ISSN: 2230-9926

Available online at http://www.journalijdr.com

IJDR

International Journal of Development Research
Vol. 07, Issue, 11, pp.17037-17044, November, 2017

ORIGINAL RESEARCH ARTICLE OPEN ACCESS

INDIGENOUS TECHNICAL KNOWLEDGE OF FEEDS AND FEEDING PRACTICES BEEF CATTLE IN WESTERN HARARGHE, ETHIOPIA

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ARTICLE INFO

Article History:
Received 10th August 2017
Received in revised form
24th September, 2017
Accepted 18th October, 2017
Published online 29th November, 2017

Key Words:
Indigenous technical knowledge,
Crop residue,
Fattening,
Beef cattle.

ABSTRACT

The objective of this study is to assess the indigenous technical knowledge (ITK) of feeds and feeding practices of cattle fattening in four districts in Ethiopia. For this purpose, two kebeles (smallest administrative unit) one from highland and the other mid-altitude agro-ecology were selected per study district. Data was collected with structured questionnaire, focus group discussion and personal observation. Totally 160 respondents were involved in the study. The result of the feed assessment identified mainly crop thinning of maize and sorghum, local grass and weeds in the wet and crop residues and grass hay in the dry season. Comparing the highland and mid altitude agro-ecology, more number of respondents in the highland used locally available feeds than their midland counterparts during wet season. However, during the dry season, more number of respondents in the mid altitude used crop residues than the highlanders. Cut and carry system of feeding was practiced by 94.4% of the respondents. Chopping of green stalk and dried stover of maize and sorghum, wetting the chopped stover with salty water, wilting leguminous crops, cooking cereal seeds, mixing agro-industrial byproducts with straw and other indigenous practices were common. Scientific way of feed formulation and treatment of crop residues with additives were recommended.

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Citation: Daniel Taddesse, Gebeyehu Goshu, Mengistu Urge and and Zemelak Goraga, 2017. "Indigenous Technical Knowledge of Feeds and Feeding Practices Beef Cattle in Western Hararghe, Ethiopia", *International Journal of Development Research*, 7, (11), 17037-17044.

INTRODUCTION

There is a new interest among researchers in the potential contribution of indigenous knowledge to find solution for sustainable developmenting agriculture. Indigenous Knowledge has been defined as a systematic body of knowledge acquired by local people through accumulation of experiences, informal experiments and intimate understanding of the environment in a given culture (Rajasakeran *et al.,* 1992). Thus ITK is the technical knowhow, accrued experience, informal experiment and understanding of the environment in a given culture. In different parts of Ethiopia, farmers who practice traditional cattle fattening employ unique and impressive indigenous knowledge of feeding their cattle for fattening. Alemayehu (2006) stated that in Ethiopia farmers involved in small-scale fattening cut-and-carry system of feeding feeding by supplying hay (from natural pasture and crop residues) feeding.

Residues of local grain by-product and beverages are mixed with salt and given to milking cows, plowing oxen and fattening animals. This system of feeding is rigorously have been seen among the small holder farmers of both in East and West Hararghe zones. The Hararghe fattening system is known as an excellent cattle fattening in Ethiopiafor long time to profitably fatten cattle utilizing cut and carry system of feeding of locally available feeds and concentrates (MoA, 1996). The ever increase in dwindling of grazing lands and incorporation into cereal crop production has made cattle fatteners in West Hararghe to focus on use of crop products and residues in feeding their fattening cattle. Therefore, the current study was undertaken with the objective of assessing the indigenous technical knowledge of feeds and feeding practices of beef cattle used for fattening purpose.

MATERIALS AND METHODS

Study area

The study was conducted in four districts of West Hararghe zone, Oromia Region, Ethiopia in 2015. The data was collected from 160 respondents who were directly involved in cattle fattening. Personal observation, focus group discussion (FGD) of relevant individuals of the community. These districts were selected based on cattle potential and abundance in fattening practice in consultation with the zonal livestock and fishery resource office experts The physical description is illustrated in Table 1.

Sampling procedure

From the four districts selected, a total of 8 rural *kebeles*, that is 2 representative rural *kebeles* per district, one from highland and the other from mid-land within the district were selected purposively. Midland (*badda darre*) (1500 – 2300 masl) and highland (*baddaa)* (2300 - 3500 masl) (PEDBRSO, 2010). Sample size was determined based on the formula recommended by Arsham (2007) for survey studies:

$$N = 0.25/SE^2$$

With the assumption of 4% standard error, a total of 156 households were taken for the study but four important respondents were added and totally 160 respondents were participated in the survey.

Data collection and statistical analysis

Personal observation by a single farm visit was made to support the data about feeding, communal grazing land, feed conservation systems and feed resource situation of the households. At the same time different pictures were taken from the study districts. Focus group discussions was conducted and facilitated in the selected districts using a checklist prepared for this purpose. A group of 10 participants per *kebele* in each districts were involved for this purpose to gather qualitative data. The group was intended to include men and women, young and elderly representing all the wealth groups in the area having knowledge and experience about cattle fattening practices. Issues such as the Indigenous knowledge of feeding cattle fattening, feeds types, and the grazing land condition were raised for discussion to collect important information. The type of feed they offer and their feeding practice and problems encountered were assessed. Data gathered from the field through FGD and personal observations was analyzed after categorizing and narrating based on the study objective. The data collected through structured questionnaire were coded and entered into Microsoft Office 2007 computer software and analyzed using statistical package for social sciences (SPSS) version 20. Descriptive statistics (Percentile for major feed resources, seasonal variation of feed resources, feed storage mechanisms, feed shortage coping up methods etc.).

RESULTS

Cattle feed resource during the wet season

The main feed resources available for fattening cattle during feed available season include crop thinning of maize and sorghum, grass and weeds which account for 85 and70, 96 and 70 and 80 and 69 % in the highland and mid-altitudinal areas of the study districts, respectively (Table 2). It is customary for farmers of the study areas to broadcast a lot of maize or sorghum seed in the cropland and at the time of the first tillage (*bekbako*), they weed out those crop which were densely grown and weak in their stand and offer for fattening and other cattle. In some cases, they sow maize deliberately for the sole purpose of feeding their fattening cattle. Personal discussion with some of the interviewees in Tullo district revealed this fact that some farmers sow maize purposely for feeding their fattening cattle is because they believe they could incur more money in selling the fattened cattle than the cereal produced. The main source of grass in the study areas was basically the hills and mountains covered by forests and nowadays these places are kept excluded from livestock and human interference. Thus every community member has the opportunity to buy the grass from the *kebele* office. Therefore, these places were becoming an ideal source of grass during its harvest time mostly after the long rainy season. The other source is small land near the crop fields purposely left and fenced for grass production. However, in Gemechis district there is a large grazing land owned by the *kebele* office which is estimated to be 55 hectares. The site was excluded during the main rainy season from animals and human interference and later on the grass is sold at the time of maturity then after, the grazing land was used communally during the entire dry season. There were private owner of grazing land in this district and these farmers sell the grass after the main rainy season. Weeds and stubble feeding were common to all study districts.

Crop residues and grass for dry season feeding

From the results of this study, it could be possible to infer that maize and sorghum stover and grass hay had substantial share of dry season feed resources in the area (Table 3). Almost all respondents in the four study districts of West Hararghe zone made use of maize and/or sorghum stover and grass hay largely than other alternative feeds. The overall percentage of respondents that utilized the different alternative feeds in the study area showed that larger number of farmers in the mid altitude areas (95, 90 and 37%) utilize sorghum, maize stover and teff straw than their highland counterparts (92, 84 and 24%). This might attribute to the relatively suitable topographic condition of the mid-altitude areas for the production of these crops as compared to the rugged and hilly unsuitable terrain of the highlands. However, more respondents in highland areas (84%) used grass hay than those living in the mid-altitudinal areas (65%) respondents in the highland were favored of the grass grown in the nearby mountains for there is a strict rule to exclude these areas from human and livestock. The grass sold finally to the community. Respondents living in the highland *kebeles* (25%) produced more barely and used the straw for feeding their fattening cattle in the dry season than those in the mid-altitudinal *kebeles* (8%).

Major types of crop residues for dry season feeding

Crop residues are plant materials remaining after harvesting. All the 160 respondents (100%) of the study areas stored crop residue mainly for dry season feeding of their fattening cattle. Larger number of respondents in the mid-altitudinal study areas stored teff straw, maize and sorghum stover (33, 88 and 98%) than those living in the highland agro ecology (22, 87 and 96% (Table 4). From all study wereds, 155 (97%), 140

(88%), 44 (28%), 22(14%) respondents stored sorghum, maize stover, teff straw and other cereal crop residues, respectively.

afraid of infliction of injury by other animals and did not have the belief that cattle intended for fattening reach expected body gain through grazing.

Table 1. Physical description of the study districts

Study Districts	Geographical Co-ordinates	Annual Temperature (^{0}C)	Altitude (m.a.s.l)	Annual Rain Fall (mm.)
Habro	7°55′–9°33′N latitude and 40°01′ and 41°39′E longitude	20-22.5	1200-2590	650-1050
Gemechis	40^0 49’ 46’- 41^0 11’ 26’’ E longitude and 8^0 40’ 25’’- 9^0 3’ 42’’ N latitude	15-30.0	1300-2400	850
Chiro	34^0 18’43” – 43^0 04’ 33” E longitude and 10^0 09’ 24”- 30^0 18’43’’ N latitude	27-38.5	1500-2800	900-1800
Tullo	9^0 1’ 45’’- 9^0 18’ 48’’ N and 40^0 58’ 24’’ 41^0 16’ 49’’ E longitude	23-32.0	1500-2797	800

Table 2. Feed resources of the study areas during the wet season of the year

	Habro				Gemechs				Chiro				Tullo				Overall			
	HL		MA		HL		MA		HL		MA		HL		MA		HL		MA	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Thinning	19	95	20	100	15	79	18	90	21	95	3	13	12	67	16	89	67	85	57	70
Maize stalk	16	80	1	5	7	37	19	95	1	5	15	65	8	44	2	11	32	41	37	46
Sorghum stalk	13	65	4	20	9	47	18	90	0	0	18	78	3	17	2	11	25	32	42	52
Grass	19	95	15	75	18	95	20	100	22	100	5	22	17	94	17	94	76	96	57	70
Weeds	20	100	19	95	10	53	19	95	21	95	4	17	12	67	14	78	63	80	56	69
Stubble feeding	1	5	1	5	1	5	0	0	0	0	0	0	1	6	1	6	3	4	2	2
Others*	2	10	2	10	2	11	0	0	0	0	2	9	7	39	4	22	11	14	8	10

N=Number of respondents; HL=Highland; MA=Mid-altitude; * Others = haricot bean leaves, sweet potato vine, elephant grass

Table 3. Feed resources of the study areas during the dry season of the year

	Habro				Gemechis				Chiro				Tullo				Overall			
	HL		MA		HL		MA		HL		MA		HL		MA		HL		MA	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Teff straw	10	50	0	0	2	11	20	100	2	9	0	0	5	28	10	56	19	24	30	37
Barely straw	0	0	0	0	5	26	4	20	10	45	4	17	5	28	0	0	20	25	8	10
Maize stover	20	100	18	90	9	47	20	100	21	95	22	96	16	89	13	72	66	84	73	90
Sorghum stover	20	100	19	95	14	74	20	100	22	100	20	87	17	94	18	100	73	92	77	95
Grass hay	19	95	14	70	14	74	18	90	17	77	6	26	16	89	15	83	66	84	53	65
Others*	13	65	10	50	7	37	2	10	7	32	0	0	16	89	4	22	43	54	16	20

N=Number of respondents; HL=Highland; MA=Mid-altitude; * Others = finger millet straw, wheat straw, pulse crops straw

Table 4. Number of respondents store crop residues for dry season feeding

	HL		MA		Overall	
Crop residues	N	%	N	%	N	%
Tef straw	17	22	27	33	44	28
Maize stover	69	87	71	88	140	88
Sorghum stover	76	96	79	98	155	97
*Others	20	25	2	2	22	14

N=Number of respondents; HL=Highland; MA=Mid-altitude;
* others = finger millet straw, barely straw, wheat straw, pulse crops straw

In general, crop residues of mainly sorghum and maize stover, tef, wheat and barley straw were stored stacked outside in the field (54.4 and 74.1%), stacked under shade (39.2 and 24.7%) and stacked both outside and under shade (6.3 and 2.5%), respectively in the highland and mid-altitude agro-ecologies of the study areas.

Feeding practices of fattening cattle

Concerning the type of feeding system, in general out of the 160 respondents from all districts, 151 (94.4%) use cut and carry system of feeding but only one respondent (0.6%) use semi grazing because this owner in highland of Gemechis district had his own plot of grazing land near his home and 6 (3.75%) respondents in the highland and mid-altitude agro-ecology of the study area use stubble feeding by letting the animals directly feeding in the crop land after harvest. Whereas 2 out of 160 respondents (1.25%) use both cut and carry and stubble feeding in the Chiro district. In focus group discussion, almost all of the participants agreed that, producers do not let their fattening animals to graze because they were

However, feeding of industrial by products mainly wheat bran and oil cakes and locally adapted concentrates such as maize flour, boiled haricot bean seed and others by mixing tef straw with wheat bran, maize flour and moistening water (mostly a home-made ration) in order to increase the palatability of the straw were frequently observed systems of feeding during personal visit. Out of 79 respondents in the highland, 78 (98.8%) and 81 respondents and in the mid-altitude 79 (97.5%) treat feed before offering it to the fattening cattle. However only one and two respondents in the highland and lowland agro-ecology did not treat feed before offering to cattle. Regarding to the type of treatment of feed, out of 78 and 81 respondents in the highland and mid-altitude agro-ecology, 29 (37.2%) and 21 (26%), respectively chop maize and sorghum stalks and stover for easy and comfortable consumption. In the Highland and mid-altitude agro-ecologies, 35 (44.8%) and 42 (52%) respondents, respectively chop stover and as the same time wetting with salty water to enhance palatability. In the both agro-ecology 14 (18 %) of the respondents in the highland and 18 (22 %) in the mid-altitude used cooking of haricot bean seed; wetting with water and adding salt to

increase palatability of the stover, wilting haricot bean leaf in the sunlight to avoid bloating and diarrhea. However, there was none respondent that used chemical treatments such as urea in the study districts.

agreed that the feed shortage is critical starting from February up to June and April up to June in the highland and mid-altitude sites, respectively of the study areas. Respondents in the study districts had their own means of coping mechanisms

Table 5. General condition of feed shortage of cattle in the study areas

		Habro	Gemechis	Chiro	Tullo
HL	Yes	12 (30%)	17 (44%)	21 (47%)	18 (50%)
	No	0	2 (5%)	1 (2%)	0
	Yes but seasonal	8 (20%)	0	0	0
MA	Yes	18 (45%)	18 (46%)	22 (49%)	18 (50%)
	No	2 (5%)	2 (5%)	1 (2%)	0
	Yes but seasonal	0	0	0	0
Overall	Yes	30 (75%)	35 (90%)	43 (96%)	36 (100%)
	No	2 (5%)	4 (10%)	2 (4%)	0
	Yes but seasonal	8 (20%)	0	0	0

HL=Highland; MA=Mid-altitudinal areas; N (%) = Number of respondents (%)

Table 6. Coping up mechanisms during critical feed shortage months

	Habro (N=40)	Gemechis (N=39)	Chiro (N=45)	Tullo (N=36)	Overall (N=160)
Coping mechanisms			N (%)		
Rely on stored feed	36(90)	21(54)	42(93)	27(75)	126(79)
Rely on crop residue	15(38)	19(49)	35(78)	6(17)	75(47)
Rely on multipurpose fodder trees	16(40)	11(28)	0(0)	0(0)	27(17)
Send animals to other areas	2(5)	0(0)	0(0)	0(0)	2(1)
Rely on market purchased feed	14(35)	17(44)	14(31)	22(61)	67(42)

N= Number of respondents. A respondent chose more than one alternative

Respondents made use of used oil jerry can cut, wide plastic dishes (utensils), vessels made of old tires and wood fenced area in the shelter (*girgmi*) for feeding their fattening cattle. In fact the first three are used to feed supplementary feeds such as wheat bran, maize flour, boiled haricot bean, and other locally available supplements whereas, *girgim* is used solely for feeding chopped stalks, stover, straw, haulms and grass. Once the cattle to be fattened is isolated, night time feeding was common phenomenon in Hararghe which is purposively done to fatten the animal within a short period of time. From all the respondents 152 (95%) of them have an experience of feeding at night time however, 8(5%) of them did not have the experience of night time feeding. The purpose of night time feeding was to compensate the time lost during the day when the cattle is trying to avoid fly bites and disturbance by human and other animals noises. Although there is some variation, usually the fattening cattle were fed concentrates in the morning and at dusk, grass and different weeds in the day and maize or sorghum stover in the night time. All respondents in the study area buy additional supplementary feed usually called agro-industrial by products from market during fattening of cattle. In the two agro-ecologies of all studied districts, 96.3% (154) of the respondents bought supplementary feed from the local feed traders. Only the rest 3.7% (6) respondents replied they did not buy feed from the market but used the crop residue and other locally available feed from their cropping land and left over feed from their home.

Feed shortage, seasonality and coping up mechanisms

There is feed shortage in general but it was aggravated during the dry season of the year in the study areas (Table 5). Respondents of this survey work 100, 96, 90 and 75 % from Tullo, Chiro, Gemechis and Habro district, respectively in general confirmed that there was high feed shortage but it was serious during the dry season of the year. However, some respondents (20%) in the highland of Habro district, replied that the feed shortage is seasonal for them. From the focus group discussion held in each district, most of the participants

concerning the dry season feed shortage (Table 6) through storing feeds such as grass hay and piling crop residues. Higher number of respondents in all study districts used storing feed as the major means of mitigation of the dry season feed deficit.

Figure1. Sorghum stover piled for dry season feeding.

Crop residues mainly maize and sorghum were fed to fattening cattle starting from the field at their growing stage after collecting the ear and head and at the final harvest by stacking in the field or under shelter. To compensate the feed shortage still farmers producing fattening cattle purchased feed mainly wheat bran, maize flour and oil seed cakes from market. In Habro and Gemechis districts, respondents indicated that they used to offer leaves of multipurpose fodder trees such as Oda (*Ficus basta*), Welensu or Gorgo (*Erythrina abysinia*), Wedesa (*Cordia africana*), and Gerbi (*Acacia albida*) because these trees are green and available during dry season. Wheat brans, cotton seed cake, noug seed cake, linseed seed cake are agro-industrial by-products and maize flour purchased and utilized by the respondents in the study areas. Most of the respondent 148 (92.5%) in both agro-ecologies used wheat bran solely for supplementing their fattening cattle but 21(13%) out of 160 respondents prepare a home-made ration with one of these oil seed cakes mixed with maize flour and wheat bran and even with tef straw to offer to their animals. Six to 7 kg of wheat bran and a handful of miaze flour mixed with salt and tef straw or without tef straw was offered twice per day before offering crop residue or grass hay (nearly 12 kg per day). The average price of wheat bran of all studied districts was 569.50 birr per quintal.

Table 7. Indigenous technical knowledge of feeding fattening cattle in the study areas

Habro	Gemechis	Chiro	Tullo
-Fenugreek flour and wheat bran and slightly added water	- Broad bean and lentil haulm	-Maize seed as it is or boiled	-Boiled fenugreek seed with sugar at the end of fattening period
-Yeast (*Trigonella foenumgraecum)* mixed with wheat bran and water	-Barley straw wetted with salty water	-Chopped sorghum stover wetted with salty water	-Chopped sweet potato slightly aerated before feeding
-Chopped sugar cane	-Sweet potato vine	-Water mixed with sugar	-Soaked maize seed with salt and warming it up
-Maize flour mixed with wheat bran or sole	-Grinded maize seed	- Common salt mixed with water	-Feeding wilted haricot bean plant at seed filling stage
-Boiled maize seed with salt	-Boiled sorghum seed	-Leaves of sweet potato (*sara mitatisa*)	-Feeding pounded and wetted sorghum stover mixed with wheat bran
-Feeding ear of maize at dough stage	-Fenugreek flour mixed with water and sugar	-Flour left over from mill houses	-Feeding boiled sorghum stover stalk left on the field after harvest
-Boiled cowpea seed with salt or feeding the whole plant at seeding filling stage	-Chopped beet root with salt - Chopped sweet potato	-Licking Amole (local common salt)	-Feeding of chick peas crop at full flowering time
-Feeding weeds of different plants	-Chopped local pumpkin with salt -Chopped *Enset* root	-Chopped sugar cane planted for cattle	-Mixing teff straw with wetted wheat bran to initiate feeding more teff straw
-Mixing wheat bran with tef straw, salt and wetting with water enhance utilization of straw	-Boiled haricot bean with its soup.	-Feeding *Erythrina abyssinicaand Cordia africana*and leaves of different *Acacia* trees during dry season	-Wetting the bed area to initiate forced feeding - Chopped maize stover wetted with salty water
-Sole sugar feeding/licking		-Water soaked fenugreek seed mixed with sugar	- Boiled haricot bean with salt
-Boiled haricot bean with salt added	-Feeding haricot bean leaves at seed filling stage	-Wetting the bed area to initiate of crop residue during the night time of fattening	- Grinded Haricot bean and sorghum seed feeding mixed with wheat bran and salt for short period (1-2 months)
-Small amount of urea added on wheat bran and salt	- Thinnings, Leaves stripped from maize and sorghum	-Pounding dry sorghum stover and mixing with wetted wheat bran	
-Leaf and bark of Wolensu *(Erythrina abyssinica)* tree			

Table 8. Indigenous Technical Knowledge of Feeds and Feeding of the Study Areas

No.	Locally available feeds	Scientific name	Feeding system	Comment
1	Crop residues			
1.1.	Broad bean and lentil haulms.	*Vacia faba* and*Lens culinaris*	Once per day when available	
1.2.	Broad bean and maize haulms	*Vacia faba and Zea mays*	Once per day when available	
1.3.	Barley straw wetted with salty water.	*Hordeum vulgare*	Ad-libitum	
1.4.	Sweet potato vine	*Ipomoea batatas*	Once per day at noon time for wilting	
1.5.	Leaves stripped from maize and sorghum	*Zea mays* and *soghum biclor*	Ad-libitum	
1.6.	Thinning of maize and sorghum crop.	*Zea mays* and *soghum biclor*	Ad-libitum	
1.7.	Feeding of Maize and sorghum stover by wetting the bed area to initiate feeding in the night time	*Zea mays* and *soghum biclor*	Ad-libitum	To prevent sleeping and continue feeding in the night time
1.7.	Feeding boiled sorghum stover stalk left on the field after harvest	*Soghum biclor*	Ad-libitum	
2	Concentrates			
2.1.	Fenugreek flour and wheat bran and slightly added water	*Trigonella foenum-graecum*	Once per day in the morning	2-3 weeks before market to bring oily texture on the skin
2.2.	Fenugreek flour mixed with water and sugar	*Trigonella foenum-graecum*	Once per day in the morning	2-3 weeks before market to bring oily texture on the skin
2.3.	Yeast mixed with wheat bran and water	*Saccharomyces cerevisiae*	Once per day late in the morning	Once per day 2-3 kg in the morning.
2.4.	Maize flour mixed with wheat bran or sole		Once per day in the morning.	Once in the morning 1:3, maize to wheat ratio.

……*Continued*

2.5.	Cooked sorghum seed		*soghum biclor*	Once per day in the morning.	
2.6.	Cooked maize seed with salt		*Zea mays*	Once per day in the morning.	
2.7.	Grinded/ maize seed as it is		*Zea mays*	Once per day 2 kg in the morning	
2.8.	Cooked cowpea seed with salt		*Vigna unguic*	Once per day in the morning	
2.9.	Flour left over from mill houses			Once per day in the morning	
2.10.	Cooked haricot bean with salt added/soup		*Phaseolus vulgaris*	Once per day in the morning	
2.11.	Small amount of urea added on wheat bran and salt			Once per day in the morning	
2.12.	Water soaked fenugreek seed mixed with sugar		*Trigonella foenum-graecum*	Once per day in the morning 2 weeks before sale to make the cattle shiny skin.	
2.13.	Cooked fenugreek seed with sugar at the end of fattening period		*Trigonella foenum-graecum*	Once per day in the morning 2 weeks before sale to make the cattle shiny skin	
2.14.	Soaked maize seed with salt and warming it up		*Zea mays*	Once per day	
2.15.	Soaked linseed with wheat bran		*Linum usitatissimum*	Once per day	
3.	Crops				
3.1.	Chopped sugar cane tuber		*Saccharum officinarum*	Once per day	
3.2.	Feeding ear of maize at dough stage		*Zea mays*	Once per day	
3.3.	Feeding the whole plant of cow pea at seeding filling stage		*Vigna unguic*	Once per day after wiling	
3.4.	Feeding haricot bean leaves at seed filling stage		*Phaseolus vulgaris*	Once per day by wilting in the sun to prevent bloating.	
3.5.	Chopped sugar cane planted for cattle or human purpose		*Saccharum officinarum*	Once per day	
3..6.	Feeding of chick peas crop at full flowering time		*Lens culinaris*	Once per day when available during October and November	
4.	Root crops				
4.1.	Chopped beet root with salt		*Beta vulgaris*	Once per day when available available	
4.2..	Chopped sweet potato		*Ipomoea batatas*	Once per day in less amount during harvest	
4.3.	Chopped local pumpkin with salt		*Cucurbita*	Once per day during harvest	
4.4.	Chopped *Enset* root		*Ensete ventricosum*	Adlibitum	
4.5.	Chopped sweet potato slightly aerated before feeding		*Ipomoea batatas*	Once per day in small amount.	
5.	Weeds				
	Amharic name	Oromiffa name			
5.1.	Weha akur	Wela gabis (Hola gabis)	*Commelina bengahalensis*		
5.2.	Ye harem negus	Balcha	*Galinsoga parviflora*		
5.3.	Alluma	Orome	*Amaranthus hybridus*	Should be fed before flowering	Inflicts bloating if fed at large quantity at flowering stage.
5.4.		Amagito	Melitotus indica		Indigenous alfalfa
5.5.	Adey abeba	Key ada	*Giziota scabra*	Before flowering	
5.6.	Chegogit (Ye setan Merfie)	Tiye	*Bidens pilosa*		
5.7.	Kuni		*Cyprus rotudus*		
6.	Mix of different ingredients				
6.1.	Mixing wheat bran with tef straw, salt and water			In the morning	To enhance palatability (utilization) of tef straw
6.2.	Sole sugar feeding/licking/in water solution			At noon time	
6.3.	Common salt mixed with water			At noon time once per day	
6.4.	Licking Amole (local common salt)			Once per two to three days freely	
6.5.	Pounding dry sorghum stover and mixing with wetted wheat bran			Once per day in the morning	
6.6.	Mixing teff straw with wetted wheat bran to initiate feeding more teff straw.				
7.	Browse tree leaves				
7.1.	Wolensu (Gorgo)		*Erythrina abyssinica*	Feeding leaves once per day in in the morning	During dry season when there is feed shortage
7.2.	Wedessa		*Cordia africana*	Feeding leaves once per day in in the morning	During dry season when there is feed shortage
7.3.	Gerbi		*Acacia albida*	Feeding leaves once per day in in the morning	During dry season when there is feed shortage
7.4.	Oda		*Ficus basta*	Feeding leaves once per day in in the morning	During dry season when there is feed shortage

Indigenous technical knowledge of fattening cattle feeds and feeding systems

There are indigenous feeding systemsforfattening cattle in all study districts. According to the participants in the FGD, these local knowledge of fattening were aimed at fattening within a short period of time, saving money from the escalating price of agro-industrial by-products especially the oilseed cakes, enhancing feeding values of some of the crop residues as a drought season feed shortage mitigating strategy. According to respondents and participants of the FGD through a course of years, respondents had developed means of minimizing the negative effect of some of the concentrate feeds while feeding their fattening cattle. Feeding fenugreek (*Trigonella foenum-graecum*) seed soaked, boiled or in the form of flour mixing it with sugar was highly accustomed in most of the study areas. They feed it purposively expecting it help for further fattening of beef cattle and makes hair and skin of the animal to shine at the end of fattening period and that is highly needed in the market. Sometimes buyers rub the skin of the fattened cattle with their fingers to detect wether it has an oily nature or not and that is taken as a good sign of fattening. Because of its lucrative nature, some respondents were specializing to cattle fattening even if they have cropland. They produce maize and sorghum and feed the whole plant at seed filling stage to get a good result within a short period of time. Table 7 shows the indigenous feeds and system of feeding used by respondents in their respective districts. The scientific names of the feeds listed in the Table 7 are Beet root (*Beta vulgaris*), Cow pea (*Vigna unguiculata*), Chick peas (*Cicer arietinum*), Enset (*Ensete ventricosum*), Fenu greek *(Trigonella foenum-graecum),* Welensu (Gorgo) (*Erythrina abyssinica*), Pumpkin (*Cucurbita*), Sugar cane (*Saccharum officinarum*), Sweet potato (*Ipomoea batatas*), Yeast (*Saccharomyces cerevisiae*) and Wedessa (Wanza) (*Cordia Africana*) and other. The rugged terrain topography of most of the land which is unsuitable for crop cultivation, shortage of grazing lands, increase in population number which dwindled the average crop land holding per individual farmer, long time experience of fattening, road access to central market and availability of local markets, and access to neighboring lowlands for consistent supply of replacement stock are all contributing to the traditional fattening and enhanced the utilization of developing ITK in feeding and other management practices of fattening cattle.

DISCUSSION

Cattle feed resource and feeding practices

Based on the result of this study among the major feed resources of the area, thinning of maize and sorghum crops, grass and weeds were the dominant ones in wet season and maize and sorghum stover, teff and barely straw and grass hay were available in the dry season of the year. Thinning in Hararghe is done using high seed rate for maize and sorghum and then thin weak and sterile plants and feed to fattening oxen. Thinning will be done in a way that supports the oxen for a longer period of time (Gebregziabher and Gebrehiwot, 2011). The crude protein content of sorghum areal part fresh ranges from 2.5 to 16.3 % DM (Heuze *et al.*, 2015). The local grasses known include *Burana* (*Digitaria abissinica*) and *Serdo* (*Cynodon nelemfuensis*) while some of the weeds include *Wela gabis (Commelina bengahalensis)*, *Balcha* (*Galinsoga parviflora*) and *Orome (Amaranthus hybrids)* (Stroud and Parker, 1989). The utilization of such feed resources mainly based on season and availability. This result was in agreement with the report of Tsigereda *et al.* (2016) who showed crop residue, natural pasture hay were available during the dry season for fattening cattle in East and West Hararghe selected districts. Estefanos *et al.,* (2014) similarly indicated that crop residue, natural pasture and weeds were mentioned as the major feed resource for cattle in the study area. Personal observation in the study areas showed that owners of fattening cattle use cut and carry system of feeding by chopping maize and sorghum stover, wetting the chopped crop residue with salt added water, wilting haricot bean leaf before feeding, buying additional supplementary feeds such as wheat brans, oil cakes, maize flour and providing animals sometimes mixing these industrial by products with chaffed tef straw to increase palatability of the tef straw and night time feeding of crop residues were feeding practices in this study areas and this report is in agreement with the report by Tsigereda *et al.* (2016); Fekadu and Alemu (1999) and Gebregziabher and Gebrehiwot (2011). Contrary to this report, Andualem *et al.* (2015) reported that grazing on natural pasture was the most dominant feeding practice for cattle which were reared on natural pasture under continues grazing systems.

Feed shortage, seasonality and coping up mechanisms

There is feed shortage in general but it was aggravated during the dry season of the year in the study areas. This study indicated that the trend of feed shortage in the high and midland agro-ecology was the similar in the study districts. The seasonal feed shortage condition in East and West Hararghe districts especially during the dry season was also mentioned by (Freweini, 2014; Bezahegn, 2014, and Tsigereda *et al*., 2016). Relying on crop residues stored in the crop field after harvest, buying of supplementary feed mainly agro-industrial by-products and use of different multipurpose trees like Oda (*Ficus basta*), Welensu (Gorgo) (*Erythrina abysinia*), Wedesa (*Cordia africana*) and Gerbi (*Acacia albida*) because these trees are green and available during dry season and owners cut the branches and offer for their fattening cattle. These were good coping strategies worth to be mentioned in these study areas. Similar findings was documented by Tsigereada *et al.* (2016). Abdi *et al.* (2014) reported feed shortage was the major constraint having the first rank and highest index 0.455 among seventeen constraints reported.

Indigenous technical knowledge of cattle feeds and feeding systems

West Hararghe farmers are well known for their best practices and use of indigenous technical knowledge of cattle fattening (Abdi *et al*., 2013). Tethering mostly one and rarely two fattening cattle and feeding on cut and carry system with a diversified indigenous knowledge of feeding is comparable to the one stated by Teshager *et al.* (2013). In feeding and supplementation strategies in Southern Ethiopia, mixing crop residues (teff, barley, and wheat straw, maize and sorghum stover,) with enset, sweet potato vines and banana leaves had commonly been practiced to increase intake and palatability of crop residues and mineral lick supplementation is also an indigenous technical knowledge practiced by farmers in the area (Deribe, 2015). Indigenous knowledge on cattle feeding like chopping of straw, mixing of green grass with straw, feeding tree leaves practiced by the rural farmers in

Bangladesh (Ahmed *et al*., 2010). Nyando *et al*. (2013) reported that communal grazing, use of crop residues, feeding animals along rivers, selected trees for grazing, leaf litter and pod and movement during drought were farmer knowledge of existing ITK in fodder management in India. Generally wilting of plant parts and cooking in water of cereals reduce anti-nutritional factors residing in leguminous feed (Soetan and Oyewole, 2009). There were in fact a wide range of feeds being used in the study areas. However, the type of feed, traditional mixing to make ration and the level of incorporation of some of palatable but potentially toxic weeds requires technical back up from the concerned offices in the study weredas.

Conclusion

Assessing the ITK help find solution for sustainable development. More importantly understanding the ITK among small holder farmers engaged in cattle fattening in West Hararghe, the practice in feeding could help as a baseline for making slight improvement by introducing technologies which are pertinent and directed towards improving the nutritive values of feeds. This adds up effective utilization and reduction of the overhead feed cost.

Recommendations

- Some of these indigenous ways of preparing home-made rations has to be well guided with an improved and scientific way of feed formulation.
- Emphasis should be given for assessing ITKs of other management aspects of cattle fattening in Hararghe situation.
- Chemical and biological treatment of crop residue should be encouraged in the area for better utilization of this feed so as to enhance productivity.

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