

Assessment of Herd Structure and Use of Cactus (*Opuntia ficus indica*) and Indigenous Browse Species as Livestock Feed in Miesso, Eastern Ethiopia

Daniel Tadesse^a, Solomon Melaku^b, Yoseph Mekasha^c

^aDepartment of Dairy and Meat Technology, Haramaya University College of Agro-industry and Land Resource, Chiro, P.O.Box 226, Ethiopia.

^bHaramaya University, School of Animal & Range Sciences, Dire Dawa, P.O.Box 138, Ethiopia.

^aEmail: dantadesse@gmail.com

^bEmail:solmelay@yahoo.com

^cEmail:y-mekasha@cigar.com

Abstract

The survey was conducted in Miesso district, West Harerghe zone, Ethiopia in five purposively selected peasant associations. These included two from pastoral and three from agro pastoralist areas. The objective of the study was to assess the utilization practices of cactus and browse species as livestock feed in Miesso district. The results of the survey showed that cactus introduction in Miesso district linked with the emergence of Ethiopia-Djibouti railway construction. Farmers allow their animals to graze cactus alone or feed in combination of crop residues, grass hay and browses during dry season and drought period. Animals consumed little drinking water after cactus feeding. However, feeding cactus is associated with bloating, soreness around mouth, loss of teeth and damage on eye and skin of animals. To alleviate these problems, farmers use various traditional prevention and treatment measures such as restricting the amount consumed; feeding crop residues before and after cactus; migration to areas where less cactus invasion and preventing animals from cactus feeding. The treatment measures include removing accumulated cactus from throat area by hand especially from cattle, drenching with pepper, salt solution, coca cola, gasoline, chasing animals and using nearby vet clinics. Browse trees were also very valuable as animal feed to the farmers/pastoralists of Miesso district. Therefore, in addition to the indigenous knowledge the farmers/pastoralists have, efforts of different organizations working in the agriculture sector in the area should focus on use feeding systems like burning the spines of cactus, chopping and drying cactus, provision of grass hay, maize/sorghum stover before cactus feeding and propagation of the spineless cactus species, banning the excessive use of browse trees for charcoal making and fuel wood through education and introducing improved forage species adaptable to the area are recommended.

Keywords: Cactus; Browse; Livestock

1. Introduction

The growing urban populations and rising incomes are fuelling increased demand for livestock products such as milk and meat and the rising human populations are placing increased pressures on grazing lands with much former pasture land being cultivated for cereal production to satisfy increasing demands for food production. These are the two main drivers that are leading to changes in feeding practices in the Ethiopian livestock sector [1]. Ethiopia's predominant source of animal feed is natural pastures, forages and browse of varying nutritive value. These feeds are generally communal, or are communally administered. These feature strong seasonality in supply, as rains are bimodal in many parts of the country, but highland and lowland areas have differential rainfall patterns. As a result, traditional patterns of seasonal livestock movement have persisted [2].

Therefore, feed is a critical constraint to intensification of livestock production in Ethiopia. Ethiopia is characterized by a high livestock population but low productivity [1]. The problem of feed shortage is more aggravated in arid and semi-arid areas where erratic nature of the rainfall hampers crop production. This in turn affects the quantity of crop residues produced, which are the major source of livestock feed in most tropical countries [3]. Low and erratic rainfall also severely affects the growth of grasses and other forages, thus animals in these areas survive only on range vegetation that has low nutritional value for most part of the year [3]. Moreover, the feed resources get scarce in the dry season leading to prolonged period of under nutrition and malnutrition.

In an effort to alleviate the feed and water problem, looking for non-conventional feed resources deserves due attention [4]. In this regard, cactus pear (*Opuntia ficus indica*) is known to have great potential. In Ethiopia cactus (*Opuntia ficus indica*) is found in arid and semiarid areas of Ethiopia [5]. Cactus pear (*Opuntia ficus indica*) became naturalized and is found widely distributed in almost every part of the country ranging from arid and semi-arid area to highland agro-ecological set up [5, 4]. Cactus pear (*Opuntia ficus indica*) became naturalized and is found widely distributed in almost every part of the country such as on the mountainous and hilly areas of Tigray, Wello, around Dire Dawa, Jijiga, Issa, Babile, Haramaya, Konso,etc. It is also found in DebreZeit and also grows in higher-rainfall highland areas [4]. Cactus is also abundantly found in Miesso district.

Similar to cactus, Ethiopia is also endowed with many browse species, which are rich in nitrogen and minerals. Browse species can also fix nitrogen and play crucial role in nutrient cycling. Although many research works have been carried out to evaluate the nutritional merit of browse species, the effort made to characterize indigenous browse species is meager. However, little research has been conducted in evaluating the use of indigenous browses in animal feeding. Nevertheless, a number of studies [6, 7, 8] have indicated that diverse species of browses are used as sources of animal feeds on rangelands in different parts of Ethiopia. Indeed, [9] has indicated that most indigenous browses have enormous potential as animal feeds due to their acceptable nutritive value. Therefore, this study was carried out with the following objectives:

- To assess the utilization practices of cactus and browse species as livestock feed in Miesso district.

2. Materials and methods

2.1. Description of the study area

The study was conducted at Miesso district, which is located in West Hararghe Zone of Oromia National Regional State, Ethiopia. The district is situated in the geographical coordinate of $40^{\circ}9'30''$ - $40^{\circ}56'44''$ E longitude and $90^{\circ}19'52''$ - $80^{\circ}49'1''$ N latitude. The area is characterized by semi-arid agro ecology with bimodal rain fall pattern with annual rainfall ranging from 635-945 mm. The mean daily annual temperature is 21°C . The altitude of the district ranges from 1107 to 3106 m.a.s.l. (peak is Asebot Monastery), but most areas are found below 1700 m.a.s.l. and bordered by mountain chains in almost all directions.

2.2. Sampling procedure and data collection

Prior to actual survey work, reconnaissance visit was made to get an insight about the utilization practices of cactus and browse species as animal feed in the district. The study district included 45 peasant associations (PAs) of which 11 are pastoralists and 34 are agro-pastoralists. A total of 5 peasant associations 2 from pastoralists and 3 from agro-pastoralists were purposively selected for the study. The number of households selected from each PA was 15, and this made the total number of households to 75, where all of them were selected based on accessibility to main road.

Semi structured questionnaires were prepared and used for data collection through interviewing the households. Data were collected on feed resource availability and feeding system. In addition, secondary data about general feed situation, major feed resources, livestock feed supply calendar obtained from the district Pastoral and Rural Development Office was used. The interview included key informant elders of the community to give an in-depth information on cactus introduction.

2.3. Statistical analysis

The qualitative data collected from the survey were analyzed using descriptive statistics [10] while quantitative data were analyzed using the General Linear Model of SAS procedures [11]. Standard livestock-unit conversion factors (head to TLU) employed by [12] (for camel 1.0, cattle 0.7, sheep 0.1, goats 0.1 and Donkeys 0.5) was used to show animal or group of animals that will eat the same amount of feed as a 250 kg bovine [13].

3. Results and discussion

3.1. Livestock holding and herd structure

There were 373 and 546 cattle, 294 and 328 goats, 45 and 39 sheep, 32 and 54 donkeys and 181 and 69 camels owned by farmers interviewed in pastoral and agro pastoral production systems, respectively. The proportion of

adult male and female, young male and female cattle and calves was 15, 29, 12, 19 and 25 for agro pastoral and 16, 34, 14, 14 and 22% for pastoral PAs, respectively. The proportion of male and female goats was 36 and 64 for agro pastoral and 39 and 61% for pastoral PAs. Keeping more female animals was given first priority both in the agro pastoral and pastoral PAs of Miesso district because females supply the herders with milk and they are the source of the replacement stock on which highest portion of the society's livelihood is based. [14] stated that because of the unreliable rainfall, crop production is limited in arid and semi arid areas. Thus, livestock rearing is the mainstay of the society. Farmers sell young bulls to highland farmers (for traction and fattening purpose) and male animals and barren females of other species for the central and export markets and for buying cereal grains. Fertile females are mostly kept as the source of the replacement stock and the culture for having high number of animals is for social prestige and minimizing the risk of losing all animals through drought and disease outbreaks. In addition the high proportion of female animals in pastoral herds is thought to help stabilize milk production by off-setting the longer calving interval characteristics of the system. On the other hand, males that are not needed for reproduction are sold to generate income for food and other purposes [15].

In Miesso market, different merchants come to buy animals for companies like ELFORA and others which sell meat products for foreign and domestic markets. Since the market place is accessible to the main highway to Addis Abeba, small ruminant animals like goats are more expensive than the neighboring towns. All these factors together with the possible improvement of management of farm animals will in the future contribute to the commercialization of livestock production activities in the area. [16] Reported more than half of the respondents in the study peasant association of Miesso district were engaged in animal sale activities as one means of income generation. Herd composition in TLU for the pastoral and agro pastoral areas in Miesso district is depicted in Table 1.

Table 1: Number and TLU per household of different livestock species in Miesso district

		Pastoral (N=30)	Agro pastoral (N=45)	
Species	Number	TLU per Household	Number	TLU per Household
Cattle	373	8.7	546	8.5
Sheep	45	0.15	39	0.09
Goat	294	0.98	328	0.73
Camel	181	6.03	69	1.53
Donkey	32	0.53	54	0.6
Total	925	16.39	1036	11.45

N=Number of respondents

The herd composition in TLU for the two agro ecological settings showed that TLU per household was higher for cattle followed by camels, goats, donkeys and sheep. Comparable TLU values were obtained for cattle and donkeys in the two areas; however, comparing the two systems; higher values were observed for small

ruminants and camel in the pastoral area. The variation in value shows how goats, camels and to a lesser extent sheep are valuable to the pastoral society in the study area. This situation is associated with the adaptation of these species to the arid environment, feed situation of the area, feeding habit of specifically goats and camels and drought resistance capability of these species.

Eighty eight percent of the respondents in the pastoral PAs have 1-3 oxen per individual pastoralist. The rest (12%) had 4 oxen. Similarly, 80% of the farmers in the agro pastoral area had 1-3 oxen and the rest 20% hold 4-10 oxen. The general livestock holding of the farmers showed that 42% of the farmers in the study area had only one ox, 21% of them 2 oxen and the rest had a range of 3-10 oxen. However, only 14% had only one cow but 86% of the farmers had range of 2-14 cows per individual in the area. Nineteen percent of the respondents had only one male goat whereas, 81% of the interviewed farmers had a range of 2-16 male and similarly, 96% had a range of 2-25 female goats and only 4% of farmers had one goat in the area.

This situation agrees with the report of [14] who indicated that pastoralists keep large flocks of sheep and goats for subsistence, income, breeding, restoring wealth and social prestige. At a subsistence level, sheep and goats are kept for occasional slaughter for meat. At present, goats are kept for their milk, especially as food for children in the dry season and for adults in times of food shortage.

Table 2 shows least square means of livestock species owned per household in Miesso district. Goats and camel are kept dominantly in agropastoral and pastoral systems. This might be due to the drought tolerant nature of these species. Generally, female animals are most important for the pastoral and agro-pastoral society of Miesso district. [14] Explained that fertile females are mostly kept as the source of the replacement stock in pastoral areas.

There was no difference ($P>0.05$) among the different classes of cattle and sheep in pastoral and agro-pastoral production system. This might be due to the culture of having a large number of cattle and the increasing demand of cattle and sheep for the central market from the pastoral and agropastoral areas and the relatively better availability of crop residues and crop thinning and the increasing income from sell of animals in the agro pastoral areas. However, due to the feeding nature, their adaptation to the pastoral area and the availability of browses, there were higher number ($P<0.05$) of male and female ($P<0.01$) goats and male ($P<0.01$) and female ($P<0.05$) camels in the pastoral area than in the agro-pastoral area of Miesso district. [17] reported that significantly large number of goats was found in lowland of his study area. The lower number of goats in the mid-altitude and highland districts of the study area was due to cultivation of the land and reduced space and browse vegetation. [18] reported higher mean number of goats, sheep and camels in pastoral than agro-pastoral study areas; however, higher mean number of different classes of cattle were found in the agro-pastoral than in the pastoral area of study which is not in agreement with the present study. The difference might be due to the presence of better accessibility of foreign market and the dominant Black Head Ogaden Sheep to the farmers/pastoralists of the author's study area.

Table 2: Number of livestock (mean \pm SE) owned per household in Miesso district

System of production			
Type of animals	Pastoral (N=30)	Agro-pastoral (N=45)	SL
Cattle			
Oxen	2.2 \pm 0.28	2.0 \pm 0.23	ns
Bulls	2.0 \pm 0.19	1.7 \pm 0.15	ns
Cows	4.5 \pm 0.92	3.8 \pm 0.75	ns
Heifers	2.0 \pm 0.48	2.9 \pm 0.41	ns
Calves	3.2 \pm 0.45	3.3 \pm 0.33	ns
Sheep			
Male	1.4 \pm 0.31	1.8 \pm 0.27	ns
Female	3.5 \pm 0.64	2.3 \pm 0.64	ns
Goats			
Male	5.2 ^a \pm 0.68	3.3 ^b \pm 0.53	*
Female	7.8 ^a \pm 0.94	4.7 ^b \pm 0.67	**
Camel			
Male	3.4 ^a \pm 0.34	1.67 ^b \pm 0.35	**
Female	5.5 ^a \pm 0.85	2.2 ^b \pm 0.92	*

^{a,b} means within a row not bearing similar superscript are significantly different *: (P<0.05); **: (P<0.01); N: number of respondents; ns: (P>0.05) not significant; SE: Standard error; SL: Significance level; PAs:Peasant associations.

3.2. Drought coping strategies in Miesso district

Farmers of the district had different drought coping strategies to mitigate the feed shortage experienced by their animals (Table 3). These include allowing animals to graze on available and accessible browses and cactus because they are the most available during the dry season, to some extent by practicing forage conservation such as grass hay and crop residues, migration in search of feed in the pastoral areas, reducing the number of animals by selling.

According to the response of farmers /pastoralists,feed shortage is most common in the district in the drier months of the year which begins from December and continues up to May and the beginning of June. Whereas, relatively better amount of feed resource is obtained in the months of September, October, November, July and August when there is grass in the natural pasture, browses and sorghum and maize thinning and stover during this time[19].

Table 3: Response of farmers/pastoralists regarding drought coping strategies in Mieso district

Drought coping strategies	N	%
Feeding browses and cactus	25	33.3
Migration	15	20
Animals lent for other persons	12	16
Feed conservation	10	13.3
Selling animals	8	10.7
Feed purchase	5	6.7
Total	75	100

N= Number of respondents

3.3. Cactus in Miesso district

Cactus introduction in Miesso district had a historical link with the Ehtio- Djibouti rail way construction. Elders of the community and retired members of the Dire Dawa rail way station explained the Frenchmen were the ones who brought and planted cactus along the rail way to keep the soil stable and avoid erosion. Thereafter, dispersion of the seeds by human beings and animals and tendency of farmers to use the plant as a live fence and as a sign of boundary demarcation and above all its very nature of drought resistance were the reasons for its expansion.

Fifty seven percent of the interviewed farmers indicated cactus feeding started 50 years ago. While 25% responded that it was started in the past ten years because the severity of the drought had intensified during this time and the rest 18% did not know when it started. Almost all farmers in the study area (95%) responded that they use cactus for dry season feeding. A few (4%) of the farmers linked the cactus feeding with the increasing rate of desertification. Cactus is drought feed and they allowed their animals to graze during months of the dry season. But during and after the main rainfall, animals incline to feed on grasses, bushes and browses and crop thinning. Concerning the place where animals feed on cactus, 71% of the interviewed farmers answered their animals graze on cactus found on communal grazing areas, while 12% used cactus that grew around backyard, farm yard and in the wild, the rest use cactus that grew in both ways.

Materials used for cutting cladodes include traditional and fabricated equipments such as ‘menca’, ‘kotto’ or axe, ‘able’ or knife, ‘fassi’, manual sickle, ‘gesso’ and ‘dangora’ or ploughing hoe. However, most of the farmers still use free grazing of the standing plant and use some of these equipments for clearing the land off cactus and other bushes for crop production. Although the spineless cactus variety was found in the area, since free grazing dominated and practiced for a long period of time and occurrence of recurrent drought, it could easily be observed that the spineless variety was overgrazed and did not have the chance to propagate equally with the spiny variety, but the remnants of this variety were seen in the backyards of some farmers and in the compounds of some offices. So the short spiny variety having tufted type of growth dominated the area. Results

of the survey showed that 90% of the farmers responded that the spiny variety was dominant in their area and 10% replied they had the two varieties.

The cactus varieties found locally were known as '*Tiniidima*' or '*Tiniitika*' meaning short variety cactus with small spines and lots of fibrous spines named glochids and having bunched type of growth and bearing fruit with purple color, '*Tinigudda*' meaning cactus having an erect type of growth with wide surfaced cladodes and long spines and those with no spines. '*Adami*', '*Tinibaalabullo*', '*Tiniiguratti*', and '*Tinniaraba*' are other names given for this drought resistant plant in the different areas of the study. Most farmers (87%) replied they did not intentionally take part in the propagation of cactus for the purpose of feeding their animals; however, cactus was propagated vegetatively by itself and most of the time planted for use as live fence. Four percent of the respondents indicated that animals are important propagators of cactus after consuming the fruit and dispersing the seeds through their feces. The other 9% responded combination of the two ways. Many farmers clear their farming area from cactus invasion with the intention of increasing crop cultivation. However, as the site clearance kept on enhancing, the invasion of marginal lands by cactus had increased because small area of attachment of the cut cladodes to the soil was enough for regrowth of the branches covering again large areas around farming lands and backyards. The reason for the increased dominance of cactus were recurrent drought because of lack of enough precipitation and bushes and acacia trees are severely browsed and used as source of income through the sale of fire wood and charcoal.

3.4. Utilization of cactus as livestock feed and water source

Shortage of feed availability was the main reason for allowing their animals to feeding cactus for the 94% of that the interviewed farmers in the study area. Whereas, the remaining 6% of the farmers replied the increasing desertification in the area led their animals not only to feed on cactus, but also satisfied their water requirement which is still a problem in the area. Ninety percent of the pastoralists in the pastoral area and only 67% of the farmers from agro-pastoral area associated the reason of cactus feeding with shortage of feed, while the rest (10% and 33%), respectively, linked cactus feeding to animals with both shortage of feed and increasing desertification in the area (Table 4).

Table 4: Main reasons of feeding cactus in Miesso district

Production system					
Pastoral	Agro pastoral				
Reason of feeding cactus	N	%	N	%	
Shortage of feed	23	90	30	67	
Desertification	3	10	15	33	
Total	30	100	45	100	

N= number of respondents

Seventy two percent of the farmers in the study area reported that cattle, goats and camels feeding cactus, 16% believed cattle and camels consumed used cactus as livestock feed, however 9.4%, replied cactus is utilized by cattle only, still the remaining others (2.6%) reported all animals utilize cactus. Details of this information are given in Table 5. Cactus is very important feed resource in the area both for large and small ruminant animals.

Table 5: Numbers of respondents and priorities given to livestock species for feeding Cactus in Miesso district.

Livestock Production system and PA	Cattle only		Cattle and Camel		Cattle, goat and camel		Cattle, sheep, goat and camel	
	N	%	N	%	N	%	N	%
Pastoral								
KurfaSewa	2	13	3	20	10	67	-	-
DirreKallo	1	6.7	3	20	11	73.3	-	-
Agro pastoral								
Harema Rodema	1	6.7	2	13.3	10	66.7	2	13.3
Fayyo	3	20	4	26.7	8	53.3	-	-
Weldajalela	-	-	-	-	15	100	-	-
Average	1.4		2.4		10.8		0.4	

N = Number of respondents; PA=Peasant Association

Seventy seven percent of the respondents in the study area allowed their animals to graze cactus in the wild and around their farm lands, while 23% practiced cut and carry system of feeding their animals. In the pastoral area, 95% allowed their animals to graze in the wild, whereas only 5% used the cut and carry system and in the agropastoral area 85% used grazing and the remaining 15% of the farmers practiced cut and carry system of feeding (Table 6). The feeding management in the study area included practices of cutting, scrubbing and chopping of young cladodes from branches of the stand for their animals and grazing.

Table 6: Forms of feeding cactus in Miesso district

Forms of feeding	Pastoral		Agro pastoral	
	N	%	N	%
Grazing	29	95	38	85
Cut-and-carrying	1	5	7	15
Total	30	100	45	100

N = Number of respondents

Farmers in the study area had an experience of feeding cactus before or after feeding other feeds. 65% of the respondents used cactus alone especially in the drier months of the year where the other sources of feeds were scarce in the district and the remaining 35% fed it with other feeds. The former groups justified that since animals graze enough of cladodes no more additional feed was necessary and had no alternative feed better than cactus, especially during drought periods. But those that fed other feeds before or after cactus reported that cactus was not sufficient to provide important nutrients for the growth of animals so they add other forages before and after cactus feeding. Among the farmers that had experience in giving other feeds before and after cactus, 24% of the farmers feed crop residues like maize or sorghum stock, 17% feed browse, 9% feed grass hay and the other 50% feed both crop residues and browse plants.

Fifty six percent of the farmers allowed their animals grazing cactus freely within the day, while 35% responded that they feed twice in a day (morning and evening). The other 9% feed only once in a day in the morning. After consuming cactus, animals' response for drinking water was different. 73% of the farmers in the study area reported a decrease in water consumption. The other 27% experienced water consumption was almost nil after feeding cactus. A number of studies indicated that water intake decreases with increasing consumption of cactus by animals [20, 21, 5].

Concerning the age of the cladodes as estimated by farmers/pastoralists for feeding animals, 67% of them preferred feeding young cladodes of 1-2 years old because the water content is lower than the very young and succulent pads and animals preferred it due to lower presence of thorns. However, 33% responded they preferred feeding on cladodes that are more than 2 years of age. They justified that cactus cladodes above 2 years of age reduce the amount of spines on the surface and the water content was lower and they believed that it had salt in it at this stage of growth. The variation between animals of the same species response regarding palatability of cactus cladodes having different ages, 75% of the respondents answered that there is variation between animals. However, the other 25% observed no difference among animals regarding palatability of cactus of different ages.

Fifty seven percent of the farmers in the study area replied that they used peel of cactus fruit for feeding their animals, while 43% responded that they had not used the peel of the fruit for feeding their animals. The former respondents used the peel immediately after removing and sometimes after wilting and they justified wilting would decrease the moisture content to some extent and immediate feeding was necessary because it is sweet and palatable for the animals at that time, while the latter group of farmers did not worry about how to feed the peel of the fruit. They supported this because they simply let their animals to graze in the grazing land and they had not even tried to collect the peel in the village for feeding animals.

Farmers in the study area mostly used feeds like grass from natural pasture and grass hay, crop residues, crop thinning, browses, cactus and a few farmers around Miesso town accustomed to use agro-industrial by-products like wheat bran and wheat meal and oil seed cakes and cereals according to their importance in the area. When ranking cactus as fodder source according to their perception, as compared to local feeds in the area, 55% of the respondents ranked cactus fourth when compared with all other feeds they stated above, while 30% ranked seventh and 15% ranked second. Grass hay, maize stover, browse plants, and cereals are the main additional

ingredients supplied with cactus in the study area. Among farmers interviewed, 70% replied cactus increased the performance of animals and 30% experienced that cactus decreased the output of animals. The former justified their reply in that when cactus was given with grass hay and other feeds, it increased the animals' performance. But the latter group said it was rather maintenance feed just helping for the survival of farm animals and if it was consumed in large amounts, it might even lead to death due to severe bloating.

3.5. Problems in cactus feeding, prevention and treatment

Problems in cactus feeding, prevention and treatments were assessed and the results showed that bloating, diarrhea, sore mouth, teeth loss, eye damage by spines and chocking of the throat, accumulation of the spine in the digestive tract, body condition loss or emaciation and death, refuse salt lick, physical weakness and skin damage are the major problems (Table 7). [4] indicated that most farmers in Irob district of Tigray associated the severity of bloat with feeding cactus pear and *Acacia etbaica* together, especially from April to September. Coiling of fiber in the rumen, sore mouth, dropping and wear of teeth are identified as problems in some districts of Tigray.

Table 7: Problem of cactus feeding in Miesso district Problems

Problems	N	%
Bloating, diarrhea and sore mouth	33	44
Teeth loss, eye damage by spines and chocking of the throat	22	30
Accumulation of the spine in the digestive tract, body condition loss and death	9	12
Refuse salt lick, physical weakness and skin damage	11	14
Total	75	100

N = Number of respondents

Table 8 shows prevention practices of feeding problems of cactus in Miesso district. Different prevention and treatment practices against the feeding problems of cactus Miesso district include restricting the amount consumed by animals, feeding crop residues before or after, wilting cladodes, migration to an area where less cactus invasion is found and prevention of animals from cactus feeding are the prevention practices utilized by farmers of the area in their order of importance. Physical deterrents such as spines, may affect palatability and intake and so utilization efficiency. The common method for removing the spines is burning.

The treatment practices against bloat include chasing animals in the field to remove the accumulated gas by eructation, Oral administration herbal juices, pepper, salt solution, coca cola, gasoline, lemon juice; trocarization of the rumen with knife in severe cases and burning with hot iron bar on the skin. These treatments may bring relief to the sick animal. Treatment against sore mouth includes picking the spines and massaging the outer mouth area with edible oil. The problem of chocking with cladodes during swallowing was alleviated by opening the mouth and removing the cladodes from the throat area by hand. The different bloat treatment methods practiced by farmers are indicated in Table 9.

Table 8: Prevention practices of feeding problems of cactus by farmers/Pastoralists in Miesso district

Prevention practices	N	%
Restricting the amount of cactus consumed	26	34.7
Feeding crop residues before and after cactus feeding	17	22.7
Wilting cladodes	14	18.7
Migration to areas with less cactus invasion	11	14.7
Preventing animals from cactus feeding	7	9.2
Total	75	100

N= Number of respondents.

Table 9: Bloat treatment methods practiced by farmers/pastoralists in Miesso district

Bloat treatment methods	N	%
Removing accumulated cactus from throat by hand	15	20
Oral administration with pepper, salt solution, coca cola, gasoline	13	17.3
Oral administration with herbal juices	9	12
Chasing animals	8	10.7
Oral administration with lemon juice	5	6.7
Using nearby veterinary Clinics	3	4
Trocariization of rumen with knife in severe cases	3	4
Burning the skin with hot iron bar	2	2.8
Total	75	100

N= Number of respondents

[5] Found different ways of traditional practices used to prevent the problems of cactus feeding in Tigray, like adding salt to the chopped cactus, drenching oil and butter, dissolved detergent, mixture of egg, pepper, salt and malt solution, female's urine, and yoghurt. [4] Also found some different prevention methods like pulling the tongue and inserting a smooth stick into the esophagus of the animal, drenching with mixture of flour of barely malt (fermented solution), dung and soil with water. To minimize the incidence of bloating, animals should first be fed with roughages before feeding them with cactus. The cause of bloating is high content of mucilage in the form of pectin which can ferment rapidly and produce huge volume of gas, which is trapped in the rumen by foam [3]. Awareness creation on the negative impact of some of the treatment practices and expansion of veterinary services should get due attention.

3.6. Multiple uses of cactus

The survey conducted in the study area indicated that other than its use for animal feeding, cactus has also a number of uses as multipurpose plant by the farmers. When the cladodes branches bear fruits, the fruit serves as food especially for children and young people and females in the village because they are the ones who look

after the mixed herds during grazing time and had the chance to collect the ripe fruits for consumption. Most farmers use cactus as a live fence and demarcation line on the boundary of their farm land and believe that it checks soil erosion. Though not scientifically supported, others still believe that cactus increases the fertility of the soil. However, cactus requires nitrogen fertilizer and irrigation to enhance the CP content and production yield and has a nature of extracting high amount of minerals from the soil [3, 22]. [23] Stated that because it grows mostly on poor soils, fertilization increases yield as well as nutrient content when the amount of rainfall guarantees its efficacy. It serves as live fence around backyards and farmyards, the fiber obtained from the root serves as a tying rope. When dried in the sun, the matured branches serve as fuel wood. A few farmers reported that cactus had changed the scene (made green) and improved ecological condition of the area. [24] Indicated that cactus prevent degradation of ecologically weak environment.

[3] Reported that in Tigray, cactus fruits were collected from the wild and sold in local markets as a source of income for the poor people and school boys. He further discussed that cactus fruit, an important source of diet during food deficit (the lean months) where all the food stored was low or exhausted. Cactus flowers were used during the dry months for maintaining the honeybee colonies and to some extent for the production of honey during the dry months. Apart from its use as fodder for animals, cactus has the ability to prevent long term degradation of ecologically weak environments [23]. [25] also explained that cactus are multipurpose range species, which could be used mainly to provide forage for livestock, fruits for humans and to a less extent for animal consumption, and as a tool to combat desertification. Cactus is also considered as a source of water for animals raised under harsh environments.

3.7. Utilization practices of browse plants

Concerning the utilization practices of browse plants, 97% of the interviewed farmers used browse species mainly for animal feed both in the pastoral and agro pastoral areas. The main purpose of use of browse plants in Miesso district is for feeding farm animals because most browse plants are available both in dry and rainy seasons. In addition to this, since most browse trees have wide canopy, they serve as a shade both for the farmer and his livestock in the area. Browse plants, especially thorny *Acacia* trees were mostly found in the wild and those found around the farm lands serve as a feed for animals specially small ruminants, demarcation point and live fence in and around farm lands. However, the terrifying feature of vegetation in this area is that trunks and branches of browse plants especially *Acacia* species is highly utilized as a source of income by the farmers for making charcoal and direct sell as fuel wood. There are no strong rules and regulations to manage the browse plants grown in the area although some efforts of banning of charcoal making and fuel wood sales were implemented by concerned offices of the district [19].

Sixty two out of 75 farmers interviewed, had explained that browse plants found in the wild are being used communally. Some 17% grow improved browse species like *Sesbania sesban*, *Leucaena leucocephala*, *Acacia saligna* in and around their farm and others which are grown around backyard. Lactating cows, goats, sheep, draft oxen and heifers are given priority of feeding browse plants according to their order of importance. Around 75% of the interviewed farmers had no experience in using improved forage plants due to inavailability of seeds of improved forages; whereas 20% had experience in planting improved browse plants such as *Sesbania sesban*,

Leucaena leucocephala, and *Acacia* species. But the other (5%) mentioned they had no information about improved forage plants. The parts of the browse plants most palatable to cattle are the leaf and the twigs. Goats, sheep and camel in addition to the leaf and twigs, they feed pods and seeds. Most farmers allowed their animals to directly browse on the plants or lop the branches to feed their animals, but few farmers use cut- and carry system of feeding. [26] Indicated that farmers in Abergelle district of Tigray utilize browse both in dry and wet months of the year. Direct grazing, lopping and cut and carry method of feeding are accustomed during the wet months and in the dry months of the year naturally fallen leaves and pods were consumed by animals. Drying and conserving these plants to use in periods of scarcity was not practiced in Miesso district since most of the browse plants had fibrous leaves and shatter their leaves easily while drying which made the process of collection difficult and storage and the presence of thorn in most browse parts of the plants made difficult the handling process.

Ninety six percent of the interviewed farmers had explained that browse feeding to animals increased milk production and growth performance of the animals. The problems in utilizing these feed were most browse trees are thorny and grow tall so that livestock (except camels) did not easily reach to browse or feed on and sometimes animals encounter bloating and death because of excess feeding, especially during wet seasons. Farmers (40%) in the agro-pastoral area however, indicated removal thorns before feeding animals, others (35%) suggested in repeated pruning of the branches, they get newly emerging branches which are soft and palatable to animals, 5% responded limiting the number of plants around villages and backyards, 8% reported identifying and avoiding the toxic plants and the remaining 12% explained planting thorn less improved species are used as a measure to alleviate the existing problems with browses in the area.

More than half of the farmers interviewed responded that there was no browse management practice in the area, but the others mentioned they manage their own improved browse trees planted around homestead and on the boundaries of their farmlands. Around 97% of the farmers responded that there are no rules and regulations in using browse species and except the cultural and traditional obligation one would not use browse trees grown on another farmer's land. Browses are multipurpose trees so that they have more importance apart from being animal feed.

Sixty four out of 75 interviewed farmers revealed that they had not encountered mortality of animals by feeding browses. But 10 farmers reported mortality of a few of their animals. However, most animals can adapt to feeding browse in arid and semiarid areas like Miesso. This was because browser animals like goats and camels feed selectively and grazer animals like cattle and sheep mostly find and feed on grasses and to some extent on only accessible browses. Fodder from trees and shrubs are an important source of protein for grazing animals. However, in some cases, not only has their CP digestibility been observed to be low but also several cases of livestock death have been associated with high tannin content of some foliage, [27].[28]stated that many *Acacia* spp. produce a range of potentially toxic compounds which prevent herbivores from eating the foliage, although it is thought that the chemicals naturally evolved as defense mechanisms against insect and fungal attack. Some members contain specific anti-nutritive factors, for example, *A. georginae* has been implicated in heavy stock losses in Australia due to its content of fluoroacetic acid.

When animals were exposed to problems of feeding on excess of some browse species, physiological impacts like reduction in feed consumption, emaciation or loss of the physical condition of animals caused by bloating and its consequent diarrhea (scour) were observed. In general, most browse species contain phenolic compounds that reduce digestibility of CP and contribute to the unpalatability and reduce intake [29]. [30] Reported that sheep fed *Acacia cyanophylla* reduced feed intake, had negative N digestibility and lost weight because of the condensed tannins present in the feed. Farmers in the study area prevented these problems by restricting animals to feed only small quantity and providing traditional medicines as an alternative solution. The traditional methods of treating the animals included drenching with local herbal juices, pepper and salt solution, drenching the juice of wooden part of Bosoka plant (*Sapium ellipticum*) and they brought sick animals to veterinary clinics. More extension works in the introduction of improved forages suitable to the area and management of the local ones including practice of feeding and prevention of toxicity of browses should be conducted in area.

4. Conclusion

Assessment of the herd structure in the district showed that due to their feeding nature, adaptation to the pastoral area and the availability of browses, there were higher number of male and female goats and male and female camels in the pastoral area than in the agro-pastoral area of Miesso district. Cactus introduction in Miesso district had a historical link with the construction of Ethio-Djibouti rail road line. Results of the survey showed that farmers allow their animals to graze cactus alone or feed with the combination of crop residues, grass hay and browses during dry seasons and drought periods. However, feeding cactus causes bloating, soreness around mouth, loss of teeth and damage on eye and skin. This was due to absence of the use of different methods of alleviating the problems encountered in the feeding practices of cactus. To alleviate these problems, farmers of the district used various traditional prevention and treatment methods. These included wilting cladodes, mixing with crop residues, prevention of animals from cactus feeding, restricting the amount consumed by animals and migration to an area where less cactus invasion is found.

The treatment practices against bloat included chasing animals in the field to remove the accumulated gas by eructation, drenching with herbal solutions, pepper, salt solution, coca cola, gasoline, lemon juice; trocarization of the rumen with knife in severe cases and burning with hot iron bar on the skin. Treatment against sore mouth was done by picking the spines and massaging the outer mouth area with edible oil. The problem of chocking with cladode during swallowing process was alleviated by opening the mouth and removing the cladode from the throat area by hand. With the incidence of recurrent drought, decline in availability of alternative feed resources such as browses, the drought coping ability of cactus and the attraction of animals to feed on it would require more attention for its sustainable use as animal feed in the area. Therefore, this assessment work will be a stepping stone for development intervention. Adding knowledge on how to manage and utilize cactus that has spine and dissemination of the spineless variety, and in general, inclusion of multipurpose browse plants in the feed and other improved forage development activities in the area should be component of the forage development activity by both government and non-government organizations working of the area. Further, identification and production potential of the existing browse multipurpose trees and the effect of feeding dried cactus with different protein rich agro-industrial byproducts on the production performance of small ruminants should be studied.

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