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Cattle feed production constraint and opportunity in south-western Ethiopia

Bajerond Tolera[1], Denbela Hidosa[2*]

[1]Animal Science Department, Jinka University, P.O. Box: 165, Jinka, Ethiopia.
[2]Livestock Research Directorate, Jinka Agricultural Research Center, P.O. Box: 96 Jinka, Ethiopia.

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***Correspondence**
Denbela Hidosa
denbelahidosa@gmail.com

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The absence of updated information on the current status of the cattle feed bases and feed production practice is one the important cattle feed production determinant that has been affecting cattle production in Jinka town of South Omo. This study was aimed to investigate cattle feed basis, feed availability, feed production constraints and opportunities in the Alga Kebele. A face-to-face household survey was conducted by interviewing 31 purposively selected cattle keeper households from the Alga Kebele based on cattle and cattle feed production experiences. The qualitative data such as cattle feed basis, feed availability, type of grazing land, grazing land productivity, grazing land management practices, feed conservation method, improved forage production status and the extent of extension service in cattle feed production were analysed using non-parametric methods, while the means of the quantitative parameters such as age and sex of households, cattle number and categories and amount of land allocated for improved forage production were analysed by using parametric methods. The result showed that about 87.1% of cattle feed producers were male-headed, while 19.1% were female-headed. Almost all (96.8%) of respondents replied that natural pasture was the main cattle resource basis, while very few (3.2%) replied that crop-residue and crop aftermath were used as cattle feed bases. Most respondents (87.1%) reported that there was not enough feed production for cattle in the last five years, while very few (12.9%) said that there was enough feed produced for cattle. All respondents mentioned that the productivity of the grazing land has been decreasing since the last five years onward due to climate variability (54.8%), a lack of grazing land management strategies (38.5%), and increasing cattle populations (9.67%). Moreover, about 67.7% of

respondents did not adopt improved forage production due to a lack of knowledge (41.93%), a lack of forage seed (12.9%), a lack of training and support (22.58%), and a shortage of land (19.35%). The shortage of land, climate variability, lack of forage seeds and capacity building are major cattle feed production constraints, while the existence of extension services and favourable agro-ecology are an important opportunity for cattle feed production in the study area.

Key words: *cattle, feed, feed availability, feed production, constraints, opportunities, Ethiopia, climatic change*

INTRODUCTION

Ethiopia has approximately 70 million cattle, with 68,180,000 (97.4%) indigenous cattle, 1,610, 000 (2.3%) hybrid cattle, and 210,000 (0.3%) exotic breeds (CSA, 2021). Cattle are the leading livestock species in the country and have a tremendous role in being a source of cash income, food (meat and milk), fulfilling cultural obligations, delivering about 68 million tons of organic fertilizer and almost 617 million days of animal traction to 3.85 million rural households in the highland and 7.15 million rural households in the lowland (Shapiro et al., 2017). The cattle consist of cows, oxen, heifers, and steers, and have the capability to adapt to the varying agro-ecological zones of Ethiopia to produce milk, meat and traction (Hagos, 2016; FAO, 2018). It is evident that the average lactation period and milk yield per cow per day at country level are estimated to be about seven months and 1.482 litters per day per cow, respectively (CSA, 2018). Despite of these notable functions, the productivity has generated from the cattle is generally low due to both technical and socio-economic cattle feed production constraints. It is evidenced that county has endowed with various feed possessions having different feed use share, which encompassed natural pasture (54.59%), crop residues (31.60%), hay (6.85%), agro-industrial by-products (1.53%), improved feed (0.31%) and others (5.11%) with low in quality and supply that adversely affecting cattle productivity (Shapiro et al*.,* 2017; Duguma & Janssens, 2021). Similarly, in the study area, there is a suitable agro-ecology for cattle feed production, while the cattle production system follows the fashion of a low-input/low-output system due to poor quality and feed supply (Hidosa et al., 2017; Denbela et al., 2018). The cattle feed basis and feeding system are comprehensively natural pasture based and it is evident that natural-pasture has a high concentration of fibres and low crude protein. As a result, the feed intakes by cattle are limited to the extent that barely satisfies even the maintenance requirements of cattle. So that this scenario remembrances the intervention approaches that may need to emphasize cattle feed production due to, currently, the information is lacking mainly related to cattle feed basis, feed availability and production practices, and feed production constraints and opportunities.

Moreover, with a rapidly growing human population, increasing urbanization, rising incomes and domestic demand for cattle products (meat, milk and milk products) is expected to increase significantly in the foreseeable future. Thus, understanding the current cattle feed status and its constraints and opportunities in the study area is essential for the provision of data that can be used to develop and implement policies aimed at the sustainable improvement of livestock feed production at the country level. Furthermore, the information provided by smallholder farmers could be of immense utility for policymakers, government agencies, NGOs, intergovernmental agencies and development agencies in formulating and implementing sustainable cattle development activities and for preparing and coping with climatic variations, such as droughts, floods and severe winter weather events. Also, understanding the current state of the cattle feed basis and production and the constraints and opportunities for cattle feed production is one of the appealing strategies

that drew cattle keepers in to analyse the cattle feed production complications and recommend researchable solutions to alleviate the existing complications. Therefore, the present study aimed to assess cattle feed production status, constraints and significant opportunities.

MATERIALS AND METHODS

Description of the study area

Jinka town is the capital city of the South Omo zone that is found in the Ethiopian Southern Nations, Nationalities and Peoples' Regional state. It is bordered on the south by Kenya, on the Southwest by South Sudan, on the west by Bench Maji, on the northwest by Keffa, on the North by Konta, Gamo Gofa and Basketo, on the Northeast by Derashe special Woreda and Konso zone, and on the East by the Oromia Region state. Alga Kebele is found in Jinka town, which has a latitude and longitude of 5°47'43''N 36°32'38''E coordinates, respectively and an elevation of 1452 meters above sea level (Jerjero et al., 2022).

Study Design and Data Collection Method

Sample Selection Procedure

Alga Kebele from the Jinka town was purposively selected based on high cattle numbers and cattle feed production experience. A purposive sampling procedure was employed; thus, 31 cattle rearing households (27 men and 4 women households) were selected for the face-to-face interview on cattle feed production.

House hold survey

Primary data were collected through face-to-face interviews of the cattle keeper households by using a semi-structured questionnaire. During the face-to-face household's survey, the cattle feed producers were asked to answer the information on the demographic characteristics of the families, cattle breed, feed resource, feed availability, feed production practices, feed production constraint, and an opportunity for cattle feed production.

Method of Data Analysis

The data from the household survey through face-to-face interviews were entered and managed using the SPSS computer program. The qualitative traits were analysed using non-parametric methods (frequency) to describe the various variables of cattle feed production practices, while the quantitative parameters' means were calculated in One-Way-Annova using the SPSS computer program version 16.

RESULTS AND DISCUSSION

Sex of respondents

The findings on the sex of respondents showed that the majority (87.1%) of cattle feed producer farmers were male-headed; while very few (12.9%) were female-headed (Figure 1). The higher male-headed involvement in cattle feed production in the study area is due to the fact that cattle feed production is a more straightforward task for men than it is for women. Women spend most of their time in household routine activities such as preparing different dishes, caring for children, fetching water, cleaning the house and barn, and

collecting firewood. A similar study reported by Adane et al. (2021) and Demerew et al. (2019) from the Bena-Tsemay and Malle districts of south Omo, respectively, demonstrated that men are more involved in cattle rearing and farm operations than women, and women are more engaged in home routine activities. Similar to the current study's findings, Chufa et al. (2022) discovered that most livestock feed producer farmers (87.7%) were male-headed households, while only 12.3% were female-headed households. However, the current study's result was lower than the reported values of (91.3%) by Asefa et al. (2013) from the Alaba district of Southern Ethiopia and (95.6%) by Solomon (2004) from the Ilu Aba Bara Zone, Ethiopia, but higher than the reported value of (85%) by Haile et al. (2012) from the Adami Tullu district.

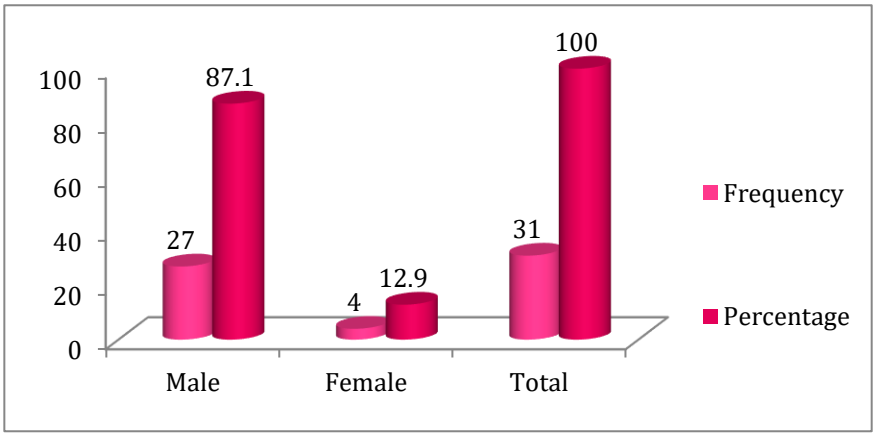

Figure 1. sex of the interviewed respondents in Alga Kebele of Jinka town

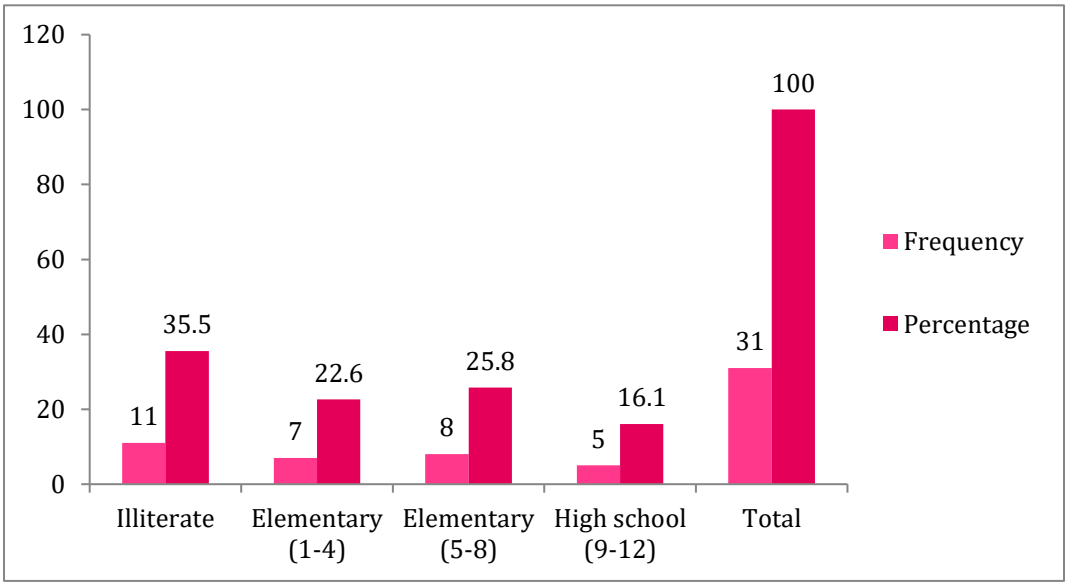

Figure 2. Educational status of the interviewed households in Alga Kebele of Jinka town

The findings of this study on the educational level of interviewees revealed that approximately 35.5% of cattle feed producer households were illiterate, approximately 22.6% had acquired primary school education (1-4th grade), 25.8% had learned Grades 5-8, and about 16.1% had learned high school education (9-12) (Figure 2). This study demonstrated that most cattle feed producers could read and write. Education is the foundation for adopting improved cattle feed production practices and innovations. This is

because farmers with some formal education are more likely to adopt improved cattle feed production and feeding practices than uneducated farmers. According to Endale (2015), the low level of education in households can have a negative impact on the transfer of agricultural technologies and their participation in development. Similarly, the study reported by Chufa et al. (2022) showed that farmers from the Derashe special district of Southwest Ethiopia who had not learned adopted improved forage production less than those who had been educated.

The average age of cattle feed producer farmers was 39 years, ranging from 35 to 43 years (Table 1). This study's findings were comparable to Mulugeta (2004) reported value of (43.2 years) from the Metekel Zone in north-western Ethiopia. The overall result for cattle feed producers' family size was 7.2 people, with a range of 5-8 people, which was comparable to the reported value of (7.3 persons) from the Derashe special district of Southwest Ethiopia by Chufa et al. (2022), and from Hawassa town (7.1 persons) and Mecha Woreda (7.2) Yisehak et al. (2013).

Table1. The family size and age of cattle feed producers in Alga Kebele of Jinka town

Family Size (means ±SEM)	Average	Range
	7.2± 0.64	5-8
Age of HHs(means ±SEM)	Average	Range
	39±1.85	35-43

HHs = Households; SEM= Standard error of mean

Cattle Compositions

The cattle compositions reported by smallholder producers in the study area revealed that householders owned more cows and oxen than others (heifer, steer, calf) (Table 2). The higher number of cows reared by studied households compared to the other cattle categories in this study is due to increased consumer demand for milk, other milk by-products such as butter and cheese, and the high price improvements in butter in the study area. Moreover, respondents stated that they needed more cows to increase their cattle population because cows were a breeding source for other cattle categories. Furthermore, the study area has a higher number of oxen because the site is dominant with crop-livestock integration, in which crops and livestock play interdependent roles, with oxen providing draught power for crop production and crop providing feed for the cattle. Similarly, Getaneh et al. (2019) and Terefe et al. (2015) reported that cattle keepers in the Malle and Mursi districts of South Omo have traditionally raised cows or cattle for milk and milk products. Likewise, a study conducted by Takele (2014) in Southern Ethiopia revealed that the lowland residents of Borana paid more attention to bulls or oxen for the market in order to increase their income. In contrast, the mid-highland population likely required oxen as a source of draught power for crop cultivation.

Table 1. Cattle compositions reared by cattle feed producer in the Alga Kebele

Variables (Mean ±SEM)		
Cattle compositions per HH	**Average**	**Range**
• Average number of ox	3±0.31	2-4
• Number of cows	3±0.48	2-4
• Average number of heifers	1±0.26	1-2
• Average number of steers	1±0.19	1-2
• Average number of calves	1±0 .18	1

Major Feed Resource Base

Almost all cattle feed producers (96.8%) reported that biomass from the natural pasture was the primary cattle feed source basis, while only a few (3.2%) of respondents were replied that crop residue and crop aftermath were the only feed sources basis for cattle in the study area (Figure 3). They stated that most of the time, their cattle grazed on pastureland by tethering on private or communal grazing lands. Crop residue and crop aftermath were only used during crop harvesting. There were no practices of collecting, storing, and treating crop residues with various quality improvement techniques for further critical time utilization to support cattle production. According to Adane et al. (2021) and Berhanu et al. (2017) households in agro-pastoral and mixed crop-livestock production systems used crop-residue, primarily maize and sorghum, as a source of feed for cattle in addition to natural pasture or grazing land. Moreover, the studies reported by different scholars shown that the primary feed source for livestock in the pastoral areas of Mursi, Bena-Tsemay, Hamer, Malle, and Dassench is grazing areas or natural pastures (Admasu et al., 2010; Terefe et al., 2015; Hidosa et al., 2017; Hidosa & Tesfaye, 2018; Getaneh et al., 2020). Furthermore, the FAO (2018) Ethiopia feed inventory report revealed that crop residues and natural pasture are Ethiopia's main cattle feed sources. It accounts for 95% of the feed biomass, with availability and quality generally good in the rainy season to meet the nutrient requirements of cattle, but rapidly declining in the dry season. In contrast to the findings of this study, Chufa et al. (2022) reported that farmers in the Derash area reported that the majority (73%) of cattle feed basis for livestock is generated from crop residues, while a small amount (23%) is contributed by natural pasture.

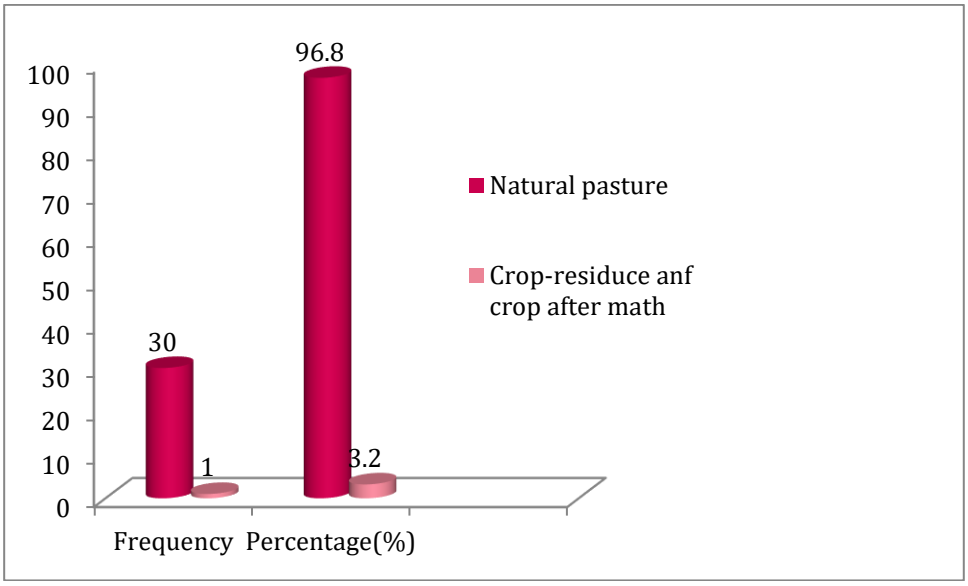

Figure 3. Major feed resources bases for cattle in the Alga Kebele

Cattle Feed Availability

The majority of interviewed households (87.1%) replied that there was insufficient feed available for cattle in the previous five years; while very few (12.9%) reported adequate feed availability to livestock in the study area (Table 3). Respondents said that a lack of good cattle feeds in the study area due to climate variability and high conversion of communally grazing sites into urban and cropping land were significant determinants of cattle feed shortage. Regarding seasonal cattle feed availability, most respondents (87.1%) have

experienced critical cattle feed shortages during the dry season, which runs from January to March, while only a small percentage (12.9%) have experienced cattle feed shortages during the wet season. They stated that during the wet seasons (March to May), more farming land that was previously used for grazing was covered with different crop varieties, causing a shortage of land for tethering cattle. Similarly, Belay et al. (2022) reported that almost all farmers in south western Ethiopia stated that the available feed resources for cattle were insufficient to meet the daily dry matter requirements, especially during the dry season. Furthermore, previous research by Assefa et al. (2015) demonstrated that biomass from the natural pasture was abundant in wet seasons, while crop residues were abundant and used as a significant feed source basis for cattle during the dry seasons in Ethiopia.

Table 3. The major cattle feed resource and seasonal availability in the Alga Kebele

	Variable (%)	
Major feed sources	**Frequency**	**Percentage (%)**
• Pasture land	30	96.8
• Crop residue and crop after math	1	3.2
• Tota1	31	100
Is enough feed available to the cattle		
• Yes	4	12.9
• No	27	87.1
• total	31	100
If not enough at what season		
• Dry season	27	87.1
• Wet season	4	12.9
• total	31	100

Cattle Feed Conservation and Utilization

The majority of respondents (71%) said they did not save feed for cattle during times of surplus production, and only a tiny percentage (29%) said that they saved feed during times of surplus production for critical time utilization in the form of hay (Table 4).

Table 4. Cattle feed conservation and utilization practice in Alga Kebele

Variables	Frequency	Percept (%)
Do you preserve feed for cattle?		
• Yes	9	29
• No	22	71
• Total	31	100%
Why do you not conserve?		
• Lack of capacity building	10	32.3
• Poor extension service	3	9.67
• Both	18	58.03
• Total	31	100
How you provide feed to your cattle?		
• Tethering on pastureland	25	80.65
• Cut and carry system	4	12.8
• Both	2	6.45
• Total	31	100

Those who have adopted feed conservation argue that they have faced a feed shortage problem for the last five years, and they have received training from experts on how to

conserve feed and have begun preserving feed such as crop residues for future use. Similarly, in the study reported by Adane et al. (2021), farmers used maize stalls as cattle feed sources by collecting and storing it outside in an open area and providing it to cattle as sole without chopping and/or treated. Furthermore, Belay et al. (2022) reported from southwest Ethiopia that farmers have adopted feed conservation practices to reduce the problem of feed supply during the dry season, which supports the current study's findings. Those who did not conserve feed during surplus production did so due to a lack of capacity building (32.3%), poor extension service (9.67%), or a combination of the two (58.03%). Likewise, the study reported by Hidosa et al. (2017) demonstrated that livestock keepers from the Salamago district are not adopting feed conservation practices due to a lack of knowledge and the absence of extension services.

Pastureland management and its productivity

Almost all (93.5%) respondents reported that the pasture land used as a source of feed for cattle was closed and covered with scattered trees, while a few (6.5%) reported that the pastureland was only covered with various types of naturally grown grass species (Table **5**). Regarding productivity, all (100%) interviewed farmers reported decreased pasture/grazing land productivity over the last five years. Climate variability (54.8%), a lack of grazing land management (35.48%), and an increasing cattle population (9.67%) were identified as potential reasons for decreased productivity of grazing area. Respondents stated that pastureland productivity was excellent before five years, and they had not faced the problem of feeding cattle. However, climate change has resulted in a low rainfall with the erratic distribution. Furthermore, respondents stated that no pastureland management practices exist in the study area and that no rules or regulations require communities to manage communal and private pastureland. As a result, many cattle are allowed to graze a small area of communal pastureland for an extended period, resulting in a decrease in pastureland productivity. Similarly, Belay et al. (2022) reported from the south-western part of Ethiopia that approximately 93.5% of communities have no control over access to communal grazing land. As a result, low biomass production was caused primarily by overgrazing (81.2%) and extended dry seasons (19.8%).

Table 5. Grazing land and its productivity in the Alga Kebele

Grazing land type	**Frequency**	**Percentage (%)**
Closed, grass and tree covered	29	93.5
Closed and grass covered	2	6.5
Open and tree covered only	0	0
Total	31	100
Land productivity	Frequency	Percentage (%)
Decrease	31	100
Increase	0	0
Total	31	100
Reasons for low productivity	Frequency	Percentage
Climate variability	17	54.85
Lack of pasture management	11	35.48
Increased cattle population	3	9.67
Total	31	100

Improved forage production

According to the polled farmers, approximately 32.3% grow improved forage such as elephant grass in their backyard, while the majority (67.7%) do not grow improved forage (Table 6). Those who did not adopt the growing of improved forage were due to a lack of knowledge (41.93%), a lack of enhanced forage seed (12.9%), a lack of training and support from the experts (22.58%), and a shortage of land for improved forage production (19.35%). The majority of farmers (48.38%) said they began growing improved forage within the last five years, while only 6.4% said they had been growing improved forage to feed their cattle for a long time. Regarding training on improved forage, about 67.7% of respondents said they did not receive any training on improved forage production and utilization, while about 32.3% received training on improved forage species production and utilization strategies from the experts. Similarly, the studies reported by Hidosa et al. (2022) & Getaneh et al. (2020) have shown that livestock feed shortages are a severe problem in the Dasenech district due to a lack of awareness and capacity building on improved forage production, except that very few agro-pastoralists were involved in Panicum grass production as a source of cattle feed and income. However, a study reported by Hidosa et al. (2017) indicated that farmers from the Dumi and Konso tribes of Salamago district reported that they had adopted improved forage production technologies and had been growing improved forage species like elephant grass in their backyards, around their compounds, in swampy areas, and on the borders of their farming land due to they had attained the training on improved forage production strategies.

Table 6. Improved forage production status in Alga Kebele

Do you growing improved forage?	**Frequency**	**Percentage (%)**
Yes	10	32.3
No	21	67.7
Total	31	100
Why not growing improved forage?	Frequency	Percentage (%)
Lack of knowledge	13	41.93
Lack of improved forage seed	4	12.9
Lack of training	7	22.58
Shortage of land	6	19.35
Total	31	100
When you start growing improved forage?	Frequency	Percentage (%)
Before two years	10	32.25
Before five years	15	48.38
Before ten years	4	12.90
Before long period of time	2	6.45
Total	31	100
Do you receive training?		
Yes	10	32.3
No	21	67.7
Total	31	100
Where planted improved forage?	Frequency	Percentage (%)
Under crop farm	31	100
Around home compound	0	0
On crop land	0	0
Total	31	100

Improved forage growing season and land allocated

The seasons in which improved forage is grown and the amount of land allocated for improved forage cultivation in the study area are presented in Table 7. Regarding the seasons of growing forage, most respondents (67.74%) replied that they cultivated improved forage species in both seasons (Belg or autumn and Mehere or summer), while about 25.81% and 6.45% were planted in the Belg and Meher seasons, respectively. They stated that improved forage species production in both seasons in the study area is due to increased rainfall availability. Furthermore, in terms of the average land allocated for improved forage species cultivation, almost all (96.77%) of the households interviewed reported that they had been allocated land for improved species cultivation ranging from 0.18 ha to 0.125 ha per household. The studies reported by Chufa et al. (2022) and Azage et al. (2013) had indicated that farmers from Derash special district and Bako, Ethiopia, respectively, allocated about 0.44 ha for improved forage, which was higher than the result from the present study.

Table 7. Seasons of improved forage grown and amount of land allocation

At what you planting improved forage?	Frequency	Percentage (%)
Belg	21	25.81
Meher	2	6.45
Bother	8	67.74
Total	100	100
How much land do you allocate for growing improved forage?	Frequency	Percentage (%)
0.18-0.125ha	30	96.77
0.125-0.25ha	1	3.23
0.25ha and above	0	0.00
Total	31	100.00

Constraints of cattle feed production

Expansion of Cropping Land

Interviewed cattle feed producers explained that the human population in the study area is increasing at an alarming rate, causing higher encroachment to graze areas that could be used for feed production and grazing areas to be converted into cropping land. During the process of converting grazing land that may be used for forage production into cropping land, vegetation clearance has occurred, and many grazing areas have become vulnerable to wind and water erosion. Similarly, due to the increasing human population, important browse species that were dry season forage have been wiped out to supply urban fuel and construction wood. It is negatively impacted the forage production to meet the biomass requirement of cattle.

Climate Change

According to the interviewed households, climate change is one of the non-technical livestock feed production constraints in the study area, as well as other areas in the South Omo Zone, that is critically affecting livestock feed production, particularly forage production, due to decreased rainfall amount and distribution compared to a previous couple of years.

Lack of improved forage seeds

The forage producers in the study area reported that the absence of any agricultural inputs promoting cattle feed production, such as forage seed and cutting and splitting materials, is a significant improvement constraint that increases the livestock feed shortage in the area.

Lack of training and awareness

Training and raising awareness is essential for addressing agricultural technologies to end users. Most interviewed householders reported that they had not received practical training on cattle feed production techniques, which does not lend credence to the forage production aspects. Furthermore, interviewed households said that a lack of awareness was linked to limitations in government support and a lack of extension services to resolve the study area's feed production problems.

Opportunities for improved forage production

Existence of Extension Services

According to respondents, there is an extension service in the Kebele, which is vital for improved forage production for cattle even though the service delivered by extension workers on the cattle feed production is very poor. They reported that they are not always advised by the extension workers and experts from Kebele on improved cattle feed production technologies such as how to produce improved forage species, how to manage improved forage species, how to utilize forage species, how to improve low-quality feed sources, how to manage communal grazing areas and how to rehabilitate degraded grazing land. Even though the service delivery system is very poor, extending services at Kebele level as compared to the past will create a good and improved cattle feed production environment for us in the future.

Availability of favorable agro-ecology

They mentioned that in the study area, the agroecologies (soil, temperature, climate) are favourable for forage production, and anyone interested in improving forage production practices can meet their desired goals due to the favourable two-season climate conditions (Belg and Mehar seasons) and the existence of relatively fertile soil for forage production.

CONCLUSION

The results showed that natural pasture was the primary feed source for cattle, and its biomass was not enough to support cattle production. There was no adoption of cattle feed conservation practices when its production was in surplus. Grazing land productivity has been declining over the last five years. The lack of knowledge, the lack of improved forage seeds, the lack of training, and the shortage of land were major constraints that made farmers less likely to adopt improved forage production for cattle feeding. The shortage of land, climate variability, lack of improved forage seeds, and lack of training and awareness are major constraints toward cattle feed production, whereas the existence of extension services and favourable agro ecology for cattle feed production are necessary opportunities for cattle feed production. Based on the survey results from the present study, it is concluded that the majority of cattle feed sources are natural pasture, which does not contain enough nutrients to meet the nutritional needs of cattle. As a result, it is preferable to encourage the introduction of improved herbaceous and browse forage species into the

studied area via seed or split supply. In the study area, feed scarcity is a common problem, especially during the dry seasons, and cattle supplementation with commercial concentrate diets is not practiced; thus, collaborative efforts in formulating locally-made concentrate diets and promoting their feeding effects to communities are required. Because the majority of cattle feed producers in the study area were illiterate, capacity building and awareness creation for improved forage species production should be promoted on a larger scale.

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AUTHOR CONTRIBUTIONS

Mr. Bajerond Tolera wrote the proposal and gathered and analysed data. Mr. Denbela Hidosa initiated the research idea, wrote and edited the entire paper, and formatted it in accordance with journal protocol.

COMPETING INTERESTS

The authors declare they have no conflict of interest. The manuscript has not been submitted for publication in other journal.

ETHICS APPROVAL

Not applicable

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