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Research Paper

Indigenous feed sources contribution for milk and butter yield in Sidama zone, southern Ethiopia

Tsedey Azeze Tebo

Southern Agricultural Research Institute, Hawassa Agricultural Research Center, P.O. box 2126, Hawassa, Ethiopia.

E-mail: tseyoso@gmail.com

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Abstract. The study was conducted in Hulla, Dale and Loka abaya district representing highland, midland and lowland agroecologies of Sidama zone, respectively. The study assessed available feed sources for dairy cattle and lactating cows, indigenous feed types for increased milk yield and butter amount, supplementary feed provision trend for pregnant and lactating cows, and the feed types. A structured questionnaire and field visual observations were used to assess the local feed sources and utilization practices. The study indicated that improved forages, *enset* (*enset ventricosum*) leaf, natural pasture, and indigenous forage types are among the dominant feed supply sources for dairy cattle in studied districts. The highest availability of indigenous feed types were reported in Loka abaya (40%) than in Dale (33%) and Hulla district (27%).The most common species of indigenous forage types that contribute for increased milk and butter yield in the lowland agroecology were "*Lalunte*" (herb type), "*Shomoda*" (grass species) and *enset* leaf as it was reported by 75, 38 and 64% of respondents respectively. The top two indigenous feed types that contributes for increased milk and butter yield for Hulla and Dale districts were enset leaf and *enset* corm. Regarding the feed shortage, respondents reported December to April as major months of the year that feed shortage occurs and it is more critical in the loka abaya (36%) than in Dale (34%) and Hulla district (30%). Supplementary feed provision trend was better for lactating cows than pregnant cows. Moreover, more supplementation was observed in the midland agroecology followed by highland and lowland agroecology for both lactating and pregnant cows. The top three supplementary feed types for lactating cows were *enset* leaf, *enset* corm and concentrates. Sugarcane stock, *enset* corm and improved forages were ranked as 1st, 2nd and 3rd for pregnant cows, respectively. Finally, it is recommended that to alleviate feed shortage during the dry season, feed conservation practices, introduction of improved forage production is required. Thus, chemical composition and productivity potential of the above mentioned indigenous forage types should be further investigated. In addition to the agronomic study of the indigenous feeds; in-vivo and in-vitro digestibility has to be investigated for efficient utilization of the feeds.

Keywords: Indigenous feed, agroecology, *enset (Ensete ventricosum)*, lactating cows, pregnant cows, sidama zone, Ethiopia.

INTRODUCTION

Despite the large livestock population in Ethiopia, the sector is less productive as compared to its potential. The average milk yield per cow per day for local cows was reported about 1.37 L which is very low (CSA, 2017). The low productivity is due to inefficient nutritional and management practices, the low genetic potential of the indigenous cows, high level of disease and parasitic incidence, poor access to extension and credit services, and inadequate information to improve animal performance (Getahun, 2012; Aynalem *et al*., 2011).

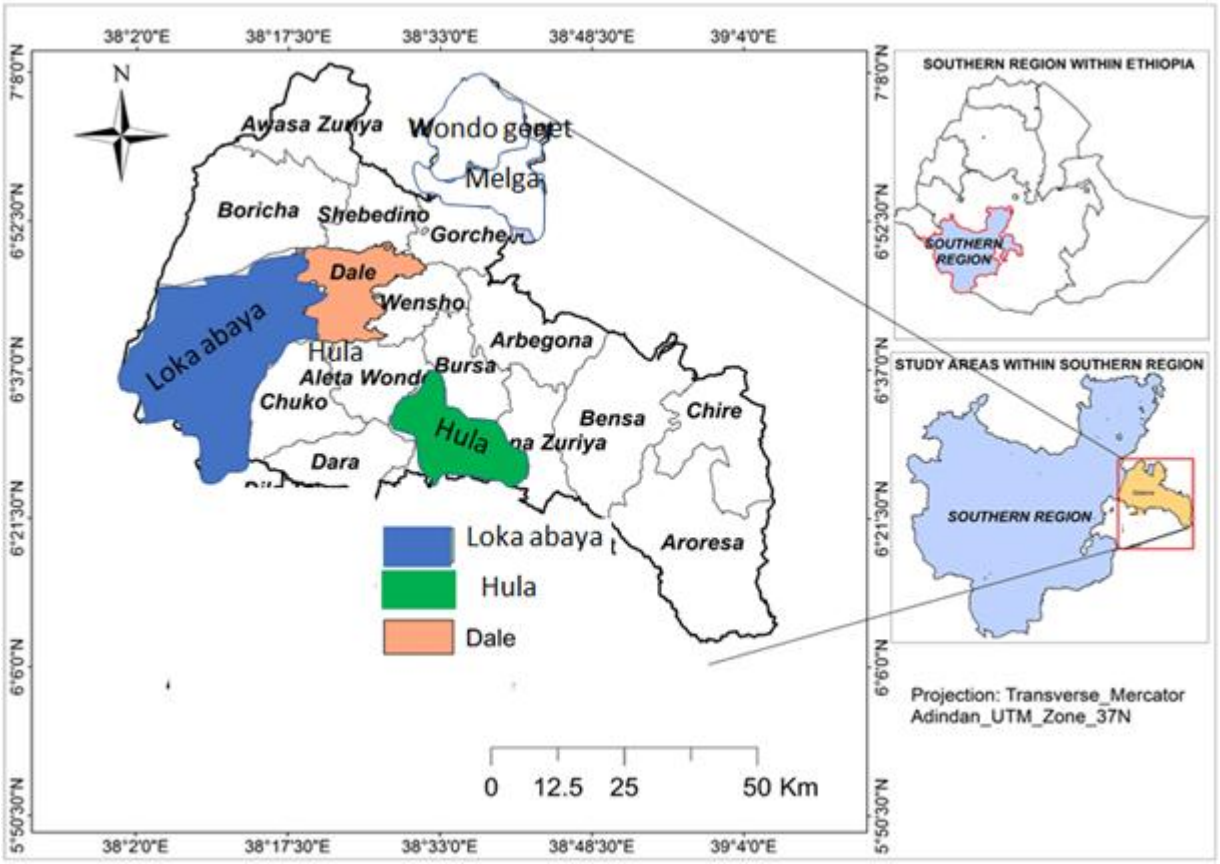

Figure 1. Map of study area.

Inadequate feeds and poor quality of feeds have been cited as the major limiting factors in the development of dairy production in peri-urban and urban dairy systems (Yitaye *et al*., 2008; Asaminew and Eyasu, 2009; Belay *et al*., 2011). Besides, dairy production is among livestock production system contributing for the economy of the Ethiopia as well as for enhancement of the nutritional status of the citizens.

Natural and improved pastures, crop residues, forage crops, agro-industrial by-products and non-conventional feeds are main feed resources for livestock in Ethiopia and Southern Nation Nationalities and Peoples Region (SNNPR) (CSA, 2015). The contribution of feed resources, however, depends on agroecology, the type of crop, accessibility and production system (Ahmed *et al*., 2010). Natural pasture is the main source of livestock feed in Ethiopia though it is gradually declining because of the expansion of crop production into grazing lands, redistribution of common lands to the landless and due to its degradation (Berhanu *et al*., 2009).

Although different improved varieties of feed were introduced in the previous years to improve milk yield, limited work has been undertaken on the improvement of local feed types. Therefore, this study was conducted to identify best indigenous feed types contributing for increased milk and butter yield. So far, there is limited information on the available indigenous feed types and utilization system in different agroecologies in sidama zone. Similarly inadequate information on livestock feed resource was also reported in kersa Malina district, south west of Oromia region, Ethiopia (Ketema, 2014). Thus the indigenous feed resource identification and characterization helps to design feeding alternatives for dairy cows to improve milk yield and butter yield in different agroecologies in Sidama zone

MATERIALS AND METHODS

Description of the study area

The assessment was conducted between October 2017 to October 2018 in the districts of Hulla, Loka abaya and Dale from the highland, lowland and midland agroecology respectively in sidama zone, southern Ethiopia. Hulla district is 366 km from Addis Ababa and 91 km from Hawassa town (Figure 1). The altitude for Hulla district is 2001 to 3000 m.a.s.l. Loka abaya is located 62 km from Hawassa and 337 km from Addis Ababa. The district's latitude and longitude is 6°.42' to 6°.83'N, and 38°.01' to 38°.36' respectively and elevation ranging from 1001 to 2000 meters above sea level (m.a.s.l). Dale district is

Table 1. Feed source for dairy cattle in Hulla, Dale and Lokabaya district (%).

Feed sources	Study districts					
	Hulla		Dale		Loka abaya	
	Yes	No	Yes	No	Yes	No
Natural pasture	20.6	79.4	36.7	63.3	42.7	57.3
Improved forage	39.7	60.3	29.3	70.7	31	69
Enset leaf	31.5	68.5	32.9	67.1	35.6	64.4
Banana leaf	0	100	34.9	65.1	65.1	34.9
Enset Corm	17.8	82.2	37.8	62.2	44.4	55.6
Sugarcane stock	0	100	23.5	76.5	76.5	23.5
Herb (Lalunte)	0	100	6.7	93.3	93.3	6.7
Crop residues	11.1	88.9	41.7	58.3	47.2	52.8

NB: The response (yes) is for each feed type per 100%, not among the feed types.
N=60 per each district. Hulla: Highland Agroecology (AE), Dale: Midland AE, Loka abaya: Lowland AE

located 35 km from Hawassa and 310 km from Addis Ababa. Its latitude and longitude is 6°.66' to 6°.84' and 38°.29' to 38°.53' respectively and elevation ranges from 1501 to 2500 m.a.s.l (BOFED, 2010).

Sampling technique

The targeted sampling districts were selected purposely considering the number of dairy cows. About three **"**kebele" per district were selected purposely based on the number of dairy cow and 20 dairy cattle owning households randomly from the identified list of households owning dairy cow. Therefore, a total of 60 dairy cow owning households were interviewed per district by using semi-structured questionnaire.

Statistical analysis

Descriptive statistics such as percentage and frequency distributions were used to analyze the data by using SPSS version 20 (SPSS, 2013). Significance variations for different parameters among the three agroecologies were determined by chi-square test to show the level of significance at ($P < 0.05$).

RESULT AND DISCUSSION

Feed sources for dairy cattle and lactating cows

Quality and quantity of feed offered to dairy cattle is very important for improving their productivity. Though the importance and contribution as livestock feed in general, limited study was undertaken on local feed resource availability and utilization practice. Understanding the existing feed production, distribution and utilization is essential to identify and design proper interventions to improve feed supply and livestock productivity particularly for milk yield. Thus, the current assessment identified different feed sources for dairy cattle in the three districts, sidama zone.

The finding showed that improved forage, natural pasture, and *enset* leaf were the top three available feed sources in Hulla district (highland agroecology) where improved forage source was also higher in the study conducted in highlands and lower in central rift valley of Ethiopia (Brandt *et al*., 1997). The author stated the proportion of farmers practicing improved forage production is only 13% in the central Highlands of Ethiopia. In the study area, high amount of improved forage production in highland might be due to the suitability of the agroecology for the growth of most improved forage species than the two agroecologies. In Dale district, the familiar feed sources for dairy cattle were crop residue (42%), *enset* corm (38%) and natural pasture (37%) while in Loka abaya were "*lalunte*" (93%), sugarcane (77%) and banana leaf (65%) (Table 1). Similar to the finding for dale district, crop residues and natural pasture were reported as the main feed sources in the study conducted all over Ethiopia and also in Adami tullu district, Oromia Region (Zewdie, 2010; Tolera *et al*., 2012). In hulla district, improved forage (40%) was reported first followed by enset leaf (32%). The reason for greater response might be due to the suitability of the agroecology for the growth of improved forages. In contrary to the current result, less than 1% of rural livestock producers reported on farm production of improved forages such as Napier grass and alfalfa in the study conducted in Ethiopia (Dawit *et al*., 2013).

In addition to the feed sources for dairy cattle, the feed types usually provided for lactating cows were also identified for the three districts (Table 2). Accordingly, the top three feed types in Hulla district are *enset* leaf, *enset* corm and "*Shomoda*" (*Conyza bonariensis)* as responded by 34, 27 and 26% of interviewees respectively. The availability of *enset* as both food and feed might be the reason for more utilization of *enset* source feeds in the studied districts. The dominant feed types in the Dale

Table 2. Feed types for lactating cows in Hulla, Dale and Loka abaya district (%).

Feed types for lactating cows (local name)	Districts					
	Hulla		Dale		Loka abaya	
	Yes	No	Yes	No	Yes	No
Enset leaf	34	66	38	62	28	72
Natural grass	20	80	40	60	40	60
Enset corm	27	73	44	56	29	71
Improved forage	22	78	55	45	23	77
Banana leaf	9	91	33	67	58	42
Sugar cane stock	2	98	37	63	61	39
Crop residues	14	86	39	61	47	53
Concentrates	7.7	92.3	83	17	9.3	90.7
Grain	-	100	67	33	33	67
Herb (*Lalunte*)	13	87	8	92	79	21
Grass type (*korchisha*)	-	100	18	82	82	18
Grass type (*Shomoda*)	26	74	12	88	62	38

NB: The herb type (Lalunte) and grass type (korchisha) have not been taxonomically classified, thus have no botanical names. The names indicated are their local names in Sidamegna a native language.
The botanical name of the grass Shomoda is Conyza bonariensis.

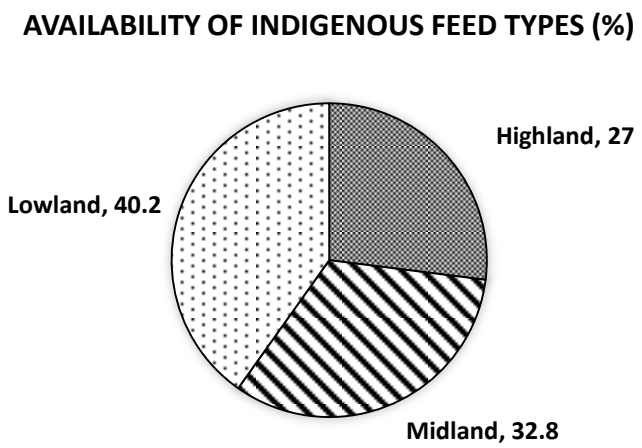

Figure 2. Availability of Indigenous feed type in Highland, Midland and Lowland agroecologies.

district are concentrates (83%), grain (67%), and improved forages (55%) whereas in the lokkabaya district, "*korchisha*" (82%), "*Lalunte*" (79%) and "*Shomoda*" (62%) usually provided for lactating cows. The increased utilization of concentrate, grain and improved forage for lactating cows might be the presence of more crossbred cows and increased awareness of farmers due to Improving Productivity and Market Success (IPMS) project in the studied district (Dale District).

Availability and types of indigenous feeds

Other than industrial by-products, improved forages, and crop residues, there are different local grass and herbaceous species dominantly utilized by farmers in the study area which are from grazing source. According to the current study, the interviewed households reported that 40, 33 and 27% availability of indigenous feed types in lowland, midland, and highland agroecologies respectively (Figure 2). The existence of limited grazing land allowing the growth of different local feed types and this could be one of the reasons for the more availability of indigenous feed types/forage in the lowland than the other two agroecologies.

Table 3 shows indigenous feed types in different agroecologies of Sidama Zone. Different studies in various parts of the region identified several indigenous forage species for milking and fattening cattle (Adugna and Said, 1992; Adugna, 2007). In the study area, most of the assessed forages have a contribution in increasing milk yield as well for butter amount. Some of the identified local forage species in the Lokka abaya district were "*Lalunte*", "*Shomoda* " (Sidamigna local language) and *enset* leaf as responded by 75, 38.3 and 33.3% of respondents respectively (Table 3). "*Lalunte"* is most of the time grown in the surrounding of *enset* plant and more available in wet season than in dry season (Figure 3).

Enset leaf and *enset* corm were reported as the top two indigenous feed types contributing for increased milk yield and butter amount in both dale and hulla districts. The third feed type identified were "shomoda" and sugarcane stock in hulla and dale districts, respectively. Moreover, the overall rank showed that *enset* leaf, *enset* crom and the herb type "lalunte" as 1st, 2nd and 3rd respectively. The reason for high utilization of *enset* leaf and *enset* corm might be due to high abundance or practice of feeding enset as a primary feed source and residue from *enset* processing "*kocho*", which is a local

Table 3. Indigenous feed types for milk and butter yield in Hulla, Dale and Loka abaya districts (%).

Indigenous feed types *(local names)*	Study districts						Overall	
	Hulla		Dale		Loka abaya			
	Yes	No	Yes	No	Yes	No	Yes	Rank
Enset leaf	20	80	46.7	53.3	33.3	66.7	100	1
Enset corm	18.3	81.7	38.3	61.7	26.7	73.3	83.3	2
Herb type (*Lalunte*)	2	98	5	95	75	25	82	3
Grass-type (*Shomoda*)	11.7	88.3	3.3	96.7	38.3	61.7	53.3	4
Sugar Cane stock	0	100	23.3	76.7	23.3	76.7	46.6	5
Bamboo leaf	8.3	91.7	6.7	93.3	0	100	15	6
Grass-type (*Korchisha*)	0	100	0	100	13.3	86.7	13.3	7

NB: The response for each feed is from 100%, the overall (yes): the summation of yes responses in the three districts for each feed type. Hulla: Highland Agroecology (AE), Dale: Midland AE, Loka abaya: Lowland AE

Figure 3. Types of indigenous feeds lalunte (A) and Shomoda (B)

food in all the studied areas. Additionally, *enset* grows optimally in the range of 2000 to 2750 m.a.s.l and the provision trend of *enset* as dairy feed is due to the growth in the mentioned altitude in the studied districts (Brandt *et al*., 1997). Studies conducted in Wolaita and Dawuro zone identified "Dambursa" (Wolaytigna language) plant which improves the quality of butter and as mending medicine for broken cattle as well as for humans (Andualem *et al*., 2015). In the same study, "*Gasaa*" and "*Cayshiyaa*" (Dawuregna language in Ethiopia) were also identified as other indigenous legume and legume browse feed types for dairy cows for increasing milk yield.

Feed shortage

The availability and quality of feed resources vary depending on season and agroecologies. Feed shortage is one of the dominant livestock production bottlenecks that constrain the productivity of dairy cows in different agroecologies. The current finding indicated that feed shortage as a critical factor in Lokkabaya (36%) than in the Dale (34%) and Hulla (30%) district (Figure 3). Relatively, there is lower feed shortage in Hulla (highland agroecology) than Lokkabaya (lowland) and Dale (midland) district, which is mainly due to a lower temperature and higher rainfall variability.

Regarding the feed shortage occurrence, respondents in the current study reported that December to April as most important months of the year that feed shortage occurs critically for Dale and Lokkabaya district (Figure 4). The feed shortage for Lokkabaya district is throughout the months though it is critical in May. In contrary to the present finding, feeds are abundant from December to February in the study conducted on Bure Woreda, Amhara Region, Ethiopia (Shitahun, 2009). A Study conducted at Angacha district in Ethiopia also showed that feed is adequately available on the onset of main rainy season (June to October) and it is almost similar with the present finding (Zewdie *et al*., 2015).

Supplementary feed provision trend for dairy cows

Figures 5 and 6 show additional feed provision habit for lactating and pregnant cows. The current result indicated that there is significant variation ($P < 0.05$) in the practice of dairy cow supplementation in both lowland and highland agroecologies than in the midland. The reason for dairy cow supplementation in the lowland agroecology

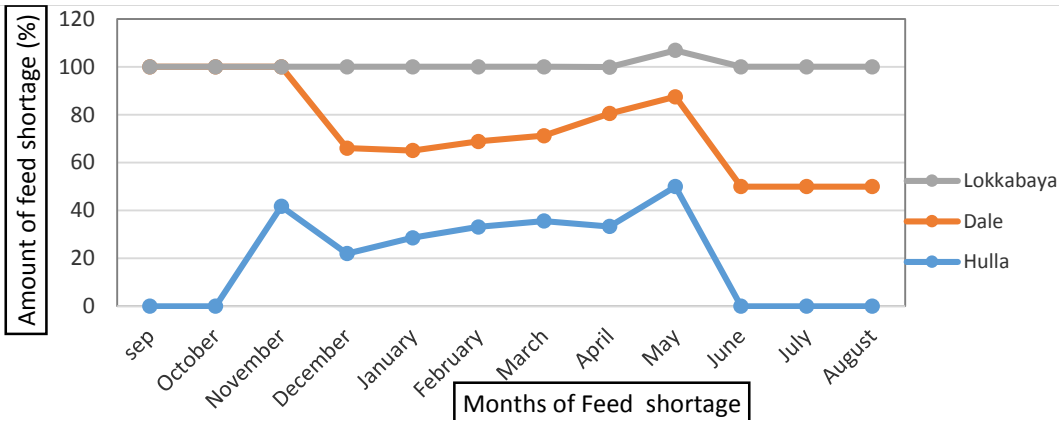

Figure 4. Trend of feed shortage in Lokkabaya, Dale and Hulla Districts.

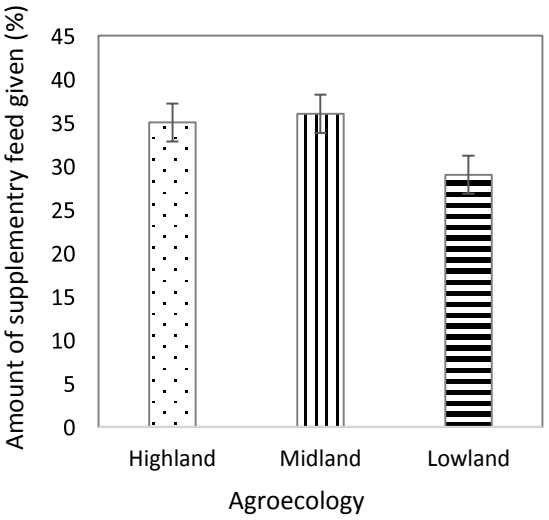

Figure 5. Supplementary feed provision trend for lactating cows.

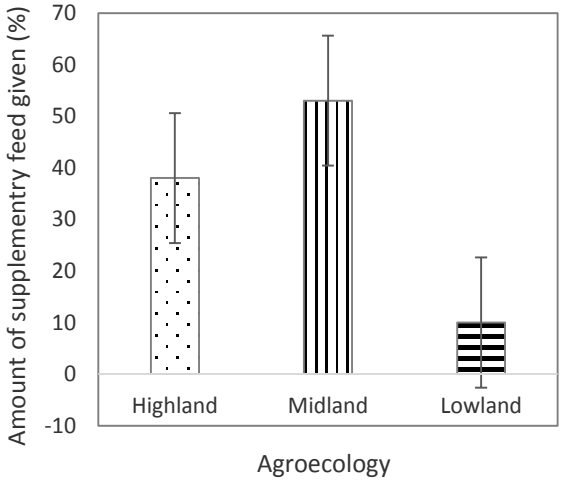

Figure 6. Supplementary feed provision trend for pregnant cows.

might be due to critical feed shortage whereas for the highland agroecology, it might be due to the availability of adequate feeds from natural pasture and *enset* plant.

Additional feed provision trend for pregnant cows is very poor in the lowland than in the highland and midland agroecology (Figure 6). In addition to that, better supplementation for lactating cows than pregnant cows (Figure 5). Even though there is a very little trend of pregnant cow supplementation in different agroecologies of the study area, there is significant variation ($P<0.05$) among the three agroecologies. Usually dairy cattle are supplemented in different physiological stages of production. Hence, the nutrient requirement varies accordingly (EADD, 2013). In the study area, farmers provide locally available indigenous feed types such as *enset*, sugar cane tops and other feeds that are easily accessible, increases intake and leads to increased milk yield.

Supplementary feed types for lactating and pregnant cows

Supplementary feed type for lactating and pregnant cows is vary from one agroecology to another. *Enset* corm, *enset* leaf, concentrates, sugarcane stock, improved forages, banana leaf, residue from local drinks and local grass and forage type are among the common supplementary feed types in the three studied districts (Table 4). In the Hulla district, enset leaf followed by *enset* corm and improved forages were the top three supplementary feeds dominantly provided for lactating cows. The top three supplementary feed types for lactating cows in the Loka abaya district are Sugarcane stock, enset corm, and enset leaf while for Dale area concentrate, enset leaf and enset corm. The overall rank in the three districts also showed that enset leaf, enset corm and concentrate as the 1st, 2nd and 3rd supplementary feed sources for lactating cows. Similarly, the leaf and stem of *enset*, banana, and sugar cane tops

Table 4. Supplementary feed types for lactating cows in Hulla, Dale and Loka abaya (%).

Supplementary feed types	Study districts						Overall	
	Hulla		Dale		Loka abaya			
	Yes	No	Yes	No	Yes	No	Yes	Rank
Enset leaf	51.7	48.3	50	50	21.7	78.3	123.4	1
Enset corm	33.3	66.7	28	72	25	75	86.3	2
Concentrate	8.3	91.7	58.3	41.7	8.3	91.7	74.9	3
Sugar cane stock	0	0	15	85	31.7	68.3	46.7	4
Improved forage	18.3	81.7	10	90	8.3	91.7	36.6	5
Banana leaf	1.7	98.3	13.3	86.7	13.3	86.3	28.3	6
Forage type (*lalunte*)	0	0	1.7	98.3	20	80	21.7	7
Chaff (*Geleba*)	3.3	96.7	13.3	86.7	5	95	21.6	8
Traditional drink residue (*Atela*)	10	90	3.3	96.7	1.7	98.3	15	9
Grass-type (*Shomoda)*	0	0	1.7	98.3	5	95	6.7	10

NB: The response for each feed is from 100%, the overall (yes): the summation of yes responses in the three districts for each feed type.

Table 5. Supplementary feed type for pregnant cows in Hulla, Dale and Loka abaya districts.

Supplementary feed types	Study districts						Overall	
	Hulla		Dale		Loka abaya			
	Yes	No	Yes	No	Yes	No	Yes	Rank
Sugar cane stock	6.7	93.3	3.3	96.7	15	85	25	1
Enset corm	15	85	6.7	93.3	1.7	98.3	23.4	2
Improved forage	1.7	98.3	11.7	88.3	0	100	13.4	3
Concentrate	5	95	3.3	96.7	0	100	8.3	4
Enset leaf	0	100	5	95	1.7	98.3	6.7	5
Banana leaf	0	100	3.3	96.7	2.2	97.8	5.5	6

were reported as a major supplementary feeds in rural households in Ethiopia (Tegegne *et al*., 2013).

Supplementary feed provision trend is much lower for pregnant cows than lactating cows. Only 15 and 7% of respondents in the Hulla district provide *enset* corm and sugar cane stock as supplementary feed for pregnant cows respectively. Improved forage and *enset corm* are supplementary feed types for pregnant cows mentioned by 12 and 7% of respondents in the dale district (Table 5).

In the Loka abaya district, about 15 and 2% of respondents provide sugar cane stock and banana leaf for pregnant cows respectively. These showed that supplementary feed provision trend and the feed types are different from one district to another based on the availability and accessibility of feed types.

CONCLUSION AND RECOMMENDATION

The study indicated that improved forage and crop residue were among the primary feed supply sources for dairy cattle for highland and midland agroecology, respectively. While *lalunte* was reported for lowland agroecology. Lactating cows were predominantly supplied as *enset* source feeds for the highland; concentrate and grain for midland and indigenous feed types for lowland agroecology. The commonly used species of indigenous forages types contributing for increased milk and butter yield were *enset* leaf, *enset* corm, *lalunte* and *shomoda* in all the studied districts. Regarding the feed shortage, respondents reported critical feed shortage in lowland agroecology than in midland and highland agroecology. Furthermore, the major months of the year that feed shortage occurs critically were December to April. Supplementary feed provision trend for both lactating and pregnant cows were reported more in the midland agroecology followed by highland and lowland agroecologies. Lactating cows were usually supplemented *enset* leaf, *enset* corm and concentrates whereas pregnant cows were given sugarcane stock, *enset* corm and improved forages. Therefore, the identified indigenous feed types have to be further investigated for chemical composition, *in vivo* and *in vitro* digestibility for efficient utilization of the indigenous feeds.

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