terms of quantity and quality), market dynamics and constraints and opportunities, and gender issues. Effort will be put in quantifying some aspects of the consensus reached during the discussions.

11. Consumption environment

- a. What feeding systems do you practice by season (by show of hand, count the number of participants)?

	Only grazing (free-range or tethered)	Mainly grazing with some stall feeding	Mainly stall feeding with some grazing	Only stall feeding (zero grazing)
Dry season				
Wet season				

- b. Which fodder type do you normally buy? Why do you buy that type of fodder?
- m. How much fodder do you buy during each month of the year? Out of a total possible score of 10, what is the proportion of fodder bought in each month?

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Prop. of Fodder (score 0-10)												

12. Fodder purchases

- a. Where in the wet and dry season do you purchase most of your fodder and in what form is it? (Which geographical location & approx. distance, which traders?) How often do you make purchases?
- b. How do you choose the people to buy fodder from? How does the choice differ between male and female consumers?
- c. What factors do you consider when negotiating prices with feed sellers?
- d. What contractual agreements (if any) do you have with the sellers?
- e. How variable are fodder prices? (when are they highest, when are they lowest?)
- f. How do you assess quality before buying fodder? Observation: feel, smell, appearance, testing etc)

- g. How does fodder quality influence your purchases? (cost, preference etc)
- h. When buying, do you pay a higher price for feed products perceived to be of higher quality? What quality attributes receive the best prices?
- i. In what form do you buy fodder? (fresh, loose, baled, processed etc.?)
- j. How variable is fodder supply? Which months is supply high, which months is the supply Low? (Score against the months: 1= no supply, 2 very low, 3= Low, 4 = High, 5 = Very high)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fodder supply												

- k. How do you transport fodder? What is the cost of transportation?

13. Fodder utilization

- a. In what form do you feed purchased fodder
- b. Do you process fodder after you purchase? If so, how do you process? What are the advantages/disadvantages of processing?
- c. What other feeds do you feed together with purchased fodder? How do you decide on the quantity of each feed?
- d. How do you store purchased fodder? If so, in what form? What are the costs, advantages/disadvantages of storing fodder?

14. Support services

- a. Do you receive technical assistance with regard to fodder purchasing and/or utilization? If so, what kind of assistance do you receive and from where do you obtain it?
- b. What other support services do you need but are not readily available? Who can best address this issue and how?
- c. Do you use credit or borrowed money? If yes, from where do you obtain credit and what do you mainly use it for? If not, why? How does use of credit facility differ between male and female consumers?

15. Constraints

- a. What are the major challenges in purchasing fodder? Are they different for male and female consumers? What are your coping strategies? What are the possible solutions? (list on the flip chart)

Challenge	Rank	Coping strategies	Suggested solution

- g. Have you joined any organizations with the aim of overcoming some of these challenges?
- h. If yes, which organizations? Groups, Cooperatives, Associations etc.
- i. How do these organizations help to overcome these challenges?
- j. What do you see as the future of fodder marketing?
- k. What future plans do you have of increasing/reducing your fodder purchases?

End of discussion

Appendix IV. Questionnaire for collecting individual information

Site: _____ FGD: _____ Date: _____

1. Participant ID _____
2. Where do you reside? _____ Location, _____
_____ District
3. Where do you operate your business? _____ Location, _____
_____ District
4. Gender _____ 1 = Male; 2 = Female
5. Age Group _____ 1 = Below 18yrs; 2 = 18 – 25yrs; 3 = 26 – 35yrs; 4 = 36 – 45yrs; 5 = Above 45yrs
6. Education Level _____ 1 = None; 2 = Primary; 3 = Secondary; 4 = Tertiary
7. Km to your farm/ business _____ Km.
8. Business Type _____ 1 = Producer; 2 = Transporter; 3 = Trader (wholesale); 4= Retail trader; 5 = Consumer; 6= Gatherer; 7= Other (specify)
9. Are you a dairy farmer? _____ 1 = Yes; 2 = No
10. Fodder acreage? _____ acres
11. How long have you been in this business? _____ Years
12. Which are the tree most common fodder types that you sell/purchase (in their order of priority)? Type 1 = _____; Type 2 = _____ Type 3 = _____
13. How much of the three most common fodder types do you sell/purchase (average per week) during the wet and dry seasons?

Fodder type	Season	Unit	Cost/unit (Tsh)
I	Dry		
	Wet		
II	Dry		
	Wet		
III	Dry		
	Wet		

Feed codes: 1 = Napier grass; 2 = Cut grass – dry; 3 = Cut grass – fresh; 4 = Maize stover – green; 5 = Maize stover – dry; 6 = Gras Hay; 7 = Lucerne hay; 8 = Lucaena leaf meal; 9 = Other feed (name) _____

Unit codes: 1 = 90 Kg Gunny Bag/sacks; 2= Bale; 3 = Wheel Barrow; 4 = Donkey cart load; 5 = Bundle; 6 = Heap; 7 = Hand cart load; 8 = Pick-up truck load; 9 = Other (specify)

Appendix V. Checklist for Key Informant Discussion

Introduction

This tool will mainly focus on collecting data through Informal Discussions with key people Informal discussions with at least five (5) key people involved in/associated with or have deep knowledge about fodder markets. We propose individual large scale farmers growing fodder for sale or key fodder traders/consumers, extension staff, staff of dairy cooperatives/dairy board etc. The objective is to gain a general understanding of the overall structure and functioning of fodder markets, market dynamics and constraints, the role of different stakeholders and general policy, institutional and gender issues.

16. What is the structure, functioning and overall status of fodder marketing in this area?
 - a. Who are the actors?
 - b. What are the fodder types traded?
 - c. How are they traded?

17. What is your role as far as fodder marketing is concerned? Do you:
 - a. Supply fodder?
 - b. Purchase fodder?
 - c. Regulate? If so how?
 - d. Offer technical services?
 - e. Offer other services? If so which services?

18. What are the challenges in fodder marketing? What strategies can be put in place to overcome these challenges?

19. What do you see as the future of fodder marketing?
(expansion, formalization, collective actions etc?)

20. What are the policy, institutional and gender issues affecting fodder marketing?
(Taxes, licenses, other regulations),

21. How can the market be improved in order to address the constraint of feed shortage
(in terms of quantity and quality) in smallholder dairy farms?

Appendix VI. Feed sampling guide

Sampling procedure:

Feeds to be sampled

- The forage and feeds chosen for sampling and analysis should be the three most common of presence and quantity.
- Identify feed to be sampled.
- Mix the whole quantity thoroughly.
- Take a known sample (preferably 500 g)
- Samples should be sent to the lab immediately. If it is not possible to send immediately, fresh samples may be kept in the open in a shade to avoid rotting.

Sampling fresh forage, silage, and high moisture products

Take fresh forage, silage, and high-moisture products samples at source i.e. from the bag, heap, store etc.

Fresh forage

Chopped forage material: Randomly take several handfuls from the top, middle and bottom of the pile of fresh forage into a plastic container. Mix silage thoroughly, and scoop a sample from this composite into a brown paper bag (provided).

Un-chopped forage material: Randomly select up to 6 -10 whole plants of fodder from the heap of feed. Chop the material, allow for seepage, mix thoroughly and scoop a sample from this composite into a brown paper bag (provided).

Loose forage material e.g. cut grass, weeds etc: Randomly scoop out handfuls from different locations of the lot, chop the material and follow the same procedure as above.

Silage can be sampled from the silo, tube or the package. If packed, collect silage from several representative packages by taking random handfuls. If samples are taken from a silo, secure random handfuls of silage from at least 10 different locations over the exposed surface area of the silage in a large plastic container. Avoid sampling from moldy or spoiled areas in silo or tube. Mix silage thoroughly, and scoop a sample from this composite into the brown paper bag (provided) then into a plastic sample bag. Exclude air, seal tightly and identify the sample. Make sure that the silo is covered tightly again after you sample.

Sampling dry forage, hay and pasture

The general procedure of sampling dry forage is the same as for the fresh forage. Except that when handling dry forage care must be taken to minimize leaf loss. Leaf loss will cause inaccurate results.

Hay: When sampling many bales or heap of loose **hay**, sample from different locations in the storage area. Grab handfuls of hay from different bales or lots of loose hay into a container. Mix thoroughly and sub sample from this composite into the brown paper bag provided.

Pasture: To sample **pasture**, clip all the forage within randomly selected quadrants to 2.5 cm (1 inch) above the ground. Mix thoroughly and sample from this composite into a brown paper bag provided.

Sampling feed ingredients

Sacked feed: If the ingredients are in sacks, a double –handful sample from each sack should be combined in a clean container. Mix the samples thoroughly and take a composite sample for analysis. Be aware that settling is quite common, even in sacked feed, hence thorough sampling is important.

Sample labelling

Once the representative sample is properly collected, the process is not yet complete. Samples must be accurately labeled. Label the bag with sample information using a marker pen. In addition to this fill the "sample input" form and staple on the sample bag. The form information and proper sample identification (coding) are extremely important to enable the laboratory to perform the correct analytical procedures. The information on sample bag will include **date sampled, sample code, description of type of feed/ forage material site ID and Farmer ID**. Use the information on sample form provided.

General guidelines to sampling and sample handling:

- Politely seek owner’s permission before you sample
- Do not crumple dry hay or grass when sub sampling as it often results in loss of leaves. Leaf loss will cause inaccurate results
- If there is no facility for immediate weighing, place samples in polyethylene bags and seal tightly so the laboratory can determine a dry matter concentration similar to that in the sample when collected.
- Use clean plastic containers and sampling equipment to avoid contamination of the sample by other feedstuffs.

Sample information form	
Date of Sampling:	
Sample no.	
Sample name: (eg Rhodes grass, Napier grass, dry maize stover etc)	
Collected by:	
Site ID (Name): District & Village	
Source ID (Name owner)	
Source of fodder (district, village, name of farm etc.)	
Type of business (producer, trader or consumer)	
Fresh or Storage form:	

Stage of maturity: e.g. knee high, waist high, milk stage, dough stage, flowering stage, dry harvesting stage, overgrown, etc	
Plant part (leaves, stem, whole etc)	
Remarks: i.e. moulded, yellow coloured, stemy, etc	

Appendix VII. Stakeholders' Workshop report

Stakeholders' Workshop report

20th January 2016, Dar-es-Salaam, Tanzania

Introduction

The goal of Maziwa Zaidi is an inclusive and sustainable development of the dairy value chain in Tanzania. However, a major challenge among others, is to develop business solutions for year round availability of quality dairy feeds. As part of the activities aimed at addressing this challenge, the International Livestock Research Institute (ILRI), in collaboration with Tanzania Dairy Board and other partners undertook an activity to understand fodder markets and fodder trading patterns in Tanzania. The study comprised intensive discussions with fodder producers, traders, consumers and key informants in six sites covered by the MilkIT project. These discussions took place in November 2015.

Workshop objectives

The objectives of the stakeholders' workshop were to share the preliminary results of the fodder markets study and to identify potential interventions for improving market performance, and improving utilization of quality forage.

Workshop process and agenda

To maximise the opportunity for participation by the stakeholders present, there were a number of brief scene-setting and study results presentation, time for facilitated discussions guided group work sessions and plenary.

Opening session

Opening remarks

In his opening remarks, the ILRI country Representative Dr. Amos Omore stressed on the importance of putting into practice research findings. Utilization of new knowledge, he said, is what makes the difference in the performance of developed and developing countries. He urged participants to continue seeking knowledge and to take action wherever and whenever they are called to do so. He reminded participants that the fodder market study aimed to inform stakeholders on how dairy production can be efficiently carried out in areas of feed deficit through fodder trading and hoped that the forum would come up with tenable suggestions.

Setting the scene

Dr Ben Lukuyu gave a background of the fodder marketing study. He observed that whereas farmers strive to produce their own forages, they often do not meet their demand due to a number of reasons, including limited land to grow forages, too many stock for the available forage supplies and strong effects of seasonality of rainfall on available forage. Therefore to try and meet the deficit, they usually purchase forages off farm, underfeed cows or feed excessive levels of concentrates, a strategy that is costly to most smallholder farmers. Anecdotal evidence had shown that there existed fodder trading around peri urban and urban towns in Tanzania and that the market was growing in importance for (i) the landless and urban and peri urban dairy farmers that have very limited ability to produce their own fodder; (ii) farmer that need access to quality fodder at reasonable prices to be able to produce milk economically and at competitive cost and (iii) as a business for the unemployed. However, it was unclear how far businesses engaged in fodder markets can serve beyond urban and peri-urban areas where they had been observed.

The objective of the fodder market study are:

1. To develop a systematic understanding of fodder markets and interactions among various players along the fodder value chain.
 - a. Mapping the fodder value chains i.e. identifying the main fodder products and the market actors: producers, intermediaries and consumers.
 - b. Profiling the fodder value chain actors including their socio-economic and gender characteristics as well as their roles and needs in the fodder value chain.
 - c. Establishing and characterizing the market chain linkages between production and consumption ends of the fodder value chains.
 - d. Determining the distribution of margin among actors along the fodder value chain.
 - e. Determine how far fodder markets can serve beyond urban and peri-urban areas?
2. To quantify the variation in nutritive value of different types of traded fodder in relation to market availability and nutritive value as perceived by different actors in the chain.
 - a. This will include annual fodder trading, demand and price patterns, including variations in types of fodder according to seasons.

The study will encompass the following activities:

- a. Geographical targeting: This activity will involve
 - identifying areas in Tanzania where planted fodder and fodder trading can be used to alleviate feed scarcity.
 - a qualitative assessment of factors that offer incentives for fodder market development.
 - include mapping of markets, overlaid with livestock density and forage production areas.
- b. A rapid appraisal of the study sites will be carried out
 - to develop a better understanding of the existence of fodder markets and their functioning including concentration and distances served, as well as the roles and needs of the various actors along the fodder market chain and
 - to establish the role of traded fodder in alleviating feed shortfalls in dry seasons for both male and female small-holder dairy producers.
- c. Quantification of nutritive value of traded fodder:
 - The nutritive value of fodder from major fodder markets will be assessed based on samples collected on the market.
 - Price/quality relationships for various traded fodder will then be analyzed
- d. Dissemination of findings:
 - A final workshop involving representatives of stakeholders and partners (possibly link to the Tanzanian Dairy Development Forum (DDF)) will be held to share the overall findings of the study and their implications for future action.

- This engagement with the stakeholders and partners will be used to solicit their feedback on the study findings and potential ideas for intervention.

The following deliverables are expected from the study:

1. Types and quality of fodder traded on the market identified.
2. Quality relationships required for ration balancing and feed substitution research developed.
3. Criteria for emergence of fodder markets identified
4. Actors in the fodder value chain identified and their roles described
5. Distribution and margins of actors in the value chain described
6. Recommendations that will ensure fair distribution of margins across the actors and ensure efficient performance of the chain made.
7. Guidelines for identification of quality fodder on the market developed
8. Geospatial map showing potential for fodder markets in Tanzania
9. A fodder trading manual produced

Understanding Fodder Markets and Fodder trading patterns in MoreMilkiT sites in Tanzania

Methodology

Study sites:

The study was carried out in the following sites:

1. Northern zone : i) Kilimanjaro, ii) Arusha
2. Coastal area: i) Tanga, ii) Dar es Salaam
3. Eastern zone: Morogoro
4. Lake region: Mwanza

Data collection:

Focus Group Discussions

The study used different checklists, tape recorder, personal observation and camera to collect information through Focus Group Discussions with fodder market actors: producers, traders, consumers and form Key Informants. A semi-structured questionnaire was used collect information on the individual profiles of the actors.

Feed sampling

Three samples each of at least 3 major fodder types sold or purchased (in terms of volume and availability) were collected from different producers, traders & consumers. The samples would be used to assess the quality of fodder at different nodes of the fodder value chain.

Prior to the start of the field activities, a planning meeting was held to review the tools, budget and logistics.

Preliminary findings

The following key results were presented:

Actors

Types

Three types of actors were identified:

1. Producers:

- Institutions (Private, public)
- Large-scale farmers
- Small-scale farmers

2. Traders:

- Gatherers
- Retails traders
- Wholesale traders

3. Consumers

- Buy to supplement
- Depend on purchased fodder only

Number

It was observed that there did not seem to be any cultural barriers in fodder marketing, hence both male and female participants were equally active during the focus group discussions. However, the proportion of producers was very low especially compared with that of consumers (21 vs. 142). Male producers and traders (14 and 65 respectively) were more than females (7 and 25 respectively) but female consumers were more than males (59 vs. 83). Among the producers, majority (80%) were farmers with less than five acres of land. The majority of traders were gatherers (approx. 68%) while majority of consumers produced their own fodder and bought extra to supplement. It is worth noting that about one third (36%) of the consumers depended solely on purchased fodder.

Majority of consumers (over 95%) and producers (over 70%) were dairy farmers whereas less than 40% of the traders practiced dairy farming. Hence they were conducting fodder trading as a business.

Age

Majority of producers were males over 45 years old, traders were males between 26 and 35 years old and consumers were both males and females over 45 years.

Education level

Overall, majority (61%) of participants had attained primary school education; on the other hand only six (2%) participants (five traders and one consumer) had not formal education.

Distribution by gender

Majority of producers were males across all sites whereas there were more male traders in all sites except Moshi and Tanga. Majority of consumers were females except in Mwanza and Arusha.

Fodder types traded

A wide range of fodder types were traded but the most common included natural grass mixture, Rhodes grass (in form of hay), elephant grass and crop residues (rice straw, bean haulms, dry maize stover, vegetable waste and banana stems and leaves). Grass mixture was available throughout the year but crop residues were available during the harvesting seasons. Some of the farmers purchased crop residues during the harvest and stored for later use.

Reasons for buying and selling:

Majority of consumers purchased fodder to supplement their on-farm production. However, they also purchased fodder which was not available locally in order to have a good mix and in other cases to improve the quality of the fodder available on-farm. Most producers, being dairy farmers, sold

fodder that was in excess of what they required for their own animals. Majority of the traders carried out fodder trading as a business.

Quality assessment:

Visual assessment was the common method of determining fodder quality among all actors. Indicators of quality included green colour, absence of foul smell, high leaf to stem ratio, absence of undesirable plants and right stage of maturity (not too young or too old). Generally, the price of fodder was determined by quantity and quality.

Policy and institutional issues

Although fodder trading was a thriving business, there is no formal policy and institutional structures for fodder trading. For example there are no formal fodder selling points, guidelines or information system. Further fodder trading is not recognized by local or national governments.

Constraints, coping strategies and solutions

Whereas constraints differed between the different actors, insufficient fodder supply due to seasonal effects, lack of capital and lack of technical knowhow were common challenges among all of them.

Future of fodder marketing

The number of dairy farmers in urban areas is increasing due to increasing demand for milk; hence the demand for fodder is also rising. Dairy farmers have in the past obtained fodder from open areas around towns but these areas are decreasing due increasing urbanization, hence dairy farmers in these areas will increasingly depend on purchased fodder. There is therefore likely to be an increase in demand for fodder since most urban farmers often rely on purchased fodder and fodder sources will fall further and further away from demand areas. This is likely to result in increase in cost of fodder transportation and generally in fodder prices.

Opportunities in fodder marketing

There is rising demand for fodder especially in urban areas and hence:

- There is potential to organize fodder market actors and grow fodder businesses in rural and urban areas
- There is huge potential for fodder value addition along the fodder market value chain
- There is huge opportunity to streamline policy and institutional support structures and services for fodder businesses in Tanzania
- There is opportunity to build the capacity of all fodder market actors along the value chain in order to grow businesses

Question and answer session

Qn 1: Is fodder shortage a problem in urban and peri-urban problem or it also exists in the extensive livestock production systems (grazing) and also among other livestock species (Goat and sheep)?

Response: The fodder market study focuses on dairy cattle feeds only, in line with the objectives of “Maziwa Zaidi” activities. However, fodder marketing is predominantly in urban and peri-urban areas where dairy production is carried out.

Qn 2: What can the government do to support and train/facilitate farmers to improve their dairy breeds and increase their knowledge of pasture production particularly selection of high quality species? Is it possible to set aside specific areas for production of high quality fodder?

Response: From the results of this study the project will come up with recommendations for appropriate interventions and forward them to the right government authorities and stakeholders.

Qn 3: What are the current project plans for soliciting for seed banks from the government?

Response: The question was a subject for discussion and would be addressed in the afternoon group session.

Qn 4: What are the strategies for ensuring that there are suitable species for cooler areas in order to overcome effects of heavy rainfall and hay spoilage?

Response: The question should be addressed in the group discussion.

Qn 5: What can be done to the challenge of low milk price?

Response: The question should be addressed in the group discussion.

Qn 6: How can the farmers be educated on fodder harvesting?

Response: The question should be addressed in the group discussion.

Group discussions

The participants were divided into three groups and each allocated a topic of discussion. The discussions were organized as follows:

Topics of discussions:

Group 1: Interventions to improve fodder production

Group 2: Interventions to improve functioning of fodder markets (buying and selling)

Group 3: Interventions to improve fodder storage, delivery, processing and utilization

Each of the topics was categorised into the following:

- Issues for immediate action and implementation
- Issues that need recommendations to policy makers for follow up.
- Issues that require new knowledge to improve fodder markets.

For each category of issue, the groups were expected to come up with suggested interventions and who is best placed to design and implement them. The results of group discussions were presented and discussed in the plenary:

Table 1 –App viii. Interventions to improve fodder production

Categories of issues	Suggested interventions	Who is best placed to design and implement
Group 1		
Issues for immediate action and implementation.	<ol style="list-style-type: none"> 1. Farmers to be encouraged to give fodder the same priority as other crops. 2. To increase production of pasture seeds. 3. Put in place sustainable strategies for breeding and bulking of fodder crops. 4. Use of agricultural technologies 5. To incorporate forage legumes with grass pasture 6. Establish irrigation schemes for forage production 7. Education on pasture production 	<ul style="list-style-type: none"> - Local Government, - TALIRI, Government institutions - NGO'S, Small Industries Development Organization (SIDO), Center for Agricultural Mechanization and Rural Technologies (CAMARTECH) - Research Institutions - Tanzania Official Seed Certification Institute (TOSCI), SEED COMPANIES - TALIRI, Government institutions
Issues that need recommendations to policy makers for follow up.	<ol style="list-style-type: none"> 1. Government to set aside land for fodder production and to streamline land tenure system 2. Introduce water harvesting for the purpose of fodder production 	<ul style="list-style-type: none"> - Local Government i.e. District and village Government - NGO'S - CBO'S - Farmers
Issues that require new knowledge to improve fodder markets.	<ol style="list-style-type: none"> 1. Carry out research to come up with fodder seeds that are disease and drought resistant. 	<ul style="list-style-type: none"> - Local Government, Research Institutes and Universities

Categories of issues	Suggested interventions	Who is best placed to design and implement
Group 2		
Issues for immediate action and implementation.	<ol style="list-style-type: none"> 1. Enhancing communication among actors 2. Promote fodder trading through exhibitions (Agric. shows, Milk week) and media. 3. Construction of temporary sheds to maintain fodder quality 4. Improvement in means of transport from production point to consumer 5. Training on feed conservation 	<ul style="list-style-type: none"> - Local Government through extension services - Ministry of Agriculture, Livestock and Fisheries Dev. - Traders and Gatherers - Ministry of Agriculture, Livestock and Fisheries Dev.

Issues that need recommendations to policy makers for follow up.	<ol style="list-style-type: none"> 1. Provision of officially recognized fodder market place by the Govt. 2. Clear policy on Fodder market should be set and made clear among producers, traders and consumers 3. Soft loans and financial assistance from financial institutions to producers and traders 	<ul style="list-style-type: none"> - Local Government - Government (central, local) - Financial Institutions
Issues that require new knowledge to improve fodder markets.	<ol style="list-style-type: none"> 1. Knowledge on quality of feeds from different sources 2. To establish a feed quality database and to put into the public 3. Develop a network for fodder market information 4. Research should be continued to ensure supply of fodder inputs according to ecological zones to reduce trading costs (The Government should allocate enough funds for Research). 5. Assess feed hazards along the fodder market value chain 	<ul style="list-style-type: none"> - Research organizations (ILRI). - ILRI - Research Institutions and Organizations

Categories of issues	Suggested interventions	Who is best placed to design and implement
Group 3		
Issues for immediate action and implementation.	<ol style="list-style-type: none"> 1. Training stakeholders on simple methods of silage making, hay making, 2. Introduce simple ways of storage e.g. dry and packaging, use of simple chopping machines 3. Encourage the use of fodder store (traders) 4. Encourage formation and use of small groups 5. Package and disseminate information along the chain (pamphlets, SMS, WhatsApp) 6. Introduce simple and cheap technologies for stovers utilization e.g. use of ash instead of salts 7. Encourage planting of high quality fodder to improve quality of purchased fodder 8. Train farmers on simple methods of ration formulation 9. Train of trainers on silage making and other conservation techniques 	<ul style="list-style-type: none"> - Ministry of Agriculture, Livestock and Fisheries Dev. (MALF) - Universities (SUA), Research Institutions (TALIRI), Local Governments (LGAs), NGOs, Actors in the fodder market value chain (farmers, traders, private sectors) - Local Government through extension services, Actors in the fodder market value chain - Universities (SUA), Research Institutions (TALIRI), Ministry of Agriculture, Livestock and Fisheries Dev., Actors in the fodder market value chain
Issues that need recommendations to policy makers for follow up.	<ol style="list-style-type: none"> 1. Increasing awareness about opportunities to increase fodder market 	<ul style="list-style-type: none"> - TALIRI, LGAs, ILRI
Issues that require new knowledge to improve fodder markets.	<ol style="list-style-type: none"> 1. Fodder safety and quality 	<ul style="list-style-type: none"> - TALIRI, TVLA, TBS, TFDA, ILRI, LGAs, MALF

The way forward for the study is:

- Write the research report and disseminate to all the key institutions.
- ILRI (Maziwa zaidi) will present the results to the stakeholders for implementation e.g. training, proposal development and soliciting for funds in order to facilitate the desired changes or bridging the identified gaps.
- Analysis of feed sample to establish a feed quality database.

In his closing remarks Dr Omore explained that the Dairy Development Forum was a union of all stakeholders along the milk value chain. He further observed that the forum was engaged in identifying constraints, opportunities and to act holistically. Some of the key challenges to which interventions were being designed:

- Improving the dairy hub through introduction of high quality dairy genetics and
- Ensuring year round availability of high quality feeds.

He urged all stakeholders to actively be engaged in order for the forum to realise its objectives.

Appendix VIII. Nutrient content (mean and s.d.) of feed types commonly marketed across all the study sites

Row Labels	No. of samples	CP(%)	NDF(%)	ADF(%)	IVOMD(%)	Me(MJ/Kg)
Natural Grass	75	9.06 ±3.47	73.06 ±6.53	46.89 ±5.36	52.62 ±3.27	7.31 ±0.36
Leucaena	15	27.96 ±4.67	49.21 ±6.70	29.17 ±7.38	63.11 ±4.42	8.33 ±0.66
Napier grass	11	12.62 ±3.45	68.11 ±2.76	42.38 ±4.60	55.15 ±3.34	7.27 ±0.55
Dry maize stover	9	6.00 ± 2.60	75.51 ±6.42	51.00 ±8.50	52.65 ±3.80	7.49 ±0.46
Hay (Cenchrus)	9	3.45 ±0.65	83.26 ±3.54	58.70 ±4.57	47.97 ±4.67	7.30 ±0.64
Bean haulms	8	6.43 ±1.64	62.62 ±8.55	53.88 ±8.52	54.33 ±3.40	7.87 ±0.30
Guatemala grass	5	13.66 ±2.21	72.65 ±4.05	48.75 ±2.32	55.70 ±1.92	7.36 ±0.16
Hay (Rhodes)	5	4.22 ±0.56	77.86 ±0.82	53.87 ±2.07	49.36 ±2.96	7.21 ±0.39
Grass/Legumes Mixture	4	6.96 ±2.20	76.17 ±1.52	52.33 ±3.09	50.13 ±2.67	7.17 ±0.32
Banana stems	3	10.90 ±6.89	62.96 ±5.60	±10.11	44.99 ±1.69	6.67 ±0.39
Elephant grass	3	11.17 ±3.53	72.48 ±4.67	44.45 ±4.74	52.52 ±3.65	7.10 ±0.35
Rice straw	3	9.43 ±2.05	66.50 ±4.43	49.15 ±4.18	48.60 ±2.80	6.34 ±0.37
Chloris gayana	2	4.72 ±0.93	79.55 ±0.99	52.80 ±1.08	53.12 ±4.97	7.78 ±0.77
Grass-weeds mixture	2	10.68 ±1.60	63.75 ±3.92	46.13 ±4.44	55.49 ±0.76	7.61 ±0.49
Mfumum	2	12.09 ±0.21	41.86 ±6.24	36.20 ±2.66	57.13 ±0.00	8.09 ±0.06
Napier-weeds mixture	2	10.95 ±0.16	70.99 ±0.88	44.61 ±0.36	53.27 ±1.01	6.96 ±0.30
Sweet potato vines	2	11.89 ±3.54	41.39 ±0.03	47.36 ±1.61	52.69 ±2.49	7.04 ±0.26
Calliandra	1	25.63	51.47	28.94	61.56	8.31
Garss-vines mixture	1	14.89	57.98	45.07	54.64	6.90
Green Maize stover	1	6.25	64.11	33.00	61.09	9.09
Indica	1	13.04	73.62	40.70	55.62	7.82
Lutema others	1	8.70	71.90	43.15	50.68	7.00
Miboyo Leaves	1	25.55	32.94	20.61	66.27	8.92
Napier-legume mixture	1	13.92	63.33	44.38	58.98	8.24
Wheat-Legume mixture	1	8.00	59.49	48.60	53.23	7.91