

# PRODUCTION, UTILIZATION AND CONSTRAINTS OF DESHO GRASS (*Pennisetum glaucifolium*) AS LIVESTOCK FEED IN ETHIOPIA

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<sup>‡</sup>Supporting Information

**ABSTRACT:** The study was conducted with the objective of assessing farmers' production practice, utilization and constraints of Desho grass (*Pennisetum glaucifolium*) production in Chench, Bule and Hula districts, Ethiopia. The methodology of this study encompassed questionnaire survey and group discussion. Simple random sampling was used to select a sample consisting of 199 households in the districts. The collected data were analyzed by SPSS and SAS software. The result indicated that of the total respondents, 69% did not use fertilizer and 72% respondents not practiced weeding. Generally, the majority of respondents, did not use any forage improvement practice after plantation. Concerning forage utilization, 48.2% plant Desho as soil band, while 26.6% plant as hedgerows and 25.1% plant in the back yard. 40.2% of the respondents reported that they plant Desho grass for both feeding animals and soil conservation, while the remaining 36.7% plant Desho only for feeding animals, 20% plant Desho grass for sale and 3% plant Desho grass for only soil conservation. Based on the laboratory result, Desho grass is classified as high quality feedstuff for the study area. The crude protein, neutral detergent fiber, acid detergent fiber, acid detergent lignin content and *in vitro* organic matter digestibility of sample Desho grass was 7.04, 72.47, 43.73, 5.4 and 52.19 percent, respectively. Land shortage and lack of awareness were ranked first and second constraints for Desho production in the study area. It can be concluded that, Desho grass have a very important function in terms of contribution of nutrients to livestock and locally available feed resource however, farmers are not getting the benefits they deserve from the use of Desho grass, which has not been improved and should be supported by research to improve its production and use.

**Keywords:** Desho grass, Feed, Forage, Production practice, Utilization.

## INTRODUCTION

In Ethiopia, the livestock sub-sector has significant contributions to the national income (Mengistu, 2012; Wondimagegnhu et al., 2019) and the livelihoods of households. However, livestock productivity is very low attributable to different factors of which poor nutrition is the major one. The livestock production is constrained by feed shortage in terms of both quantity and quality (Duguma et al., 2017). The feed resources are natural pasture, crop residues, agro-industrial by products; improve forage and weeds from cropland. Productivity of natural pasture is gradually decreasing due to rapidly increasing human population pressure, cropping is expanding and grazing areas are shrinking, leading to a shortage of livestock feed (Tolera, 2007; Duguma and Janssens, 2021).

Among the recommended mitigation strategies of feed shortage in the country is the utilization of indigenous adaptable multi-purpose fodder species such as Desho grass. Desho grass is indigenous to Ethiopia, which is highly popular and widely cultivated in southern Ethiopia as source of livestock feed (Smith, 2010). The grass is also widely used in soil and water conservation activities to combat land degradation and to improve productivity of land (Yakob et al., 2015). Farmers in many parts of Ethiopian highlands adopted Desho grass production because of its merits as animal feed and in soil and water conservation and management (Yakob et al., 2015; Umer et al., 2019). It has the potential to meet the challenges of feed scarcity as it gives high biomass yield per unit area and ensures year round forage supply due to its rapid growth and drought tolerance (Danano, 2007; Shiferaw et al., 2011). However, improved production and utilization practices of Desho grass are also very important besides the introduction and popularization of Desho grass by small-scale farmers (Mengistu et al., 2012, 2021).

Assessment of production and utilization of Desho grass have been survived at specific location (Burie zuria and Doyogena districts) in Ethiopia in earlier studies (Asmare et al., 2017). The study of Asmare et al. (2017) focused on the determinants of alternative and competing uses of the Desho grass and has little information on production practices of Desho grass. Previous study on Desho grass has focused on the potential value of the grass for soil and water conservation without considering its feed value, production and utilization (Yakob et al., 2015). The report by Smith (2010) and Danano (2007) indicated that the origin of Desho grass was Chench district in Southern Nations, Nationalities, and Peoples' Regional States of Ethiopia. However, there is lack of information with regard to production and utilization of the grass in Chench.

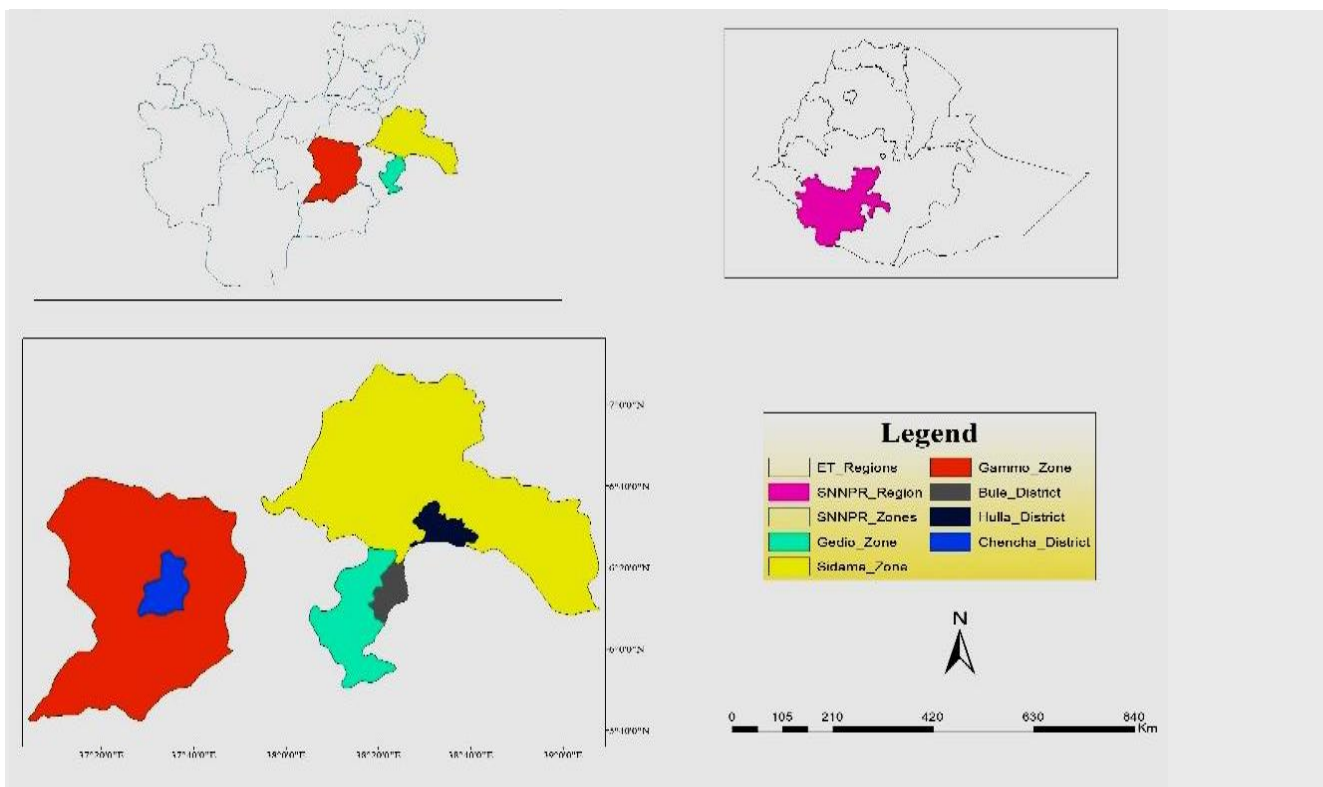
Identification of constraints to improved forage technologies in a given agricultural system helps to design appropriate interventions. Beshir (2014) indicated that since the adoption of improved technologies is dynamic having information about the current technologies being adopted by farmers is very important. Knowledge of their production management, utilization and constraints are important to identify intervention for efficient utilization (Beyene and Fayessa, 2007). However, despite its abundance and expansion in different parts of the country, there is little available information with regard to status of Desho production and utilization practices, as well as, constraints to integrate into the farming system in southern Ethiopia. Therefore, the objective of this study was to assess the production, utilization and constraints of Desho grass in southern Ethiopia.

## MATERIALS AND METHODS

### Description of study areas

The study was conducted in selected district (Chencha) of Gamo zone and Bule district of Gedeo zone of Southern Nations, Nationalities, and Peoples Regional States of Ethiopia and in Hula district of Sidama Regional State of Ethiopia (Figure 1). The climate of Chencha, Hula and Bule districts are characterized as high altitude agro-ecology, where the farming system of the study areas is mixed crop-livestock production system. The rainfall pattern is characterized by two rainy seasons (main and short seasons). The main rainy season extends from June to October and the short rainy seasons from March to April (Dersseh et al., 2016).

Chencha district located in the Gamo Zone of southern region, 37 kilometers north of Arba Minch, Chencha has a longitude and latitude of 6° 15' N 37° 34' E and an elevation of 2732 meters above sea level. The minimum air temperature ranges from 11 to 13 °C and the maximum ranges from 18 to 24 °C. The average annual rainfall is 1172 mm (Dersseh et al., 2016). Hula district geographically located between 6° 03' North latitude and 38° 31' East longitude about 90 km far from the regional capital city. The district has an elevation ranging from 2100-3200 meter above sea level and temperature range 10-18°C. The rainfall pattern of the area is bimodal and receives ranging from 1100-1400 mm per annum (Egziabher et al., 2020). Bule district is situated 120 km to south of, Hawassa city; and 27 km from Dila town. Geographically it lies between 6° 04' -6° 23' North latitude and 38° 16' -38° 26' East longitudes. The mean annual rain fall of Bule district ranges from 1,200mm - 1,800mm and the mean annual temperature in degree Celsius is between 15.1°C and 22.5°C (Keteam et al., 2015).



**Figure 1 - Map of the study area**

### Chemical analysis

Chemical analysis of forages representative samples of Desho grass was taken from all study areas (Chencha, Bule and Hula). After weighing, the biomass yield samples were mixed together and 500 g of representative samples were used for laboratory work. The air-dried samples were analyzed for Dry Matter (DM), Ash, Crude Protein (CP), Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF) and Acid Detergent Lignin (ADL).

## Data collection and statistical analysis

The survey was conducted in Chencha and Bule districts of Southern Nations, Nationalities, and Peoples' Regional States of Ethiopia and in Hula district of Sidama Regional State. The study districts were selected based on Desho grass production and utilization practices. From each district, two Kebeles were selected purposively based on wider availability and utilization of Desho grass. The house holds selected randomly and the number of households were 80, 59 and 60 from Chencha, Hula and Bule, respectively proportional to their population. The sample size was calculated according to the formula of Yamane (1967). The survey was conducted using a semi-structured questionnaire completed as a personal interview. The data were complemented with information obtained from key informants, comprised of elder farmers from each Kebeles, including animal science and natural resource experts. The discussion were made with using prepared checklist.

Livestock holding per household was converted to standard units (Tropical Livestock Unit, i.e. one TLU = 250 kg) based on conversion factors set previously (ILCA, 1990). Rank index was calculated according to the formula of Mekonnen et al. (2012). The overall rank of the Desho grass production constraints were calculated as following: Index = the sum of (5 times first order + 4 times 2<sup>nd</sup> order + 3 times 3<sup>rd</sup> order + 2 time 4<sup>th</sup> order + 1 times 5<sup>th</sup> order) for individual variables divided by the sum of (5 times first order + 4 times 2<sup>nd</sup> order + 3 times 3<sup>rd</sup> order + 2 time 4<sup>th</sup> order + 1 times 5<sup>th</sup> order) for all variables.

Household survey data was analyzed using statistical package for social science (SPSS, version, 20). Descriptive statistics (percentage, mean and standard error) were used as a preliminary investigation procedure to gain an understanding of inherent significant socio-economic characteristics of the smallholder farmers. Further, data on livestock and land holding and land use pattern of the surveyed households were systematically coded and analyzed using general linear model of SPSS. Data were analyzed using SPSS version 20 for descriptive statistics and one way analysis of variance in which the three districts (the Chencha, Hula and Bule districts) of the study area were used as fixed factors. Duncan's new multiple range tests was used to determine the differences (statistical significance) between districts, mean values for the quantitative parameters at 5% level of significance. The statistical model used to analyze the quantitative data was:  $Y_{ij} = \mu + A_i + e_{ij}$ ; where,  $Y_{ij}$  = response variable,  $\mu$  = overall mean,  $A_i$  = effect of districts and  $e_{ij}$  = random error.

## RESULTS AND DISCUSSION

### Livestock, land holding and land use pattern of the households

The average tropical livestock units (TLU) and landholding (ha) per household and land use patterns of the respondents are presented in Table 1. Average family size was 6.71 person. Each family owned on average 4.56 TLU, which were maintained on a farm size of 1.51 ha. Average experience with Desho grass production was 2.15 years and average land size allocated for Desho grass was 0.01 ha. The current survey showed that the average livestock, land allocated for Desho grass and total land holding per household in Hula district was higher ( $P < 0.05$ ) than Chencha and Bule districts. The average land allocated for Desho grass per household in Bule district was higher ( $P < 0.05$ ) than Hula and Chencha districts could be due to increase the awareness on Desho grass as animal feed and government advocate planting of Desho grass in the slope land as soil conservation in addition to animal feed. Farm size is an important factor which normally determines the adoption of improved forages (Yami and Markel, 2008). The experience with Desho grass production in Chencha districts was more ( $P < 0.05$ ) than Hula and Bule districts could be due to the grass was first planted and used at chencha district in Southern Nations Nationalities and Peoples' Region. Welle et al. (2006) reported that Desho grass is native to the highlands of Ethiopia. It was discovered as a species in 1991 in the Chencha district of the southern region of Ethiopia. The average family size was not significantly different among locations. Desho grass is considered as improved forage because it requires allocation of resources such as land, fertilizer and labor in addition to management practices (Asmare et al., 2017). With regard to landing holding, the average land size of (1.51 ha) in the current study is smaller than that reported by Admasu (2008) where average farm sizes were 2.55 ha per household in Southern Nations, Nationalities, and Peoples' Regional States of Ethiopia. On small farms, a greater percentage of the available area may be required to provide food for the family, leaving less to grow forage for livestock. Zereu and Lijalem (2016) reported that land shortage was major obstacle in highland of Ethiopia.

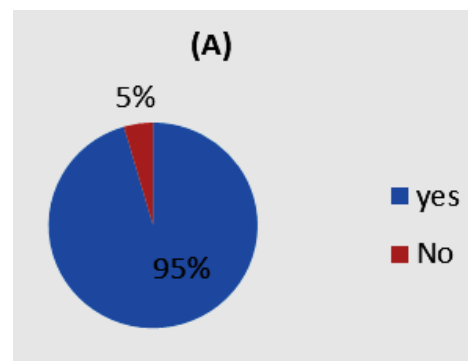
**Table 1 - Family size, livestock and land holding and experience in Desho cultivation**

Parameters	Chencha (N = 80)	Hula (N = 59)	Bule (N = 60)	Total (N = 199)	SL
Family size [Mean ( $\pm$ SE)]	6.60 $\pm$ 2.28	6.27 $\pm$ 1.19	7.28 $\pm$ 3.01	6.71 $\pm$ 2.73	Ns
Livestock holding (TLU)	3.02 $\pm$ 1.63 <sup>b</sup>	7.46 $\pm$ 3.89 <sup>a</sup>	3.79 $\pm$ 3.89 <sup>b</sup>	4.56 $\pm$ 3.43	**
Total land (ha)	1.07 $\pm$ 0.49 <sup>b</sup>	2.67 $\pm$ 0.82 <sup>a</sup>	0.95 $\pm$ 0.61 <sup>b</sup>	1.51 $\pm$ 0.99	**
Land for Desho grass (ha)	0.01 $\pm$ 0.02 <sup>b</sup>	0.01 $\pm$ 0.01 <sup>b</sup>	0.02 $\pm$ 0.03 <sup>a</sup>	0.01 $\pm$ 0.02	**
Experience in Desho grass cultivation (yr.)	2.95 $\pm$ 0.78 <sup>a</sup>	1.46 $\pm$ 0.63 <sup>c</sup>	1.77 $\pm$ 0.81 <sup>b</sup>	2.15 $\pm$ 0.10	**

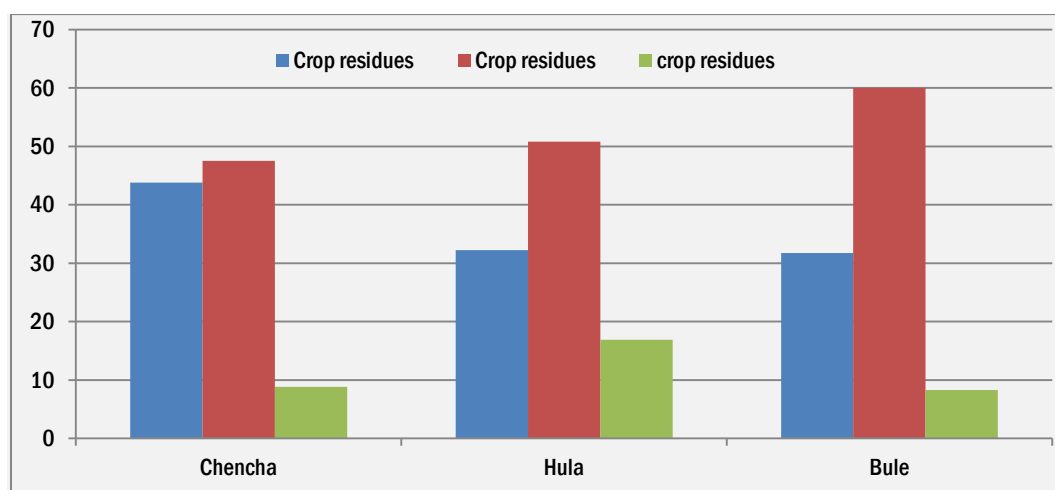
<sup>a, b, c</sup> Mean values with different superscript within the rows are significantly different at  $P < 0.05$ , SL: significant level, ns: not significant, TLU = Tropical livestock unit. N=Number,

### Feed shortage and coping strategies

Shortage of feed was the major problem reported by all respondents in all districts (Figure 2). In Chench district, 93.8% of respondents faced seasonal feed shortage, with 56.3% of these experiencing the problem only during the dry season, while the remaining 43.8% faced shortage in both dry and wet seasons. In Hula district, 98.3% of respondents faced feed shortages, 55.9% of these in the dry season only and the remaining 44.1% in both wet and dry seasons. In Bule district, 95.0% of respondents faced feed shortages, 55.8% of these in the dry season only and the remaining 44.2% in both wet and dry seasons. The major problem of livestock production in current study districts was shortage of feed in both dry and wet seasons is in agreements with previous studies in different parts of the country (Shapiro et al., 2015; Abule et al., 2017). Asmare et al. (2016) who reported that 98.3% in Burie Zuria and 99.2% in Doyogena district faced seasonal feed shortage, which is similar to the present finding. Feed shortage coping strategies employed in all three districts were similar, with only the proportions differing between districts. In Chench district, strategies were: use of crop residue only (43.8%), use crop residue plus Enset leaf (47.5%) and crop residue plus rented grazing land (8.8%). Corresponding values in Hula district were 32.2, 50.8 and 16.9%, respectively, and in Bule district were 31.7, 60.0 and 8.3%, respectively (Figure 3).



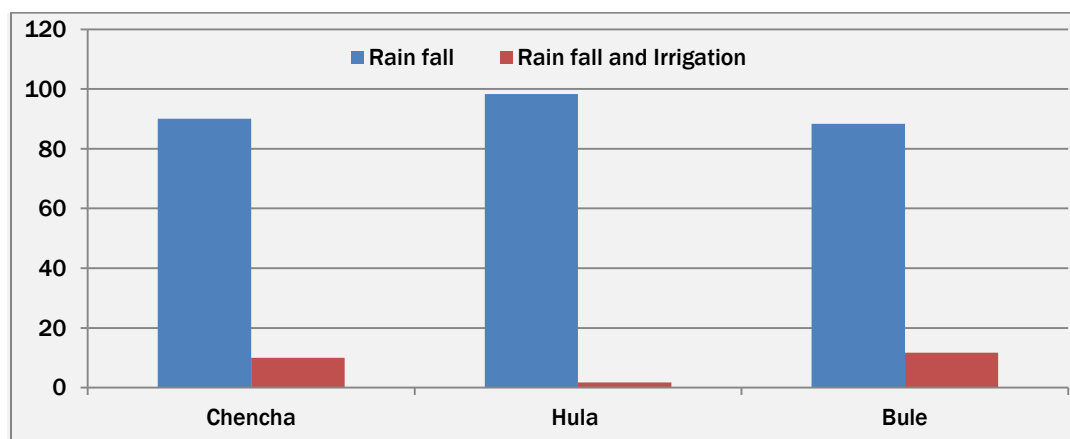
**Figure 2 - The mean perceived feed shortage (A) and time of scarcity (B)**



**Figure 3 - Feed shortage mitigation strategies by respondents in the three districts (%)**

### Rainfall or irrigation used for Desho grass production

The cultivation of Desho grass in the study areas were dependent on rainfall (92%), while the remaining (8%) used irrigation (Figure 4). In Chench district 90% of respondents depended on rain for Desho grass production, while 10% had access to irrigation. In Hula district 98.3% of respondents depended on rain for Desho grass production, while 1.7% had access to irrigation. In Bule district 88.3% of respondents depended on rain for Desho grass production, while 11.7% had access to irrigation. The current study is in agreement with previous study of Asmare et al. (2016) who reported that 80% in Burie Zuria and in Doyogena district all depended only on rainfall, which is lower than present finding.



**Figure 4 - Source of of water (rain fall or irrigation) for Desho grass production**

### Type and time of fertilizer utilization for Desho grass production

The majority of respondents were not utilizing fertilizer (69.3%), while the remaining 1/3 (30.7%) used fertilizer. Gerba et al. (2013) reported that fertilizer application in the form of manure or artificial fertilizer is important for Desho grass production. Asmare et al. (2016) who reported that 58% in Burie Zuria and 65% in Doyogena district applied either manure or artificial fertilizer to the Desho grass, which is higher than the present finding. High costs of fertilizer, lack of awareness on use of fertilize and farmers' assumption for their land is fertile are the main reasons for not using fertilizer. However, fertilizer usage was not uniform in either the application or form of fertilizer. The majority of respondents used manure (70.9%) while the remaining 15.6% used compost and 13.6% used chemical fertilizer (Table 2). The majority (23.1%) of respondents were applying fertilizer at planting, while the remaining (21.6%) applying fertilizer twice a year and (19.6%) applying fertilizer once a year.

### Time and frequency of weeding for Desho production

The majority of respondents not practiced weeding (71.9%), while the remaining practiced weeding (28.1%). The majority of respondents did the weeding if there are weed on the Desho grass (25.6%) while the remaining did the weeding at rainy season (20.6%). The majority of respondents did the weeding twice a year (23.6%), while the remaining did the weeding once a year (5.5%) and 3% times a year (Table 3). The current study is contrast with previous study of Asmare et al. (2017) who reported that weeding of Desho grass was practiced neither Burie zuria nor Doyogena district.

**Table 2 - Type and time of fertilizer utilization for Desho grass production**

Variables	Chencha (N=80)		Hula (N=59)		Bule (N=60)		Total (N=199)		Chi-square
	%	Freq.	%	Freq.	%	Freq.	%	Freq.	
<b>Fertilizer application</b>									
Yes	23.8	19	23.7	14	46.7	28	30.7	61	22.16*
No	76.2	61	76.3	45	53.3	32	69.3	138	
<b>Reason for not using fertilizer</b>									
Soil is fertile enough for Desho growth	15.0	12	20.3	12	16.7	10	17.1	34	21.80*
Lack of awarness	36.2	29	5.1	3	38.3	23	27.6	55	
High cost of fertilizer	48.8	39	74.6	44	45.0	27	55.3	110	
<b>Type of fertilizer</b>									
Chemical fertilizer	7.5	6	5.1	3	30	18	13.6	27	10.36*
Manure	71.3	57	81.3	48	60	36	70.8	141	
Compost	21.2	17	13.6	8	10	6	15.6	31	
<b>Time of application</b>									
At planting	16.2	13	13.6	8	41.7	25	23.1	46	95*
Once a year	21.3	17	32.2	19	5	3	19.6	39	
Twice a year	50.0	40	0	0	5	3	21.6	43	
Not used	12.5	10	54.2	32	48.3	29	35.7	71	

N = Number, % = percentage, Ferq. = frequency, \* = significant difference (P < 0.05)

**Table 3 - Time and frequency of weeding for Desho grass production**

Variables	Chencha (N=80)		Hula (N=59)		Bule (N=60)		Total (N=199)		Chi-square
	%	Freq.	%	Freq.	%	Freq.	%	Freq.	
<b>Weeding practices</b>									
Yes	11.3	9	27.1	16	51.7	31	28.1	56	27.72*
No	88.8	71	72.9	43	48.3	29	71.9	143	
<b>Time of weeding</b>									
if there are weed	7.5	6	25.4	15	50	30	25.6	51	77.32*
At rainy season	3.8	3	30.5	18	33.3	20	20.6	41	
None	88.8	71	44.1	26	16.7	10	53.8	107	
<b>Frequency of weed</b>									
Once	2.5	2	3.4	2	11.7	7	5.5	11	19.46*
Twice	18.8	15	20.3	12	33.3	20	23.6	47	
Three time	0	0	3.4	2	6.7	4	3	6	
None	78.8	63	72.9	43	48.3	29	67.8	135	

N = Number, % = percentage, Ferq. = frequency, \* = significant difference (P < 0.05)

### Spacing between plants and rows for Desho grass production

The majority of respondents' practiced row planting (75.9%), while the remaining 24.1% did not practice row planting (Table 4). In all study districts, the main spacing between plants was 50 cm and greater than 50 cm with equal



percentage (34.7 %) of respondents following this practice. However, the majority of respondents were used 50 cm between rows (79.9%) while the remaining (20.1%) used 100 cm.

#### Planting time and planting material used for Desho grass production

Majority of respondents used root spilt as planting material (79.9%), while the remaining (20.1%) used cuttings as planting mattering. High survival rate and fast growth nature of root split are the two main reasons for use of root split as planting material. The majority of respondents were planting two cutting per hole (48.2%), while the remaining 22.6% plant three cutting per hole, 18.8% plant greater than three cutting per hole and 10.6% planting one cutting per hole (Table 5). The majority (45.2%) of respondents were planting in July, while the remaining (42.7%) were planting in June while some (12.1%) was planting in April (Table 5).

#### Planting strategies used for Desho grass production

Majority of respondents planted Desho as soil band (48.2%), while 26.6% planted as hedgerows and 25.1% plant in the back yard (Table 6). This may be because the strategy is more convenient for the cut and carry feeding system, enabling intensive management and thus high yields in areas where land shortage is a problem. The current study contrast with findings of [Asmare et al. \(2016\)](#) who reported that in Burie Zuria and doyogena districts, the dominant form of Desho grass production was as a backyard enterprise with 86.3% of respondents following this practice.

**Table 4 - Spacing between plants and rows for Desho grass production**

Variables	Chencha (N=80)		Hula (N=59)		Bule (N=60)		Total (N=199)		Chi-square
	%	Freq.	%	Freq.	%	Freq.	%	Freq.	
<b>Planting in row or not</b>									
Yes	87.5	70	45.8	27	90	54	75.9	151	41.68*
No	12.5	10	54.2	32	10	6	24.1	48	
<b>Spacing between plants</b>									
<50cm	10	8	49.2	29	40	24	30.7	61	59*
50cm	33.8	27	15.3	9	55	33	34.7	69	
>50cm	56.3	45	35.6	21	5	3	34.7	69	
<b>Spacing between rows</b>									
50cm	63.8	51	89.8	53	91.7	55	79.9	159	21.79*
100cm	36.3	29	10.2	6	8.3	5	20.1	40	

N = Number, % = percentage, Freq. = frequency, \* = significant difference (P < 0.05)

**Table 5 - Planting time and planting material used for Desho grass production in study area**

Variables	Chencha (N=80)		Hula (N=59)		Bule (N=60)		Total (N=199)		Chi-square
	%	Freq.	%	Freq.	%	Freq.	%	Freq.	
<b>Month of planting</b>									
April	3.8	3	0	0	35	21	12.1	24	50.48*
June	55	44	50.8	30	18.3	11	42.7	85	
July	41.3	33	49.2	29	46.7	28	45.2	90	
<b>Number of cuttings perhole</b>									
One	6.3	5	5.1	3	21.7	13	10.6	21	31.31*
Two	61.3	49	52.5	31	26.7	16	48.2	96	
Three	26.3	21	16.9	10	23.3	14	22.6	45	
>Three	6.3	5	25.4	15	28.3	17	18.8	37	
<b>Part of plant used</b>									
Cutting	11.3	9	25.4	15	26.7	16	20.1	40	6.56*
Root spilt	88.8	71	74	44	73.3	44	79.9	159	
<b>Reason for using root spilt</b>									
Fast growth	56.3	45	39	23	45	27	47.7	95	4.32 <sup>ns</sup>
High survival rate	43.8	35	61	36	55	33	52.3	104	

N = Number, % = percentage, Freq. = frequency, \* = significant difference (P < 0.05), ns = non-significant

**Table 6 - Planting strategies used for Desho grass production**

Variables	Chencha (N=80)		Hula (N=59)		Bule (N=60)		Total (N=199)		Chi-square
	%	Freq.	%	Freq.	%	Freq.	%	Freq.	
<b>Planting strategies</b>									
Backyard	20	16	23.7	14	33.3	20	25.1	50	12.30*
Hedge rows	22.5	18	40.7	24	18.3	11	26.6	53	
Soil band	57.5	46	35.6	21	48.3	29	48.2	96	

N = Number, % = percentage, Freq. = frequency, \* = significant difference (P < 0.05)

### Time of harvesting and feeding form of Desho grass

The majority of respondents harvested the Desho grass when there a need (48.7%) while the remaining 31.7% looking the biomass yield and 19.6% depend on the plant height of the grass. The majority of respondents were harvest at 2-month interval (41.2%) while the reminder (32.7%) depend on rainfall and 26.1% greater than 2 weeks of interval (Table 7). The current study not agrees with findings of [Asmare et al. \(2016\)](#) who reported that frequency of cuts for Burie Zuria district every 2 weeks (44.7%), more than 2 weeks (20.3%), depends on rain/moisture availability (35%); and for Doyogena, every 2 weeks (23.8%), and depends on rain/moisture availability (74.6%). The majority of respondents were feeding Desho grass as fresh (80.4%), while 19.6% used in the form of hay.

### Access of training on Desho grass production

Majority of respondents were not trained on Desho production and utilization (77.9%), while the remaining 22.1% had training (Table 8). This suggests that effort should be made to provide training and information on production and utilization Desho grass. The current study disagrees with findings of [Asmare \(2016\)](#) who reported that 70% of farmers in Burie Zuria have received training in Desho grass production.

### Use of Desho grass in the study area

Desho grass has multiple uses for the small holder farmers (Table 9). Majority of the respondents (40.2%) reported that they plant Desho grass for both feeding animals and soil conservation, while the remaining 36.7% plant Desho only for feeding animals, 20% plant Desho grass for sale and 3% plant Desho grass for only soil conservation. The non-feed roles of the grass are as soil conservation and income source by selling the grass to other farmers. The current study in agrees with [Danano \(2007\)](#) who reports that Desho grass also provides a small business opportunity for farmers. There was no difference ( $P > 0.05$ ) between district as income source for Desho grass. Significant difference ( $P < 0.05$ ) was found for feed and soil conservation, which was higher at the Chencha (52.5%) and Bule (51.7%) than Hula (11.9%). This might be due to the difference in the topography of the districts, in chancha and Bule districts, as the topography is more mountainous and grazing is limited. Thus, Desho grass was planted for both soil conservation and feed purpose. The current study is in line with findings of [Tegegne et al. \(2013\)](#) who reported that farmers in many parts of Ethiopian highlands showed adoption of Desho grass production because of its merits as animal feed and in soil and water conservation and management. Desho grass was used for both soil conservation and feed purposes in all the study districts, as reported by other workers ([Welle et al., 2006](#); [Leta et al., 2013](#)). Shortage of feed was the major problem in all study districts could be due to limitations of grazing land, exposure of soil towards erosion and high density of livestock per household create a higher potential for Desho grass to be utilized as both feed and for soil conservation in the study area.

**Table 7 - Time of harvesting feeding form of Desho grass production**

Variables	Chencha (N=80)		Hula (N=59)		Bule (N=60)		Total (N=199)		Chi-square
	%	Freq.	%	Freq.	%	Freq.	%	Freq.	
<b>Time of harvest depend on</b>									
Plant height	30	24	5.1	3	20	12	19.6	39	13.85*
Biomass yield	25	20	39	23	33.3	20	31.7	63	
When need arises	45	36	55.9	33	46.7	28	48.7	97	
<b>Frequently of harvest</b>									
>2 weeks	20	16	23.7	14	36.7	22	26.1	52	19.20*
depends on rain	30	24	23.7	14	45.0	27	32.7	65	
after 2 months	50	40	52.5	31	18.3	11	41.2	82	
<b>Form of feeding</b>									
Fresh	80	64	79.7	47	81.7	49	80.4	160	0.09 <sup>ns</sup>
Hay	20	16	20.3	12	18.3	11	19.6	39	

N = Number, % = percentage, Ferq. = frequency, \* = significant difference ( $P < 0.05$ ), ns = non-significant

**Table 8 - Access of training on Desho grass production and utilization**

Variables	Chencha (N=80)		Hula (N=59)		Bule (N=60)		Total (N=199)		Chi-square
	%	Freq.	%	Freq.	%	Freq.	%	Freq.	
<b>Access to trainings?</b>									
Yes	22.5	18	11.9	7	31.7	19	22.1	44	6.79*
No	77.5	62	88.1	52	68.3	41	77.9	155	

N = Number, % = percentage, Ferq. = frequency, \* = significant difference ( $P < 0.05$ ), ns = non-significant

**Table 9 - Use of Desho grass in study area**

Variables	Chencha (N=80)		Hula (N=59)		Bule (N=60)		Total (N=199)		Chi-square
	%	Freq.	%	Freq.	%	Freq.	%	Freq.	
<b>Use of Desho grass</b>									
Feed	21.3	17	69.5	41	25	15	36.7	73	50.87*
Soil conservation	7.5	6	0	0	0	0	3	6	
Feed & soil conservation	52.5	42	11.9	7	51.7	31	40.2	80	
Sale	18.8	15	18.6	11	23.3	14	20.1	40	

N = Number, % = percentage, Ferq. = frequency, \* = significant difference ( $P < 0.05$ )

### Priority of feeding Desho grass to different class of livestock

The majority of respondents feed Desho grass to large ruminants (47.7%), while 38.2 and 14.1% of the respondents reported that they give preference of feeding Desho grass for all animal and small ruminants, respectively (Table 10). The current study agrees with the findings of [Asmare \(2016\)](#) who reported that 42% of farmers who fed Desho grass did so to only lactating cattle, 3% fed it to small ruminants and 53% fed it to all livestock species. However, percentage was not uniform in priority of feeding Desho grass to different class of livestock.

### Trends of Desho production in the study area

Majority (71.4%) of the respondents stated that the trend of Desho grass utilization as livestock feed is increasing from time to time (Table 11). Many factors triggered the increasing use of Desho grass as animal feed. Critical feed shortage is the main driver given by the respondents for the increasing interest in including Desho grass production.

### Constraints of Desho grass production in study area

Constraints of Desho grass production in the study area are presented in Table 12. Responders identified land shortage, both land shortage and lack of awareness, lack of awareness, land shortage and lack of planting material, labor, market and planting material as the major constraints for Desho production in the study areas. Among these six factors, land shortage was ranked as the major constraint for Desho cultivation in the study area. Lack of awareness on Desho grass production and utilization was ranked as a second constraint. The respondents reported that they have not received training on production and utilization of Desho grass. Labor and market problem also influenced Desho production in the study areas. Planting material was ranked last in terms of its influence on Desho production and utilization. The current study is in agreement with previous study of [Assefa et al., \(2015\)](#) who reported that shortage of land (1<sup>st</sup>), high expense of forage planting materials (2<sup>nd</sup>) and lack of awareness (3<sup>rd</sup>) were the main constraints hindering adoption of improved forages in Shashogo district of Hadiya zone, southern Ethiopia. [Zereu and Lijalem \(2016\)](#) reported that land shortage (1<sup>st</sup>), lack and high cost of planting materials (2<sup>nd</sup>), poor extension service (3<sup>rd</sup>), drought (4<sup>th</sup>) and lack of awareness (5<sup>th</sup>) as the major constraints for improved forage cultivation in Wolaita Zone, Southern Ethiopia.

**Table 10 - Priority of feeding Desho grass to livestock**

Variables	Chencha (N=80)		Hula (N=59)		Bule (N=60)		Total (N=199)		Chi-square
	%	Freq.	%	Freq.	%	Freq.	%	Freq.	
<b>Desho prioritize to feeding</b>									
Yes	66.3	53	59.3	35	53.3	32	60.3	120	2.43 <sup>ns</sup>
No	33.8	27	40.7	24	46.7	28	39.7	79	
<b>For which Animals?</b>									
Large ruminants (Cattle)	52.5	42	45.8	27	43.3	26	47.7	95	6.04 <sup>ns</sup>
Small ruminants	13.8	11	20.3	12	8.3	5	14.1	28	
All animals	33.3	27	33.9	20	48.3	29	38.2	76	

N = Number, % = percentage, Freq. = frequency, \* = significant difference (P < 0.05), ns = non-significant

**Table 11 - Trends in Desho grass production as livestock feed**

Variables	Chencha (N=80)		Hula (N=59)		Bule (N=60)		Total (N=199)		Chi-square
	%	Freq.	%	Freq.	%	Freq.	%	Freq.	
<b>Trends of Desho Production</b>									
Increasing	38.8	31	100	59	86.7	52	71.4	142	75.44*
Decreasing	23.8	19	0	0	0	0	9.5	19	
As usual (no change)	37.5	30	0	0	13.3	8	19.1	38	

N = Number, % = percentage, Freq. = frequency, \* = significant difference (P < 0.05)

**Table 12 - Major constraints of Desho grass production in study area by ranks weight index rank**

Constraints	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>	Index	Rank
Land shortage	87	30	8	5	0	0.329	1
Land shortage and lack of awareness	50	25	10	7	0	0.220	2
Lack of Awareness	36	15	5	3	2	0.147	3
Land shortage & lack of planting material	11	20	15	5	4	0.108	4
Labor shortage	5	10	15	10	5	0.076	5
Market problem	2	5	4	3	1	0.027	6
Lack of planting material	8	10	15	16	8	0.092	7
Total	199	115	72	49	20	1.000	

Index sum of [(5 × number of responses for 1<sup>st</sup> rank) + (4 × number of responses for 2<sup>nd</sup> rank) + (3 × number of responses for 3<sup>rd</sup> rank) + (2 × number of responses for 4<sup>th</sup>) + (1 × number of responses for 5<sup>th</sup>)] divided by [(5 × total responses for 1<sup>st</sup> rank) + (4 × total responses for 2<sup>nd</sup> rank) + (3 × total responses for 3<sup>rd</sup> rank) + (2 × total responses for 4<sup>th</sup> rank) + (1 × number of responses for 5<sup>th</sup>)].



### Chemical composition of Desho grass

Dry Matter (DM), Crude Protein (CP), Ash, Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF) and Acid Detergent Lignin (ADL) are parameters used to evaluate sample Desho grass in (Table 13). The dry matter (DM) content of all sample fresh forages was 89. The CP content of Desho grass in the current study is comparable with the findings (7.12%) of Waziri et al. (2013). The CP content (7.33%) reported by Asmare et al. (2017) for Desho grass is higher than the current finding. The difference observed in CP content might be attributable to the stage of the harvest of the Desho grass as it has been reported by Asmare et al. (2017) that young (90 days after planting) Desho grass had higher CP content (9.33%) than the mature (150 days) ones (6.93%). Also, the difference observed might be attributable to the difference in altitude associated with photosynthesis and nutrient assimilation as it has been reported by Asmare et al. (2017) that lowland Desho grass had higher CP content (9.33%) than the highland one (7.33%). The difference observed in the chemical composition of the feeds might be attributable to the stage of the harvest and altitude.

**Table 13** - Chemical composition and *in vitro* organic matter digestibility (% DM basis) of Desho grass

Sample name	Chemical composition (%)						IVOMD
	DM	Ash	CP	NDF	ADF	ADL	
Desho grass hay	89	10.35	7.04	72.47	43.73	5.29	52.19

DM = dry matter , CP = crude protein, NDF = neutral detergent fiber, ADF = acid detergent fiber, ADL = acid detergent lignin , IVOMD = in vitro organic matter digestibility

The neutral detergent fiber (NDF) content of sample Desho grass was 72.47%. Singh and Oosting (1992) pointed out that roughage feeds containing NDF values of less than 45% could be classified as high quality, those with values ranging from 45% to 65% as medium and those with values higher than 65% as low quality. Based on it, Desho grass can be classified as low-quality feed, But the NDF value mainly depends on the time of cutting date, when forages cut at 112 days their quality becomes high but their biomass yield becomes low than Desho grass harvested 154 days (Mergia et al., 2020). The acid detergent fiber (ADF) content of sample Desho grass was 43.73. According to Kellems and Church (2011), roughage with less than 40% ADF are categorized as high quality and those with greater than 40% as poor quality. Based on the laboratory result, Desho grass is classified as high-quality feedstuff for the study area.

Lignin (ADL) content of Desho grass was 5.29%, which limits DM intake. The major cell wall content of given forages was mainly depending on age of the plant. When the plant becomes aged, the cell wall content becomes very hard on the contrary; when the plant becomes young, the cell wall part becomes more palatable.

### CONCLUSION

The result of current study showed that the majority of the farming households in the study area predominantly use Desho grass as feed sources and soil conservation. The study revealed that use of Desho grass as livestock feed by smallholder farmers' has been steadily increasing over the past few years. Critical feed shortage is the main driver given by the respondents for the increasing interest in including Desho grass production. Land shortage and lack of awareness were ranked first and second constraints for Desho production. Based on the laboratory result, Desho grass is classified as high quality feedstuff for the study area. Overall, Desho grass have a very important function in terms of contribution of nutrients to livestock and locally available feed resource however, farmers are not getting the benefits they deserve from the use of Desho grass, which has not been improved and should be supported by research to improve its production and use. Therefore, it can be concluded that intervention on the management and utilization practices of the Desho grass need to be done

### DECLARATIONS

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I contribute on the write up of the proposal, data collection, data analysis and the write up of the manuscript

#### Conflict of interests

The authors have not declared any conflict of interests.

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#### Author's Authors Contribution

Mergia Abera participated in the design of study, performed the experiments and writing original manuscript. Adugna Tolera, Ajebu Nurfeta, Diriba Geleti critically revised, and editing the manuscript for important intellectual contents.

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