Identification of Feed Resources for Cattle Fattening and Chemical Composition Determination in Dessie and Kombolcha Towns, Ethiopia

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Abstract

This study was designed to identify common conventional and non-conventional feed resources worth of feeding oxen for cattle fattening in and around Dessie and Kombolcha towns and evaluate the sources, availability, quantity, distribution, price and limitation of different feeds. Urban and peri urban *kebeles* who practices cattle fattening were totally considered in both study towns. Accordingly, 3 and 6 urban, 4 and 6 peri urban *kebeles* were selected from Dessie and Kombolcha towns, respectively. Complete enumeration techniques were applied to select urban and peri urban *kebeles*. Totally, 190 and 147 cattle fatteners were selected and interviewed in the identification process of feed resources used for cattle fattening practices in Dessie and Kombolcha towns, respectively. In both study towns 42 feed resources used for cattle fattening practices were identified. The identified feed resources were characterized in to different categories according to their nature and prioritized based on availability and abundance. Further feed resources categorized in to three groups based on their importance and level of significance for cattle fattening purpose, *i.e.,* 1st, 2nd and 3rd choice. From the totally identified feeds, nine major and highly significant feed resources, which were nominated by the respondents from both study towns, were selected and subjected for chemical analysis. The collected samples were examined to determine the DM, Ash, CP, NDF, ADF and ADL. In Dessie and Kombolcha towns, the identified cattle feed sources were poultry farms, flour factors, milling houses, micro and small food processors, local brewery houses, farmers, brewery factory, oil seed processers, pasture lands, feed traders, sugar processing factory, university and government aids. There was

high seasonal variability of feed availability and distribution in both study towns. September to December relatively there was abundant feed resources. On the other hand, the feed shortage and price increased severely towards January to June. As a result, storing and saving available cattle fattening feed resources during surpluses time is crucial for proper cattle fattening practices. In addition, the government intervention is recommendable to solve poor distribution, limited access of feed resources and to decreases transportation difficulties and costs.

Keywords: Conventional, cattle, feed, fattening, non-conventional

Introduction

The government of Ethiopia is trying to increase the export of ruminant livestock and meat that can contribute to market-led economic growth and poverty reduction in the country. One of the main constraints hampering this effort is the supply of cattle, sheep and goats which can meet export quality requirements (Adugna, 2007). Correspondingly, one of the major constraints to supply the indicated livestock is lack of feed, both in quality and quantity (Tilahun *et al.,* 2005). Poor nutrition and feed shortages are root causes for the poor performance of the livestock sector in Ethiopia. Most livestock destined for export or slaughter are produced in the pastoral areas from rain fed pastures and are slaughtered with little or no access to better quality feeds required to increase weight, improve condition, dressing percentage and reduce age at slaughter. Poor nutrition results in slow growth rate in growing animals and low production and reproduction performance. Poorly fed fattening cattle take too long to reach optimum slaughter weight and the meat produced by such animals may not satisfy the desired quality attributes (such as tenderness) to fulfill the demand of the consumers. When the quality of the fodder is low, animals are not able to eat what is required to put on weight. Because of the slow growth rate, the animals become old before they reach the desired live weight for sale. Hence, the quality of the beef becomes far from satisfactory. In addition, feed utilization is very inefficient as most of the feeds (about 85%) are used for body maintenance. In such a system there appears to be a tremendous potential for improvement.

Accordingly, current and up-to-date baseline information related to feed availability and quality is lacking in peri-urban areas under the prevailing situations. As a result, there is a need to investigate the feed demand and supply situation in the urban and peri-urban areas with the aim of identifying suitable strategies to provide adequate amounts and sufficient quality fodder to the animals (Zewdie, 2010). In addition, the availability of feed resources in the highlands of Ethiopia depends on the mode and

intensity of crop production as well as population pressure (Seyoum *et al.,* 2001). Generally, there is feed deficiency during dry seasons, and plenty of resource in other season (Firew and Getenet, 2010). On the other hand, there is a significant potential for feeding livestock from occasional surplus grains and agro industrial by-products such as oilseed cakes, milling by-products, molasses and feeds coming from poultry farms (poultry litter) and, brewery factories (spent grain). However, nutritive values and seasonal availability are not well documented (Adugna, 2007). Instead, in the current study towns, cattle fattening is one of the newly emerging activities under urban agriculture. The sector is generating employment opportunities and income generation for urban and peri urban dwellers. Particularly, cattle fattening is becoming an effective tool for poverty alleviation and an important business sector for those cattle fattening associations organized at small scale enterprise level and displaced farmers of urban and peri urban areas due to urbanization and industry zone establishment. Dependably, the sector is hindered by feed shortage, high prices and lack of available information regarding available feed resources. One of the most viable and simple management interventions to avert the gap (the severe feed shortage) is to identify the type, source, availability, quantity, distribution and price of locally available and accessible feed resources. Cognizant of this fact that, the current research was engrossed to alleviate information gap and to assess quality of selective feed resources used for fattening cattle in Dessie and Kombolcha towns. Accordingly, based on the above background, this study was designed to identify the availability, quantity, distribution and price of common conventional and non-conventional feed resources used for cattle fattening with their respective merits and demerits and to assess chemical composition of selective feed resources in Dessie and Kombolcha towns.

Materials and Methods:
The Study Areas:
        The study was conducted in Dessie and Kombolcha towns. Dessie is located in northern part of Ethiopia in Amhara National Regional State, South Wollo Zone at a distance of 400 km from Addis Ababa, Ethiopia. Its astronomical location is at 11°8′N -11^0 46' North latitude and 39°38′E-41013' East longitude. Relatively it is bounded by Kutaber *Woreda* in the north, Dessie Zuriya *Woreda* in the east, and by Kombolcha town in the south. The topography of Dessie is a highland type surrounded by 'Tossa' mountain (Dawit, 2013). Its elevation ranges between 2,470 and 2,550 meters above sea level (http://en.wikipedia.org/wiki/Dessie, retrieved in December 2014). Annual maximum and minimum temperatures of Dessie are 23.7 ºC and 9 ºC, respectively, recorded in 2015 (Kombolcha meteorology station). Dessie is one of the reform towns in the region and has

a city administration consisting of municipality, 10 urban and 6 peri urban *kebeles*. Kombolcha is an industrial town found in the north-central part of Ethiopia in South Wollo Zone of the Amhara Regional State of Ethiopia. It is situated at a distance of 377 km from north of Addis Ababa, 505 km from the Regional capital city, Bahirdar, 23 km from the zonal town Dessie and 533 km from port Djibouti. Astronomically, the town is located at about 11^0 6' N latitude and 39^0 45' E longitudes. The delimitation of the town is bounded by Dessie Zuria Woreda in the North East and North west, Kalu Woreda in the South and Albuko Woreda in the South West (Muluwork 2014). Mean annual rainfall is 1046 mm while annual maximum and minimum temperatures are 28.1 ºC and 12.9 ºC, respectively, recorded in 2015 (Kombolcha meteorology station). The town is located in a range of altitudes between 1,500 and 1,840 m above sea level. Kombolcha is one of the reform towns in the region and has a town administration municipality, 5 urban and 6 peri urban kebeles. The city shares Kombolcha airport with its neighboring town, Dessie. Kombolcha is one of the few towns in Ethiopia with a relative greater number of large scale manufacturing plants including ELFORA-Meat Processing Factory, BGI-Brewery Factory and Flour Factories. On top of this, the town is selected to be an industrial zone by Amhara National Regional State and the Federal Government of Ethiopia (Eskinder *et al.*, 2010).

Sampling Procedure and Sample Size:

Based on objectives of the research and the parameter required structured questionnaire was prepared. The questionnaire comprised data or information on types, quantity, seasonal availability, price, limitations, and users of different feed resources. Accordingly, those urban and peri urban *kebeles* where cattle fattening is practiced, were considered in both study towns for identification of feed resources used for cattle fattening. Accordingly, 3 and 6 urban, 4 and 6 peri urban *kebeles* were selected from Dessie and Kombolcha towns, respectively. Complete enumeration technique was applied to select urban and peri urban *kebeles*. Due to manageable number of cattle fatteners,' complete enumeration a technique was applied to select individuals from urban and peri urban *kebeles*, in the case of Kombolcha town. While, systematic random sampling technique for peri urban and complete enumeration technique for urban was applied to select individuals' in Dessie town. In the case of Dessie town, sampled households in peri urban *kebeles* were determined based on the principle of probability proportional to size'. Consequently, 190 and 147 cattle fatteners were selected totally and interviewed in the feed resources identification

used for cattle fattening practices in Dessie and Kombolcha towns, respectively.

Data Collection and Analysis:

A single visit formal survey was employed to collect all the required data. To strengthen the survey data, group discussions were held with individuals who have knowledge and experience about common conventional and non-conventional feed resources used for cattle fattening. In addition, key informant interviews were made with towns and *kebeles* Agricultural Experts, Development Agents and different feed suppliers. Field observation was carried out to take different feed samples and pictures. Accordingly, focus group discussions and key informant interviews were conducted between February and April, 2016 whereas the household level surveys were carried out in May, June, July and August of the year 2016. As a result, common conventional and non-conventional feed resources (types), sources, availability, season of distribution, price/kg, current and overall production supply potential and different feed suppliers of governmental and private organizations, limitations and worthiness of feed resources used for cattle fattening in Dessie and Kombolcha towns were studied through structured questionnaires, key informant interviews, group discussions and field observation.

Representative feed samples from each study town were collected from different cattle fatteners and feed suppliers. In addition, during field observation and sample collection pictures were captured to strengthen the information obtained during survey, group discussion and key informants interviews. The feeds were categorized into conventional and non-conventional based on their nature. Again, conventional feed sources were further classified in to dry roughage, green roughage and concentrate categories. In addition, cattle fatteners prioritized feed resources based on availability and abundance. Furthermore, as per group discussion, cattle fatteners grouped the overall identified feed resources in to three categories, explicitly, 1st choice, 2nd choice, and 3rd choice feed resources based on importance and significance for cattle fattening. Index was calculated to provide ranking of conventional and non-conventional feed resources according to the indicated formula. Index of conventional and non-conventional feed resources was calculated. First a weighted value was given for each feed based on their rank (3 for the 1st feed, 2 for the 2nd feed, and 1 for the 3rd feed). The number of households' response for a particular feed was multiplied by a given weighted value. Then the rank was given by dividing the value of each feed to the total sum of all feeds value.

Finally, based on the analysis result via considering the respondent response, availability of the feeds, abundance, distribution, accessible potential and significance of feed resources for cattle fattening from the totally identified feeds, nine major and highly significant feed resources which were score 1st rank by the respondents from both study towns were selected and subjected for chemical analysis. Chemical analysis of the selected feeds was done at Holleta Agricultural Research Centre Nutrition Laboratory in Ethiopia. The collected samples were thoroughly mixed and enough sub-samples were taken to determine the DM, Ash, CP, Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL). Hemicellulose (HC) and cellulose (C), OM contents were calculated as NDF minus ADF, ADF minus ADL and DM minus Ash, respectively.

Results:

Identified Feed Resources used for Fattening Cattle in Dessie and Kombolcha Towns

In Dessie and Kombolcha towns totally 42 feed resources used for cattle fattening practices were identified (39 feeds in common from both study towns and 3 feeds uniquely from Kombolcha Those identified feed resources were used as major and supplementary feeds by the interviewed cattle fatteners which grouped further into three categories: viz; (i) green roughages, (ii) dry roughages and (iii) concentrates. Moreover, cattle fatteners prioritized the identified feed resources based on availability and abundance as presented in Table 1 and 2

Table1: Identified roughage and non-conventional feed resources used for cattle fattening purpose in Dessie and Kombolcha towns with availability and significance status

Identified feed resources		Local name in Amharic	Category	priority via Significance	Dessie n = 190						Kombolcha n = 147						Source Town
					Feed priority via availability & abundance			Weighted value	Index	Rank	Feed priority via availability& abundance			Weighted value	Index	Rank	
Green roughage					1st	2nd	3rd				1st	2nd	3rd				
1	Green grass	*Yewober sar*	C	2nd	115	34	41	454	0.398	1	82	52	13	363	0.412	1	DK
2	Green maize Stover	*Ertebi yebekolo ageda*	C	2nd	54	75	31	343	0.301	2	40	57	25	259	0.294	2	DK
3	Sugar can tops	*Shenkora ageda chaf*	C	2nd	11	48	77	206	0.181	3	15	34	18	131	0.149	3	DK
4	Different weeds	*Wokiya*	C	3rd	10	33	41	137	0.12	4	10	4	91	129	0.146	4	DK
Dry roughage																	
1	Hay	*Derkoshi*	C	1st	111	44	35	456	0.539	1	82	52	13	363	0.554	1	DK
2	Maize Stover	*Yebekolo ageda*	C	2nd	37	70	24	131	0.155	2	20	31	41	92	0.14	2	DK
3	Teff straw	*chid*	C	2nd	10	24	54	88	0.104	3	3	15	17	35	0.053	4	DK
4	Wheat straw	*Yesende chid (geleba)*	C	3rd	0	8	30	46	0.054	4	0	8	9	17	0.026	7	DK
5	Barley hulls	*Yegebise geleba*	C	2nd	9	5	9	23	0.027	5	3	3	9	15	0.023	8	DK
6	Oat hulls	*Yaja geleba*	C	2nd	8	7	7	22	0.026	6	3	5	4	12	0.018	9	DK
7	Grass pea hulls	*Yeguwaya geleba*	C	2nd	3	9	8	20	0.024	7	10	4	11	25	0.038	5	DK
8	Corn head & cob	*Enbut bekolo*	C	3rd	3	4	5	12	0.014	8	0	3	4	7	0.011	13	DK
9	Pea hulls	*Yater geleba*	C	3rd	3	5	4	12	0.014	8	8	3	7	18	0.027	6	DK
10	Bean hulls	*Yebakela geleba*	C	3rd	3	4	3	10	0.012	10	3	3	6	12	0.018	9	DK
11	Barley straw	*Yegebise chid (geleba)*	C	3rd	0	2	5	9	0.011	11	0	4	6	10	0.015	11	DK
12	Sorghum Stover	*Yezengada ageda*	C	3rd	0	6	3	9	0.011	11	12	13	16	41	0.062	3	DK
13	Lentil hulls	*Yemeser geleba*	C	3rd	3	2	3	8	0.009	13	3	3	4	10	0.015	11	DK
Non-conventional feed																	
1	Poultry litter (layer &pullet)	*Yedoro kus (enkulal tayi and keb)*	NC	1st	115	40	35	460	0.404	1	64	65	18	340	0.385	1	DK
2	Poultry litter (day old)	*Yedoro kus (yechachut)*	NC	1st	51	80	36	349	0.306	2	63	44	30	307	0.348	2	DK
3	Poultry litter (broiler)	*Yedoro kus (ye sega)*	NC	1st	21	56	64	239	0.21	3	20	27	41	155	0.176	3	DK
4	'Atela' left over	*Yetela atela*	NC	3rd	3	6	25	46	0.04	4	0	3	39	45	0.051	4	DK
5	'Korefe' leftover	*Yekeorefe atela*	NC	3rd	0	6	16	28	0.025	5	0	4	13	21	0.024	5	DK
6	University leftover food	*Yemegeb treferafi*	NC	3rd	0	2	14	18	0.016	6	0	4	6	14	0.016	6	DK

Duka^= leftover and occasional surplus or damaged grain during processing C = conventional NC non-conventional DK= Dessie and Kombolcha towns

Table 2: Identified concentrate feed resources used for cattle fattening purpose in Dessie and Kombolcha towns with availability and significance status

Identified feed resources (Concentrate)	Local name (Amharic)	Category	priority via significance	Dessie n = 190						Kombolcha n = 147						Source
				Feed priority via availability & abundance			Total weight	Index	Rank	Feed priority via availability & abundance			Total weight	Index	Rank	
				1st	2nd	3rd				1st	2nd	3rd				
1 Wheat bran	*Yeferes furishika*	C	1st	36	14	16	152	0.133	1	12	13	10	72	0.08	4	DK
2 Corn grain	*Bekole*	C	1st	31	22	13	150	0.132	2	38	32	13	213	0.236	1	DK
3 Dried brewers grain	*Derek yebira chimaki*	NC	1st	28	23	7	137	0.12	3	24	9	8	98	0.109	3	K
4 Wet brewers grain	*Ertib yebira chimaki*	C	1st	20	22	5	109	0.096	4	24	26	12	136	0.151	2	K
5 Wheat middling	*furshikelo*	NC	2nd	14	16	9	83	0.073	5	13	9	4	61	0.068	6	DK
6 Grass pea leftover	*Yeguwaya duka^*	C	1st	13	9	11	68	0.06	6	13	9	6	63	0.07	5	DK
7 Oat grain	*Aja*	C	2nd	10	13	9	65	0.057	7	3	12	17	50	0.055	7	DK
8 Pea leftover	*Yater duka^*	C	1st	5	9	24	57	0.05	8	7	0	2	16	0.018	14	DK
9 Wheat leftover	*Yesende duka^*	C	1st	0	8	30	46	0.04	9	0	8	9	25	0.028	9	DK
10 Flour factory leftover	*Yeduket fabrica bitary*	C	3rd	9	5	9	46	0.04	9	3	3	9	24	0.027	11	DK
11 Linseed cake	*fagulo ye telba*	C	2nd	5	7	14	43	0.038	11	0	2	0	4	0.004	18	DK
12 Different feed left over	*Entiritaryi*	C	2nd	3	9	8	35	0.031	12	0	4	11	19	0.021	12	DK
13 Noug seed cake	*fagulo ye nuge*	C	3rd	4	5	8	30	0.026	13	0	1	0	2	0.002	19	DK
14 Milling leftover	*Yewoficho bet tiragi*	C	3rd	0	7	9	23	0.02	14	0	2	9	13	0.014	15	DK
15 Barley leftover	*Yegebise duka^*	C	2nd	3	5	4	23	0.02	14	4	3	7	25	0.028	9	DK
16 Bean leftover	*Yebakela duka^*	C	1st	3	4	5	22	0.019	16	0	3	4	10	0.011	17	DK
17 Lentils leftover	*Yemeser duka^*	C	3rd	3	4	3	20	0.018	17	0	3	6	12	0.013	16	DK
18 Formulated ration	*Yetemetatene meno*	C	1st	3	2	3	16	0.014	18	3	3	4	19	0.021	12	DK
19 Molasses	-	C	2nd	0	6	3	15	0.013	19	3	5	16	40	0.044	8	K

Duka^= leftover and occasional surplus or damaged grain during processing C = conventional NC non-conventional D= Dessie and Kombolcha towns K= Kombolcha

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Classifications of the Identified Feed Resources Based on Significance for Cattle Fattening in Dessie and Kombolcha Towns

As per the group discussion, in both study towns cattle fatteners were categorized the overall identified 42 feed resources in to three categories depend on cattle fatteners day to day practical experience, explicitly, 1st, 2nd, and 3rd choice feed resources according to their importance and significance level for cattle fattening purpose as indicated in Table 1 and 2 .

Potential Feed Suppliers:

Major feed suppliers for cattle fattening practices were identified exhaustively in Dessie and Kombolcha towns. In addition, the type of feed or feeds each supplier produced, current as well as overall production capacity and marketing price were also evaluated. By and large, the information about the identified feed sources and current and overall production capacities of each feed sources were summarized and tabulated in Table 3 and 4.

Table 3: Major feed suppliers (flour factories) and production potentials of different feeds for fattening cattle in Dessie and Kombolcha towns

	Flour factories	Type of animal feed produced	Animal feed production efficiency of the apparatus	Current animal feed production capacity per year (quintals)	Total daily capacity to produce animal feed (Quintal per day)	Total yearly capacity to produce animal feed (quintal /year)	Town
1	Fowa bel	Mix of wheat bran, middling & left over	27%	4212	450	31590	Dessie
2	Fabry	Mix of wheat bran, middling & left over	20%	27560	600	31200	Dessie
3	Kenean	Mix of wheat bran, middling & left over	24%	22464	360	22464	Dessie
4	Wollo	Mix of wheat bran, middling & left over	22%	14300	1180	67496	Dessie
5	Jama Degollo	Mix of wheat bran, middling & left over	27%	17550	820	57564	Jama
6	Nur selam	Mix of wheat bran, middling & left over	-	-	-	-	Dessie
7	Flower	Mix of wheat bran, middling & left over	19%	12350	660	32604	Kombolcha
8	Hussen & his sons	Wheat bran, wheat middling & left over	23%	14950	600	35880	Kombolcha
Total				**113,386**		**278,798**	

NR= Not Reported

Table 4: Major cattle feed suppliers and production potentials of poultry farms, oil seed processers, beer factory, milling houses used as feed sources for fattening cattle in Dessie and Kombolcha towns

Supplier organization	Feed type	Production capacity/ month	Production capacity/year	Town
Poultry farms				
1 Kombolcha	Poultry litter	126.3 quintals	1515.31 quintals	Kombolcha
2 Gerado	Poultry litter	150 quintals	1800 quintals	Dessie
3 Bishoftu	Poultry litter	Access via traders	Access via traders	Bishoftu
4 Small scale private farms	Poultry litter	-	-	Dessie & Kombolcha
Small scale oil seed processers (SSOSP)				
1 Seid Ali **SSOSP**	Noug seed & Linseed cake	-	Locked due to oil seed shortage	Dessie
2 Huda **SSOSP**	Noug seed & Linseed cake	10 quintals	120 quintals/year	Dessie
3 Lemma **SSOSP**	Noug seed & Linseed cake	-	Locked due to oil seed shortage	Kombolcha
Beer factory				
1 Kombolcha BGI ETHIOPIA	Wet Brewers Grain and Dried Brewers Grain	130-150 car	1560-1800 car	Kombolcha
Milling house				
1 34 milling house in Dessie town (15 quintal per each per month)	Different feed Left over and hulls	510 quintals	5100 quintals	Dessie
2 39 milling house in Kombolcha town (15 quintal per each per month)	Different feed Left over and hulls	585 quintals	5850 quintals	Kombolcha
Food processers at micro level				
1 18 small scale food processer in Dessie town (12 quintal per each per month)	Different feed Left over and hulls	216 quintals	2160 quintals	Dessie
2 36 small scale food processor in Kombolcha (12 quintal per each per month)	Different feed Left over and hulls	432 quintals	432 quintals	Kombolcha

One car has a capacity to hold 16 m³ wet brewery grain; one quintal= 100kg NR=Not Reported

Marketing price of the identified feed resources:

The marketing price of different feed resources is presented in Table 5, 6, and 7

Table 5: Identified non-conventional and green roughage feed resources used for cattle fattening practices, price, sources and users in Dessie and Kombolcha towns

	Feed resources	Unit	Current price (Birr)	Price range (Birr)	Sources	Users
Non-conventional feed						
1	Poultry litter from day old	kg	2	2-4.5	Dominantly from Kombolcha poultry farm, sometimes form Dessie /Gerado/ and Bishoftu poultry farm	Urban cattle fatteners
2	Poultry litter from layers	kg	2	2-4.5	Dominantly from Kombolcha poultry farm, sometimes from Dessie Gerado and Bishoftu poultry farm	Urban cattle fatteners
3	Poultry litter from broiler	kg	2	2-4.5	Dominantly from Kombolcha poultry farm, sometimes from Dessie Gerado and Bishoftu poultry farm	Urban cattle fatteners
4	'Atela' left over	Per 25 litter	15	10-20	Small scale home brewing in DK	Urban cattle fatteners
		Monthly rent	250	200-300	Small scale home brewing in DK	Urban cattle fatteners
5	'Korefe' leftover	Per 25 litter	12.50	12-20	Small scale home brewing in DK	Urban cattle fatteners
		Monthly rent	200	150-250	Small scale home brewing in DK	Urban cattle fatteners
6	University leftover food	-	-	-	Wollo University (Dessie and Kombolcha campus)	Nearest peri urban cattle fatteners
Green roughage						
1	Green grass	*'Besew shekim'*	65	50-80	Farmers farm	Peri urban cattle fatteners
2	Green maize Stover	*'Besew shekim'*	-	-	-	Peri urban cattle fatteners mostly
3	Sugar can tops	Per single can top	0.25	0.25-1.00	DK sugar cane market	Urban cattle fatteners
4	Different weeds	*'Besew shekim'*	-	-	Farmers farm in DK	Peri urban cattle fatteners only

'Besew shekim' means measured or quantified based on the ability to carry of a matured person; DK= Dessie and Kombolcha towns NR= Not Reported

Table 6: Identified dry roughage feed resources used for cattle fattening practices, price, sources and users in Dessie and Kombolcha towns

	Dry roughage feed resources	Unit	Current price (Birr)	Price range (Birr)	Sources	User
1	Hay	Donkey capacity	100	90-120	Farmers grazing land in DK	Peri urban and urban fatteners
		Horse capacity (50kg)	120	120-160	Farmers grazing land in DK	Peri urban and urban fatteners
		Car capacity (Isuzu)	3000	2500-3000	From Chefa and Kemisse area	Urban cattle fatteners
		Per piled	55	50-60	From Chefa and Kemisse area	Urban cattle fatteners
2	Maize stover	Per 'Kemer'	300	300-500	Farmers farm in DK	Peri urban cattle fatteners dominantly
3	Teff straw	Donkey capacity	170	150-200	Farmers farm + market in DK	Peri urban cattle fatteners dominantly
		Per piled	85	47-85	Market in DK	urban fatteners
4	Wheat straw	Donkey capacity	160	140-200	Farmers farm in DK	Peri urban cattle fatteners dominantly
5	Barley hulls	kg	4	4-5	Milling house and small scale food processer in DK	Peri urban & urban fatteners
6	Oat hulls	kg	5	4-5	Milling house and small scale food processer in DK	Urban fatteners
7	Grass pea hulls	kg	5	4.5-5	Milling house and small scale food processer in DK	Peri urban & urban fatteners
8	Corn head & cob	-	-	-	Farmers farm in DK	Peri urban fatteners only
9	Pea hulls	kg	5	4.5-5	Milling house and small scale food processer in DK	Urban fatteners
10	Bean hull	kg	5	4-5	Milling house and small scale food processer in DK	Urban fatteners
11	Barley straw	Donkey capacity	160	140-200	Farmers farm in DK	Peri urban fatteners dominantly
12	Sorghum Stover	Per 'Kemer'	250	250-450	Farmers farm + market around Kemisse	Peri urban & urban fatteners
13	Lentil hulls	kg	5	5-5.50	Milling house and small scale food processer in DK	Urban fatteners

DK= Dessie and Kombolcha, Donkey *capacity = 40kg* , Horse capacity=50kg, one piled = 15-20 kg, *'Kemer'=400kg NR=Not Reported*

Table 7: Identified concentrate feed resources used for cattle fattening practices, price, sources and users in Dessie and Kombolcha towns

	Identified concentrate feed resources	Unit	Current price (birr)	Price range (Birr)	Sources	Users
1	Grass pea leftover^	kg	6.50	6-8	Milling house and small scale food processer DK	Peri urban & urban fatteners
2	• Un processed corn grain	kg	5.30	4-5.40	From farm and Market DK	Peri urban & urban fatteners
	• Processed corn grain	kg	6.00	5.20-6.10	Feed market in DK	Urban fatteners
3	Dried brewers grain	per car	2700	2700	Kombolcha Beer factory (BGI ETHIOPIA)	Urban fatteners
		per sack	125	120-130	Market in DK	Urban fatteners
4	Wheat bran	kg	4.70	3.80-5.20	Flour factory in DK	Peri urban & urban fatteners
5	Wet brewers grain	Per car	2000	2000	Kombolcha Beer factory (BGI ETHIOPIA)	Urban fatteners
6	Oat grain	kg	32	26-34	Feed market in DK	Urban fatteners
7	Wheat middling	kg	5.50	5-5.50	Flour factory in DK	Peri urban & urban fatteners
8	Molasses				Tendaho sugar processing factory	Urban fatteners
9	Wheat leftover^	kg	7	6.50-7.50	Milling house and small scale food processers in DK	Urban fatteners
10	Flour factory leftover	kg	5	2-5	Flour factory in DK	Urban fatteners
13	Linseed cake	kg	8	6-8	Small scale oil seed processer in Dessie town and from other towns dominantly	Urban fatteners
11	Different feed left over	kg	5	4-5	Flour factory in DK	Peri urban & urban fatteners
12	Noug seed cake	kg	8	6-8	Small scale oil seed processers in Dessie town and from other towns dominantly	Urban fatteners
14	Milling leftover	kg	5	3-5	Milling house in DK	Urban fatteners
15	Barley leftover^	kg	5	5-6	Milling house and small scale food processer in DK	Peri urban & urban fatteners
16	Bean leftover^	kg	7	6.5-7	Milling house and small scale food processer in DK	Urban fatteners
17	Lentils leftover^	kg	7	6.50-7	Milling house and small scale food processer in DK	Urban fatteners
18	Formulated ration	kg	5.40	5-8	Government aid	Peri urban and urban fatteners
19	Pea leftover^	kg	7	6.50-7	Milling house and small scale food processer in DK	Urban fatteners

duka^ or leftover ^ = means damaged or surplus feed during processing, DK= *Dessie and Kombolcha towns*

Seasonal Availability and Months of Distribution of the Identified Feed Resources:

The seasonal availability and months of distribution of the overall identified feed resources is summarized in Table 8 and 9.

Table 8: Identified roughage and non –conventional feed resources used for cattle fattening, month of availability and distribution in Kombolcha and Dessie towns

Identified feed resources		Local name (Amharic)	Type	Month of availability and distribution											
				Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Ma.	April	May	June	July	Aug.
Green roughage															
1	Green grass	*Yewober sar*	C	***	***	**									**
2	Green maize Stover	*Ertebi yebekolo ageda*	C	**	***	*									*
3	Sugar can tops	*Shenkora ageda chaf*	C					*	*	**	**	**	*		
4	Different weeds	*Wokiya*	C	**										*	**
Dry roughage															
1	Hay	*Derkoshi*	C			***	***	***	***	**	**	*			
2	Maize Stover	*Yebekolo ageda*	C	*	***	***	*								*
3	Teff straw	*chid*	C		*	*	**	**	*						
4	Wheat straw	*Yesende chid (geleba)*	C			**	**	**	**	*					
5	Barley hulls	*Yegebise geleba*	C				**	**	**	*	*				
6	Oat hulls	*Yaja geleba*	C				*	*	*	*	*				
7	Grass pea hulls	*Yeguwaya geleba*	C	*	**	**	**	**	*	*	*	*	*		
8	Corn head & cob	*Enbut bekolo*	C	*	*										*
9	Pea hulls	*Yater geleba*	C			*	*	*	*	*	*	*			
10	Bean hulls	*Yebakela geleba*	C			*	*	*	*	*	*	*			
11	Barley straw	*Yegebise chid (geleba)*	C				**	**	**	*	*				
12	Sorghum Stover	*Yezengada ageda*	C		*	**	**	*							
13	Lentil hulls	*Yemeser geleba*	C				*	*	*						
Non-conventional feed															
1	Poultry litter (day old)	*Yedoro kus (yechachut)*	NC	**	**	**	**	**	**	**	**	**	**	**	**
2	Poultry litter (layer & pullet)	*Yedoro kus (enkulal tayi)*	NC	**	**	**	**	**	**	**	**	**	**	**	**
3	Poultry litter (broiler)	*Yedoro kus (ye sega)*	NC	**	**	**	**	**	**	**	**	**	**	**	**
4	'Atela' left over	*Yetela atela*	NC	*	*	*	*	*	*	*	*	*	*		
5	'Korefe' leftover	*Yekeorefe atela*	NC	*	*	*	*	*	*	*	*	*	*		

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| 6 | University leftover food | *Yemegeb treferafi* | NC | * | * | * | * | * | * | * | * | * | * | * | * |

***= Abundantly available **= Moderately available *= Less available C = Conventional NC = Non-conventional

Table 9: Identified concentrates feed resources used for cattle fattening, month of availability and distribution in Kombolcha and Dessie towns

Identified feed resources Concentrates		Local name (Amharic)	Type	Month of availability and distribution											
				Sep	Oc	No	De	Jan	Feb.	Ma.	Apr	May	Jun	July	Aug.
1	Grass pea leftover^	*Yeguwaya duka^*	C	*	**	**	**	**	*	*	*	*	*		
2	Corn grain	*Bekole*	C	**	**	***	***	***	***	**	**	**	**	**	**
3	Dried brewers grain	*Derek yebira chimaki*	NC	**	**	**	**	**	**	**	**	**	**	**	**
4	Wheat bran	*Yeferes furishika*	C	*	***	***	***	**	**	*	*	*	*	*	*
5	Wet brewers grain	*Ertib yebira chimaki*	NC	**	**	**	**	***	**	***	**	**	**	**	**
6	Oat grain	*Aja*	C				*	*	*	*	*				
7	Wheat middling	*furshikelo*	C	*	***	***	***	**	**	*	*	*	*	*	*
8	Molasses	-	C	-	-	-	-	-	-	-	-	-	-	-	-
9	Wheat leftover^	*Yesende duka^*	C	*	*	*	*	*	*	*	*	*	*	*	*
10	Flour factory leftover	*Yeduket fabrica bitary*	C	*	*	*	*	*	*	*	*	*	*	*	*
13	Linseed cake	*fagulo ye telba*	C		*	*	*								
11	Different feed left over	*Entiritaryi*	C	*	*	*	*	*	*	*	*	*	*	*	*
12	Noug seed cake	*fagulo ye nuge*	C		*	*	*								
14	Milling leftover	*Yewoficho bet tiragi*	C	*	*	*	*	*	*	*	*	*	*	*	*
15	Barley leftover^	*Yegebise duka^*	C				**	**	**	*	*				
16	Bean leftover^	*Yebakela duka^*	C			*	*	*	*	*	*	*			
17	Lentils leftover^	*Yemeser duka^*	C				*	*	*						
18	Formulated ration	*Yetemetatene meno*	C							**	**	**	**	*	
19	Pea leftover^	*Yater duka^*	C			*	*	*	*	*	*	*			

***= Abundantly available **= Moderately available *= Less available ^leftover/ duka^ = Occasional surplus or damaged grain during processing

C = Conventional NC = Non-conventional

General Limitations and Challenges Related to Feed Resources Used for Cattle Fattening:

Limited access of feed resources, difficulties related to transportation and cost to collect different feeds from different feed suppliers, recurrent drought, feed shortage, price increment and unpredictable feed cost variation, lack of governmental feed processing factories and suppliers, limited brewery grain access, poor distribution of the available feed resources, illegal cattle feed traders and difficulty to access molasses were pronounced challenges and limitations reported by cattle fatteners in Dessie and Kombolcha towns.

Chemical composition of selected feed ingredients

Chemical composition of selected feed ingredients used for cattle fattening in Dessie and Kombolcha towns is explained in Table 10.

Table 10: Chemical composition of selected feed ingredients used for cattle fattening in Dessie and Kombolcha towns

Feed ingredients	Chemical composition								
	DM (%)	Ash	OM	CP	NDF	ADF	ADL	HC	C
					% DM				
Natural grass hay (NGH)	95.29	8.59	86.7	4.79	58.29	42.41	6.23	15.88	36.18
Dried breweries grain (DBG)	89.69	4.45	85.24	31.39	56.21	23.79	8.17	32.42	15.62
Poultry litter (layer)	95.86	12.56	83.3	23.33	27.19	22.7	7.65	4.49	15.05
Poultry litter (pullet)	95.77	10.87	84.9	22.33	26.4	21.31	7.26	5.09	14.05
Poultry litter (day old)	95.83	9.75	86.08	23.36	26.16	22.02	8.33	4.14	4.19
Grass pea leftover (GPLO)	92.00	9.35	82.65	7.64	62.5	45.47	8.51	17.03	36.96
Processed corn grain (PCR)	93.70	1.61	92.09	7.59	16.16	4.77	3.41	11.39	1.36
Wheat middling (WM)	92.34	4.17	88.17	15.37	39.07	15.26	5.23	23.81	10.03
Wheat bran (WB)	90.43	5.7	84.73	16.73	43.12	14.81	3.82	28.31	10.99

ADF=Acid detergent fiber; ADL=Acid detergent lignin; CP=Crude protein; DM=Dry matter; NDF=Neutral detergent fiber, HC = Hemicellulose, C = Cellulose

Discussions:

Identified Feed Resources used for Fattening Cattle in Dessie and Kombolcha Towns:

Those identified feed resources were used as major and supplementary feeds by the interviewed cattle fatteners which grouped further into three categories: viz; (i) green roughages, (ii) dry roughages and (iii) concentrates. The green roughage category, which included green grass which is native wet grass comes from the adjacent farm land, locally called '*wober*' or pasture land, green maize stover, sugar can tops and different weeds were ranked 1st, 2nd, 3rd and 4th, respectively, based on availability and abundance in both study towns. Particularly, green grasses, different weeds,

green maize stover were predominantly available for peri urban cattle fatteners and farmers who have pasture land. The indicated feeds were difficult to acquire at market level unless otherwise purchased from farmers farm and pasture lands in green form (Table 1).

In the category of dry roughage, hay, maize stover, teff straw, wheat straw, barley hulls, oat hulls, grass pea hulls, corn head and cob, pea hulls, bean hulls, barley straw, sorghum stover and lentil hulls, were ranked 1st to 13th based on availability and abundance in Dessie town, respectively, whereas, hay, maize stover, sorghum stover, teff straw, grass pea hulls, pea hulls, wheat straw, barley hulls, oat hulls, bean hulls, barley straw, lentil hulls, and corn head & cob were ranked 1st to 13th based on availability and abundance in Kombolcha town, respectively (Table 1). The current results agreed with Zewdie (2010) who reported that teff and wheat straws are important sources of livestock feed in the highland. Barley and oat straws are also important and accessible in the area. Straw supplementation is commonly restricted to work-oxen and lactating cows.

Underneath non-conventional feed resources category, poultry litter from layer house, poultry litter from day old chicken house, (Figure 9) poultry litter from broiler house, 'Atela' left over, 'Korefe' leftover and university leftover food were ranked 1st to 6th, respectively, based on availability and abundance in Dessie and Kombolcha towns (Table 1). From concentrate feed category, wheat bran, corn grain, dried brewers grain, wet brewers grain, wheat middling, grass pea leftover, (Figure 9) oat grain, pea leftover, wheat leftover, flour factory leftover, linseed cake, different feed left over, noug seed cake, milling leftover, barley leftover, bean leftover, lentils leftover, formulated ration and molasses were ranked 1st to19th based on availability and abundance in their logical order in Dessie town. Although, in the case of Kombolcha town, from concentrate category, corn grain, wet brewers grain, dried brewers grain, wheat bran, grass pea leftover, wheat middling, oat grain, pea leftover, barley leftover, wheat leftover, flour factory leftover, different feed left over, formulated ration, molasses, milling leftover, lentil leftover, bean leftover, linseed cake and noug seed cake were ranked 1st to19th in their logical order based on availability and abundance (Table 2). 'Duka' is leftover and occasional surplus or damaged grain during processing. The current findings and feed resources classification agree with Younas and Yaqoob, (2015) who indicated that green roughages included fodder crops, grasses including shrubs and forbs, sugar beet tops, sugarcane tops, silages and tree leaves. Dry roughages included hay, straws, stover's and hulls. Concentrates included cereal grains, oilseed cakes and meals, cereal brans and polishing's, molasses and sugar beet pulp. Non-conventional feed resources have the potential to play a major role in meeting the feed shortage in the years to come.

Classifications of the Identified Feed Resources Based on Significance for Cattle Fattening in Dessie and Kombolcha Towns

Thus, feed resources categorized under 1st choice were hay, poultry litter comes for day old chicken house, layer house, pullet house and broiler house, grass pea leftover, corn grain, dried brewers grain, wet brewers grain, wheat bran, bean leftover, formulated ration, wheat leftover, and pea leftover in both study towns. As a 2nd choice cattle fattener were picks green grass, green maize stover, sugar can tops, maize stover, teff straw, barley hulls, oat hulls, grass pea hulls, oat grain, wheat middling, molasses, different feed leftover, barley leftover and linseed cake in both study towns. In the 3rd position, different weeds comes from farm, wheat straw, corn head & cob, pea hulls, bean hulls, barley straw, sorghum stover, lentil hulls, *'Atela'* left over, *'Korefe'* leftover, university leftover food, flour factory leftover, noug seed cake, milling leftover and lentils leftover in both study towns. The identified feed resources classification were totally similar in both towns, this is due to cattle fatteners in both towns use similar cattle market, and such condition creates media to sharing experience one from the other.

Based on the report of cattle fatteners and their practical experiences, those feed resources listed under first choice were mandatory and must be incorporated in the cattle fattening ration for their significance and importance in nutritional values. They explained that feed resources ranked in the 1st order have potential to fatten cattle within short period of time. When the condition was not suitable to full fill or incorporate the first choice feed resources in the ration or if they missed some of the first choice feed ingredients, they were used feed resources ranked in the second order via considering the cost and availability of the feeds. Particularly, cattle fatteners were incorporate those feed resources categorized under 3rd choice to increase the bulkiness or quantity of the ration planned to give for a given number of cattle. Generally, in both study towns cattle fatteners reported that feed resources selection was highly dependable with the availability and price of each ingredient. At a time of no alternatives, particularly urban cattle fatteners were forced to purchase and use any of the feed categories accessible in the market.

Potential Feed Suppliers:

Poultry farms, flour factors, milling houses, micro and small food processors, local brewery houses, farmers, brewery factory, oil seed processers, pasture lands, traders, sugar processing factory, university and government aid were the identified cattle feed sources in Dessie and Kombolcha towns.

Poultry farms: Two poultry farms used as poultry litter sources were identified in Dessie and Kombolcha towns, namely, Kombolcha poultry farm which is governmental enterprise is found in Kombolcha town and Dessie Gredado private poultry farm found in Dessie town. In addition, in both study towns there were private small scale organized poultry farms used as supplementary poultry litter sources for cattle fattening purpose which were structured by Micro and Small Enterprise Office. Furthermore, via feed trader's cattle fatteners were accessed poultry litter from Bishoftu town. Therefore, layer poultry litter, pullet poultry litter, day old poultry litter, and broiler poultry litter were the identified non-conventional feed resources used by cattle fatteners in both study towns (Figure 1). The current finding similar with Asrat *et al.,* (2008) which reported that poultry litter has been identified as one of the non-conventional feeds for ruminant production.

Local brewery houses: Local brewery houses were one of the identified feed sources in both study towns. Under non-conventional feeds '*Atela'* left over and '*Korefe'* leftover were the two identified feed resources comes from local brewery houses in both study towns which is used for cattle fattening purpose. There are two types of '*Atela'* left over namely, '*diffedef'* the solid part which is extracted before the main product and '*kerery'* the residue watery portion. Similarly, '*Korefe'* leftover has two portions, viz., '*diffedef'* the solid part which is extracted before the main product, and '*kereryi'* residue of the watery portion (Figure 2). The current result agree with Zewdie (2010) reported that non-conventional feeds such as '*Atela'* is not available at large and their contribution to livestock feed is small but used as a cooping strategy.

University output: University leftover food was another identified non-conventional feed resource in Dessie and Kombolcha towns. Such feed comes from Wollo University, especially those cattle fatteners and livestock holders near the university campus use such feed resources for fattening cattle and other livestock's. Due to limited availability few fatteners only get the services. The problem related to such feed resources reported by cattle fatteners were unless otherwise the feed resources dried properly it creates blotting on fattening cattle.

Figure 1: Poultry litter collection process from Kombolcha poultry farm	**Figure 2**: Non-conventional feed source '*korefe difidif*' collected from Dessie town

Flour factories: Flour factories were the major and dominate feed sources identified in both study towns for fattening cattle. There are 6 and 2 large flour factors in Dessie and Kombolcha towns, respectively (Table 3). Wheat middling, wheat bran, factory leftover were the output of the factories and dominate, common and major feed resources used for cattle fattening in both study towns (Figure 3). The current result disagrees with report of Firew and Getenet, (2010) which clarify that use of concentrate and agro-industrial by-products as livestock feeds especially for fattening and dairy is not common. Generally, in both study towns, individual and organized groups of urban and peri urban cattle fatteners were used the byproduct as major, common and dominate supplements for cattle fattening.

Figure 3: Cattle fatteners wait to collect wheat bran from flour factory in Dessie town

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Micro and small food processors and milling houses: Private micro and small food processors and milling houses were other potential feed sources identified in both study towns. There were 18 and 36 micro and small private food processors, and 34 and 36 milling houses in Dessie and Kombolcha towns, respectively (Table 4). Particularly, barley hulls, oat hulls, grass pea hulls, pea hulls, bean hulls, lentil hulls, grass pea leftover, corn grain, wheat leftover, bean leftover, (Figure 9), different feed left over, milling leftover, barley leftover, lentils leftover, pea leftover were comes from micro and small food processors and milling houses. The limitations related to the indicated by products was transport challenge due to small but frequent supply of the feed resources. It needs to check the door of micro and small food processors and milling houses frequently to acquire the required amount. Due to the indicated reasons and difficulties the product was mostly accessible and used the product as major and supplements to urban cattle fatteners than peri urban cattle fatteners in both study towns. Cattle fatteners in both study areas were use '*Duka*' dominantly than hulls due to higher nutritive value. '*Duka*' is leftover and occasional surplus or damaged grain during processing. Mainly cattle fatteners were used different feed resources hulls for the purpose to increase palatability and feed intake. For example, cattle fatteners were reported that oat hulls increase feed intake due to its taste nature. In addition, barely hull is used for the purpose of odor. Generally, processed feed resources has odor which leads cattle to take more. The current finding is agree with Firew and Getenet (2010) which reported that small-scale local mills in one way or another have contribution in supplying varieties of grain by-products. Pulse hulls are commonly used as feed for animals.

Governmental aid: Governmental aid was one feed sources for fattening cattle recognized during the study in both towns. As per the group discussion, when there was occurrences of sever feed shortage the government provide formulated ration for those drought affected groups. During such time the feed resources were available in the market. The limitation of such feed source was inadequate and irregular availability

Oilseed processer: Only one small scale oil seed processer which has a capacity to produce 120 quintal per year was identified in Dessie town (Table 4). Linseed cake, and nug seed cake were the output comes from the indicated oil seed processer. Generally, except the indicated sources there was no potential oil seed processor due to absence of oil seed production and agronomic practices in both study towns. The current result agrees with Firew and Getenet (2010) which reported that in Amhara region, there are many small-scale oil mills, which notably contribute to the oilseed cake

supplies. Despite that, their contribution is declining from year to year due to increased price and decreased availability of oilseeds.

Feed traders: Feed traders were other main feed sources suppliers identified in both study towns. Oat grain, poultry litter and corn grain comes from feed traders. Particularly, in both study towns there was ample amount of corn grain with minimum price throughout the year and corn grain categorized as main crop and produced broadly in and around both the study areas. As well as through feed traders' abundant corn gains were available in trader houses in both study towns. Per quintal pure corn costs 400 - 540 birr (Table 7). Therefore, almost all of the cattle fatteners in both study areas use corn grain as a major and dominate feed supplement. On the other hand, oat grain is limited due to absence of strong agronomic practices in and around both study areas. In addition, even if the feed resources were preferred primary by cattle fatteners the price is very expensive when compare to other locally available feed resources (Table 7). Feed traders were used as a source for sugar can tops but the availability of the product was limited. Due to this reason less cattle fatteners use the product. At study town level relatively in Kombolcha town there was better accessibility of sugar can tops than Dessie town.

Sugar factory: Sugar factory was another identified feed source which provides molasses comes from Tendaho sugar factory. The limitation to use the indicated feed resources was difficulty of transport cost at individual cattle fattener level and lack of cooperatively with in cattle fatteners in both study towns.

Brewery factory: Kombolcha brewery factory was the only identified source for wet and dried brewery grains in and around the study towns which is established in Kombolcha town. Dried brewers grain, and wet brewers grain were the byproducts of the factory. Dessie and Kombolcha towns are also a beneficiary of the by-products of the brewery factory (Figure 4 and 5). The current result in line with (McDonald *et al.,* 2002) who reported that, brewers dried grains is a good source of protein for fattening cattle in addition to their energy value. Because of its bulky, fibrous nature and low energy content, BDG (Dried Brewery Grains) is more suitable for ruminants than non-ruminants. It is not highly palatable, therefore; it should be mixed with feeds of better palatability. The supply of BSG (Brewery Spent Grains) could not satisfy the demands of the farmers found in Dessie and Kombolcha towns. This finding agrees with Firew and Getenet, 2010 who explained limited supply of the by product. The limitation of the product were limited access due to presence of high demand and particularly

the wet brewery grain unless otherwise stored properly it creates bad odor with in the community.

Figure 4: Wet brewery grain in the process of drying in Kombolcha town and cattle fatteners pit to store wet brewery grain	**Figure 5**: Dried brewery grain after processed in Kombolcha town

Small holder farmers and pasture lands: Small holder farmers and pasture lands were the major dry and green roughage feed sources identified in Dessie and Kombolcha towns. Green maize stover (Figure 6), different weeds comes from farmers farm, green grass is native wet grass comes from the adjacent farm land (Figure 7), hay, dried maize stover, teff straw, wheat straw, corn head & cob, barley straw, sorghum stover were the identified feed resources comes from such feed source in both study towns. The limitation of such feed resources was except hay, majority of the feed resources mostly accessible for farmers and peri urban cattle fatteners who have pasture land. In addition, it is difficult to access at market level unless otherwise purchase the resources from the pasture land or farmers farm as its wet base. Due to limited availability of such feed resources cattle fatteners' particularly urban cattle fatteners was focused on hay as roughage feed sources.

Figure 6: One of green roughage (green corn) collected from Dessie town	Figure 7: Native green grass in the process of harvesting nearby Wollo University, Dessie town	Figure 8: Native grass harvested and piled in the form of hay nearby Wollo University, Dessie town

In general, hay is dominant dry roughage feed based on availability and abundance which is used for cattle fattening in Dessie and Kombolcha towns. Hay relatively available with minimum price September to December when compare to other months (Figure 8). The current finding in line with Zewdie (2010) which explain hay is commonly used way of feed preservation technique in Ethiopia which is expected to mitigate problems of livestock feeding during the dry period and therefore such experience is a good indicator that feeds are being efficiently utilized.

Seasonal Availability and Months of Distribution of the Identified Feed Resources:

As per group discussion like other areas in both study towns there was high seasonal variability of feed availability and distribution. This is due to seasonal agronomic practices, limited supply, and inbalancement of demand and supply and transport difficulties. As a whole, in the current both study towns specially September to December relatively there was abundant feed resources. On the other hand, the feed shortage and price increased severely towards January to June. During this period the scarcity and the feed price increased in alarming rate. This finding support the idea which shows alternating periods of surplus and deficit animal feed result in a very low level of production for the entire year (Aklilu 2004) and the current finding similar to Getachew (2002) reported that the quantity of feed is inadequate in the dry season for the existing livestock while there is surplus in the wet season. Similarly, agro industrial by products comes from flour factories such as wheat middling, wheat bran, and factory leftover were abundantly available throughout the year relative to other feed resources in both study towns. Particularly, November to December the feed resources were abundantly available with minimum price (Table 7 and 9). This is due to the indicated months were the major period to harvest different crops in and around both the study areas which will be inputs for factories. Consistently, in the peri urban *kebeles* farmers particularly, cattle fatteners were used their own feed resources come from the farm. According to Tessema *et al.,* (2003), seasonal variations in feed quality and quantity are the main limitation to animal production and cause fluctuation in productivity throughout the year, particularly in the dry seasons during which feed is limited. In addition, feed resources comes from micro and small food processors and milling houses show great variability in accessibility, particularly grass pea leftover, relatively available. This is because food processors use mostly grass pea for the preparation of human food called '*shuro*' due to its reasonable cost than other ingredients.

Therefore, grass pea leftover takes the dominant share and easily available as compere to other feed resources. Consistently, through

considering the price, availability and degree of importance cattle fatteners were provided different grade for different feed resources comes from such micro and small food processors and milling houses sources. Hay is mostly available in abundance from September to November in both study towns when compare to other months. The indicated months particularly October to November was a major harvesting season. Commonly urban cattle fatteners were collect green grass via bid from different governmental and non-governmental organization such as schools, hospitals, farmers and private owner which has pasture land. Generally, except dried brewery grain in the current both study towns' majority of the identified feed resources show great variation in availability and price due to limited supply and transportation problem. Particularly, oil seed cakes were greatly limited throughout the year with high cost.

| Processed corn | Wheat middling | Wheat bran | Barely left over | Bean left over |

| Grass pea leftover | Poultry litter (layer) | Poultry litter (day old) | Poultry litter (pullet) |

Figure 9: Some of the identified feed resources used for cattle fattening in Dessie and Kombolcha towns

General Limitations and Challenges Related to Feed Resources

Limited access of feed resources, difficulties related to transportation and cost to collect different feeds from different feed suppliers, recurrent drought, feed shortage, price increment and unpredictable feed cost variation, lack of governmental feed processing factories and suppliers, limited brewery grain access, poor distribution of the available feed resources, illegal cattle feed traders and difficulty to access molasses were pronounced challenges and limitations reported by cattle fatteners in Dessie and Kombolcha towns. The current result is in line with Firew (2010) which

reported that inadequate feed supply is one of the major constraints hampering market-oriented livestock development in the Amhara National Regional State (ANRS) in particular and in Ethiopia in general. Similarly, Belete *et al.,* (2010) explain the cattle fattening practice is constrained by high feed cost, poor quality and low availability of feed resources. Therefore, producing a high quantity and quality of feed for animals is a key factor in raising healthy and productive livestock sector (Bezahegn, 2014). Firew and Getnet (2010) reported that feed processing plants in Ethiopia are very few and still are not producing to their full capacity. Most of them are concentrated around the main highway between Addis Ababa and Adama.

Conclusion

To boost up the newly emerging urban as well as peri urban cattle fattening sector, feed shortage problem solving activities should get the first and foremost considerations. Therefore, to alleviate and minimize feed shortage, the effective approach is to focus on and due emphasis the use of locally available, identified potential feed resources in both towns. Predominantly, for effective and economical fattening program proper usage of the identified and potential feed resources should be the main thought. Accordingly from the identified 42 feed resources 9 feeds were highlighted with their chemical composition (first choices) based on availability, significance, current and future production potentials, accessibility and quantity to be released, supplier's actual potential to deliver, minimum and maximum price range and also based on cattle fatteners practical experience of both study towns. The proposed feed resources were corn grain, wheat middling, wheat bran, dried and wet brewers grain, hay, day old poultry litter, layer and pullet poultry litter, broiler poultry litter, and grass pea leftover. As a result, to run effective, profitable, economical cattle fattening program and to boost up the newly emerging urban as well peri urban cattle fattening practices in Dessie and Kombolcha towns, it is recommendable to focus on the proposed feed resources via considering their nutritive values.

Recommendations:

To minimize feed shortage difficulty in both study towns the following proposed solutions were forwarded:

- It is valuable to advice cattle fatteners to collect available feed resources and enriched their feed bunk before the feed scarcity and price increment observed with strong extension service.
- As immediate remedy, Agriculture Offices in both study towns should take action to balance feed demand and supply via analysis and coordination of feed suppliers with cattle fatteners. Additionally, for

proper distribution and usage of poultry litter and brewery grain peri urban and urban cattle fatteners should be organized and scheduled according to their feed demand and supply.

- The government should initiate private micro and small feed processing enterprises to be part of the sector. In addition, governmental cattle feed processing plant should be established as a long term remedy.
- Hay preparation as well as use of poultry litter experience of urban and peri urban cattle fatteners should be supported and strengthened with strong extension service.
- Broadly, there should be functional linkage between stakeholders such as different governmental offices (particularly Agriculture and Micro and Small Enterprise Offices), urban and peri urban cattle fatteners and feed suppliers in both study towns.

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