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# Assessment of Goat Feed Resources, Their Nutritional Composition and Feeding Practices in Mirab Abaya District, Southern Ethiopia

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## Abstract

The study was conducted in Mirab Abaya District of Gamo Zone Southern, Ethiopia in order to assess availability of major feed resources of goat, their nutritional composition and relation to agro-ecology and season. Cross sectional household survey, field measurements and laboratory analyses were employed to generate data. Multistage sampling was employed in order to draw household samples. A total of 194 respondents were interviewed for formal survey. Major feeds of small ruminants were collected, identified and subjected to laboratory analysis in order to determine Dry Matter (DM), ash, Crude Protein (CP), Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF), Acid Detergent Lignin (ADL) and In Vitro DM Digestibility (IVDMD). The major feed resources in the study area were natural pasture, crop residues, fodder trees and agro industrial byproducts. The NDF content of the sampled feed from the study area was not more than 59.2%, which was recorded for natural pasture. The highest value of CP was recorded for Terminalia Browinii with 17.38%, followed by *Strychones* (15.39%) and *Balanites Aegyptiaca* (14.39%). Overall feeding systems in dry season were 48.12%free grazing, 5.17% tethering, and 44.09% herded grazing ($P<0.05$), whereas during wet season overall feeding systems were 28.92% free grazing, 8.5% tethering, and 59.25% herded grazing ($P<0.05$). Cumulative effort serious development action should be taken into account in order to overcome feed shortages in both quality and quantity by employing different approaches of feeds and feeding practices.

**Keywords:** Agro Ecology; Feed; Goat; Season

## Introduction

Availability, quality and cost of feeds have been identified as the major constraints to acceptable animal's productivity across the various regions and agro-ecological zones of Africa. The predominant goat production system in Ethiopia is traditional and characterized by poor nutrition, poor management and a high prevalence of diseases, as animals are left to roam on communal grazing land, crop stubble, fallow lands, roads, riversides and bush areas in the dry season while they are forcibly limited to communal and private grazing lands in the wet season. There are marked seasonality in quantity and quality of available feed resources due to various environmental determinants drought, frost, flood etc. [1]. Feed shortage is particularly more serious in arid and semi-arid livestock production systems. And the current study area also shares the same phenomena. In such areas erratic rain fall hampers crop production, animal feed and fodder production, as well as it limits the productivity of pasture lands and range lands which are the major sources of feed [2, 3]. According to the report of Yisehak and Geert [4] feed shortage in terms of quality, quantity were the major factors that hinder the productivity of all livestock species. In order to develop feeding systems, it is necessary to relate information on the nutritional characteristics of feed resources to the requirements for nutrients, depending on the purpose and the rate of productivity of the animals is in question. In the industrialized countries, this information has been incorporated in tables of "feeding standards" which interpret chemical analyses of feed resources in terms of their capacity to supply the energy, amino acids, vitamins and minerals required for the particular productivity purpose. For optimum productivity, the available feed resource should match with the production systems practiced and the number of animals in a given area. On the other hand, the availability and relative importance of different feed resources vary from place to place and from time to time depending on agro-ecology, production systems and seasons of the year [4]. It is imperative to generate detail information on availability, feeding system and nutrient balance of feed resources small ruminants in the study area. Moreover it will help to identify the existing feed resources, feeding system, feed utilization, feeding practices, feed availability and their chemical composition of small ruminant's feeds in the current study area. The study will also help to identify and prepare accurate intervention related to feeds and feeding practices of goat the study area. Lastly, the study will also help as the source for the other researcher who will do the researches related to this issue. Hence the aim or objectives of this study were

- To identify goat feed resources , availability and nutritional composition in study area
- To assesses feeding practices of goat in the study area.

## Materials and methods

### Description of the study area

The study was conducted in Mirab Abaya district of Southern Nation Nationalities and peoples of regional state (SNNPR). This is 455 km far from the capital city of the country to the South direction. It has 23 rural Kebeles administrations and has a total land of 107,971hectare. The district is situated between 1100 and 2800 m.a.s.l. and it is located at 600′0 ″N to 1505′0″N latitude and 3500′0″Eto 4500′0″E longitude respectively. The district is divided into three agro-ecological zones,

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namely, Dega, Woina Dega and Kola which account for about 11%, 27% and 62% of the total area, respectively.

## Sampling Techniques

Multi-stage sampling was followed. First the district will be stratified in to Low-land, and Midland Agro-ecology. Then purposive sampling was employed to select kebeles based on their potential of goat production. The total sample size for household interview was determined by using probability proportional to sample size by technique.

## Method of data collection

Discussion with key informants, which includes the district livestock experts in each Farmers administration, was held in order to get information in depth. Study issues by using pretested questionnaire and checklist in order to cross check whether the study patterns (attributes) are really found at household level. In other words this was important to state clearly the validation of questionnaire prepared for household surveys. Focus group discussion was employed using check lists which contain small ruminant production system, feed resources, feed availability and feeding system specifically in the study area. Then semi- structured questionnaire was prepared in order to collect the primary data from the households related to the issues of study concern. Focus group discussion and key informants' interview was employed to identify, and rank top browse species which are fed by goats.

### Feed Sample Collection and Preparation

Sample of major common feeds resources was collected from the study areas; weighed measurement was taken at field at different time. Representative samples of top four feed which are majorly grown and utilized by small ruminants was collected from each agro-ecology respect to the season. The feed samples were collected by trained enumerators under the supervision of the researcher collected feed samples were composited or bulked to base on their type, agro-ecology and season separately in different season. The composited/bulked feed samples were dried in the air in order to remove their moisture. After all the dried samples of feed were transported to Hawassa University, Animal nutrition laboratory for nutritional composition analysis.

### Determination of Chemical Composition and In vitro Dry Matter Digestibility

The samples were oven dried at 65°C for 72 hours and feed samples are ground to 1 mm particle size with a Wiley mill. Feed samples were analyzed for DM, according to AOAC. Nitrogen was determined using the micro-Kjeldahl method (AOAC). The CP content was calculated by multiplying nitrogen content by a factor 6.25 (N x 6.25). The determination of neutral detergent fiber (NDF) and acid detergent fiber (ADF) were followed using Van Soest et al. [5] and Vansoest and Robertson, respectively. The acid detergent lignin (ADL) was determined using Ankom Daisy II incubator according to AOAC. The Ankom200 Fiber analyzer and AnkomDaisy II incubator were used to determine *in vitro* DM digestibility (IVDMD) [6]. Nitrogen content of sampled feed was analyzed at Arbaminch University Advanced Chemistry Laboratory.

### Statistical Model and Data Analysis

All perceived and measured data were analyzed using the Statistical Package for Social Sciences (SPSS) version 20. Statistical variation of categorical data was tested by means ofcross tabulation, assuming significant differences when $P < 0.05$; while the descriptive statistics for the numerical data were analyzed using the general linear model (GLM) procedure of SPSS and assuming significant differences when $P < 0.05$. Descriptive statistics such as means, percentages and standard error of the means were used to present the results of perceptions and measurements. The appropriate statistical model used was indicated below

$$Yijk = \mu + \alpha i + \beta j + \alpha\beta ij + \Sigma jik$$

Where: *Yijk* = Total observation due to i, j, and k, $\boldsymbol{\mu}$ = is overall mean, $\boldsymbol{\alpha i}$ = the ith effect of location/agro-ecology (lowland &midland), $\boldsymbol{\beta} j$= the jth effect of season (wet and dry season), $\boldsymbol{\alpha\beta ij}$= the interaction effect between location and season, and $\boldsymbol{\Sigma jik}$= random error

### Feed resources and feed availability

The major feed resources of goats in the study area were shown at table 1. The major available feed resources of sheep and goats in the study area were natural pasture, shrubby grasslands, bush lands and crop residues (maize stalk, sorghum stalk, barely, common bean, Teff straw, cotton leaf, local supplements (atela, home left over , grinded and mixed cereal grains) industrial by products( wheat bran), local grass species local browses. Availability, and the utilization practices of the listed feed resources was differ across season and agro-ecology in the study area.

Natural pasture, crop residue, local fodder trees, shrubs and

**Table 1:** Major goat feed resource in the study area.

| Season | Feed resources | Lowland (n=114) | | Midland (n=80) | |
|---|---|---|---|---|---|
| | | Index value | Rank | Index value | Rank |
| **Dry season** | Natural pasture | 0.0084 | 8 | 0.0024 | 8 |
| | Crop residues | 0.23571 | 1 | 0.2859 | 2 |
| | Local Fodder tress and browses | 0.196284 | 2 | 0.2546 | 1 |
| | Aftermath | 0.125946 | 4 | 0.144 | 4 |
| | Supplements | 0.112044 | 7 | 0.0116 | 7 |
| | Home left over | 0.074329 | 6 | 0.0693 | 6 |
| | Others | 0.136614 | 3 | 0.14 | 3 |
| **Wet season** | Natural pasture | 0.2778 | 1 | 0.283 | 1 |
| | Crop residues | 0.038373 | 4 | 0.036 | 4 |
| | Local Fodder tress and browses | 0.21 | 2 | 0.24 | 2 |
| | Aftermath | 0.0469 | 3 | 0.0568 | 3 |
| | supplements | 0.018 | 8 | 0.0114 | 8 |
| | Home leftover | 0.028 | 6 | 0.0491 | 6 |
| | Others | 0.0097 | 7 | 0.00254 | |
| Where n= number of the respondents. | | | | | |

browses, home leftover, aftermaths and supplements were the major feed resources for sheep and goat in the current study area. However the dominant feed resources in the area was differ among the season. During dry season major feed resources were categorized under local fodder trees and browses which are evergreen, crop residues, and aftermaths and other supplements with their indices value; 0.196284, 0.23571, 0.125946, 0.112044 respectively. However sometimes prolonged drought may cause the decrements of local browse and fodder trees in their quantity and nutritional quality. The availability of the feed resources listed in the above could also vary among two agro ecologies. During dry season the crop residues were ranked were ranked 1st with indices values of 0.2459 followed by local fodder trees and other browses with index value of 0.2546 in midland agro ecology. Whereas during wet season natural pasture was ranked as 1st indices value of 0.278 and 0.283 for low land and mid land agro-ecologies respectively. This result was in line with Samson et al., [7] for jig-jiga zone Ethiopian Somali region, Tekleyohannes et al., [8] for Bena-tsemay and Hamer districts of south Omo zone southern Ethiopia, and Felekech et al. [9] for central rift valley of Ethiopia and Mulugeta et al., [10] for Tahtay Koraro district Northern Ethiopia.

**Seasonal Availability of feed sources in the study area**

About 85% of respondents witnessed that season are one of the major factors which determine availability of livestock feed in quality and quantity. . Since the animals of tropics and sub-tropics majorly rely on the feed resources from communal grazing land, natural pasture, and range lands, seasonal variations has significant effect in the productivity of rangelands**.** Thus, availability in quantity and quality is differing from season to season. This was also holds true for the current study area in which availability of feed vary from season to season even month to month (Table 2).

Chemical composition and invitro dry matter digestibility of the major feeds for goats' in study area was presented in Table 3. The results revealed that the DM content of major feeds in study area was ranged from 88.36% for *Grewia .F* to 97.02% for *Balanites Aegyptiaca* (Table 3). The result also showed that DM content of leaf of *Balanites Aegyptiaca* was 96.02% which was comparable with the result of Nigatu [11] which was 95.2% for the same study District. According to the current findings the CP for *Terminalia Brwonii* was recorded to be 17.38% (Table 3), which was slightly higher than the previous findings of Muluken et al. [12]; 16.6% for north eastern dry lands of Ethiopia. This might be due to eco-type differences of the study areas. The dry matter of *Terminalia Brwonii* was 94.02% which was also slightly higher than the finding of above author (92.64%). This could also be due to eco-type differences of the browse tree. The crude protein content of *Terminalia Brwonii*, *Balanites Aegyptiaca* and *Strychnos* ranges between(16.08% to 17.38%), (15.63% to 16.94), (15.69% to 16.34) respectively (Table 3). The fruit kernel of *BalanitesAegyptiaca* tree was also used as feed for goats. This indicates that the leaf from those browse trees had higher CP content from natural pasture and other crop residues irrespective (regardless) of season. The high amount of CP might allow chance for them as supplementary feeds with low quality feeds from natural pasture and crop residue. The NDF contents of the major feeds vary between 37.97% in *Balanites Aegyptiaca* to 59.2% in natural pasture (Table 3). The ADF content was also ranged from24.12% to29.60% in natural pasture. A maximum of 12.64% and a minimum of 8.04% were recorded for *Grewia ferriginea* and *Terminalia Brwonii* respectively.

**Table 2:** Seasonal supply and availability status of feed resources in the study area.

| Feed types | Jan | Feb | Mar | April | May | June | Jul | Aug | Sep | Oct | Nov |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |
| NP | - | - | - | - | + | + | + | + | + | # | # |
| FTS | # | # | # | # | + | + | + | + | + | + | + |
| CR | + | + | + | # | # | # | # | - | - | - | - |
| Other | # | # | # | # | | + | + | # | # | # | # |
| Aftermath | - | - | - | - | - | - | - | - | | | |

NP = natural pasture; + = abundance time; # = limited amount; FTS = fodder trees &shrubs; CR = crop residues

**Table 3:** Chemical composition and invitro DM digestibility of major feeds in study area.

| Variables | | Sampled feeds | DM% | ASH% | CP% | NDF% | ADF% | ADL% | IVDMD% |
|---|---|---|---|---|---|---|---|---|---|
| **Dry season** | Lowland | NP | 90.64 | 11.06 | 7.93 | 59.2 | 29.603 | 10.45 | 56.01 |
| | | T.Brownii | 94.02 | 9.04 | 17.38 | 48.02 | 24.12 | 8.64 | 48.02 |
| | | Strychnos | 96.08 | 11.16 | 14.69 | 38.49 | 28.846 | 11.608 | 52.02 |
| | | Grewia.F | 87.29 | 11.84 | 14.63 | 50.036 | 29.07 | 12.08 | 48.64 |
| | | B.Aegyptica | 97.02 | 10.75 | 15.94 | 42.97 | 34.82 | 11.64 | |
| | Midland | NP | 90.4 | 11.02 | 8.64 | 58.02 | 30.01 | 9.68 | 56.42 |
| | | Strychnos | 94.08 | 10.79 | 16.02 | 53.89 | 28.64 | 10.02 | 52.08 |
| | | Bersama. A | 93.34 | 8.95 | 12.06 | 50.02 | 32.71 | 11.64 | 45.36 |
| | | T.Brownii | 94.02 | 9.08 | 16.75 | 49.02 | 24.02 | 8.07 | 49.21 |
| **Wet season** | Low land | NP | 92.32 | 10.96 | 8.06 | 58.23 | 30.02 | 10.08 | 56.39 |
| | | T.Brownii | 94.71 | 8.98 | 16.08 | 49.68 | 24.04 | 8.04 | 48 |
| | | Strychnos | 94.25 | 10.96 | 15.39 | 39.09 | 25.35 | 8.07 | 51.04 |
| | | Grewia.F | 88.36 | 10.72 | 13.82 | 40.6 | 25.24 | 10.08 | 49.28 |
| | | B.Aegypitica | 96.8 | 10.68 | 15.63 | 37.97 | 28.12 | 10.75 | 49 |
| | | Bersama. A | 92.5 | 9.06 | 11.92 | 51.23 | 30.12 | 12.04 | 45.6 |
| | Mid land | NP | 90.64 | 10.91 | 7.93 | 59.201 | 29.72 | 9.45 | 53.01 |
| | | Strychnos | 94.08 | 10.09 | 14.34 | 58.09 | 28.64 | 9.02 | 52 |
| | | T.Brownii | 94.02 | 9.02 | 17.24 | 48.22 | 25.02 | 8.21 | 50.02 |

ADF= Acid Detergent Fiber, ADL= Acid Detergent Lignin, CP= Crude Protein, INVDMD= Invitro Dry Mater Digestibility, NDF= Neutral Detergent Fiber, NP= Natural Pasture

The ADL content *Terminalia Brownii was* slightly higher than the result of Muluken et al., [12] for North Eastern Ethiopia which was 7.29%. This might be due to eco-type differences with the browse species. The same author reported that nitrogen content of *Terminalia Brwonii* was 16.6% which is slightly lower than current result which was 17.38%. This could be due to ecotype difference with the species. The current finding also revealed that the NDF, ADF and ADL result of *Terminalia Brwonii* browse was 42.97%, 29.12% and 11.64%, respectively which was comparable with findings of Nigatu [11].

**Feeding Practices of Small Ruminants in Study Area**

Table 4 indicates the major feeding practices of sheep and goats in the study area. The major feeding practices of sheep and goats in the study area were free grazing and browsing in communal grazing lands, herded grazing on road side and marginal areas of farm lands and tethering. During dry season an overall feeding practices in the study area were 48.12%, 5.17%, 44.09%, were free grazing, tether feeding and herded grazing, respectively Table 4. On the other hand during wet season an overall feeding system of small ruminants in the study area were 28.92% free grazing, 8.5% tether feeding, and 59.25% herded grazing, respectively Table 4.

The feeding practices and feeding system of the small ruminants in the study area were significantly different among season $P<0.05$). There is the variation among agro-ecologies and seasons on application those feeding practices. During dry season at low altitudes the major feeding practices applied by house hold was free grazing; because the most of farm lands are not cultivated or occupied by field crops.

Thus, animals are free to graze on farm land aftermath, marginal areas of crop lands and also fallow land without limitations. In opposite during wet season almost all farm lands are covered by field crops in order to control crop damage by animals' farmers practiced herded grazing by herds man. Most of respondents reported that their children watch after all livestock species including sheep ad goat in order to prevent crop damage. So, movement is limited by herdsman so they graze only on communal grazing land, road side, around river and marginal areas of crop land, fallow lands and bush land, and private grazing lands around homestead. In contrast to this in mid altitudes the major feeding practices small ruminants was dominated by herded grazing. This might be due land shortage in mid altitudes; not only this but also the most of respondents reported that they use herded grazing in order to prevent their cash crops like chat and other root crops like enset, other vegetables around their homestead. According to respondents they also use tether feeding more than low altitudes during wet season and feed their animals with local browse trees, leaves of different weeds from their farm lands, leaves of enset, and they also use cut carry system from farm lands, private grazing lands and fallow lands and they practiced stall feeding. This finding was also similar with the findings of previous findings by Funte et al. [13] for UmbuloWacho watershed of Southern Ethiopia to protect the crop land from damage due to livestock. Because animals' movement is more limited at mid altitudes due to land shortage and dense human population. As a result, most of respondents reported that they use herd's man for herded grazing [14].

## Conclusion

The findings of this study indicated that the major feed resources for sheep and goats in the study area irrespective of agro-ecologies were natural pasture, communal grazing lands, crop residues, crop aftermath, fodder trees, and shrubs/bushes, home leftover and agro-industrial byproducts. Crude protein and Neutral detergent fiber of the sampled major feeds in the study area was not exceeded from 17.24% and 59.2%, respectively. An acid detergent fiber and acid detergent lignin of the sampled major feeds was also not exceeded from 34.28% and 12.08%, respectively. The current study also revealed that there was severe feed shortage in dry season regardless of agro-ecologies. This was major constraints which cause a potential decrease in productive and reproductive performance of their animals in the study area. Farmers of study area practiced different coping mechanisms'/ strategies / to keep their animals productive beyond maintenance. Major coping strategies used by farmers during the dry season were using different supplements like home leftover, grinded cereals and different milling byproducts, leaf foliage's of different fodder trees, horticultural crops and agro-industrial byproducts like wheat bran. The most commonly practicing feeding system in the study area were free grazing on communal grazing lands, herded grazing on roadside, marginal area of crop lands and fallow lands. In the current study area, there were different indigenous and locally available fodder trees, browse species and shrubs in communal grazing lands. Of this browse fodder tress *Terminalia Brownii*, *Balanites Aegyptiaca*, *Grewia.F* and *Strychnos* were the major browse trees which are characterized by good nutritional quality, prolonged drought resistance, high fodder productivity and excellent palatability. This could be taken as major feeds and feeding opportunities of small ruminants in the study area.

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**Table 4:** Feeds and feeding practices of small ruminants in the study area.

| Variables season | Feeding system | Respondents in % | | | p- values |
|---|---|---|---|---|---|
| | | Agro ecology | | | |
| | | Lowland (n=114) | Midland (n=80) | Overall (N=194) | |
| **Dry** | Free grazing | 67.75 | 28.5 | 48.12 | 0.001 |
| | Tethering | 2.8 | 4.75 | 5.17 | 0.001 |
| | Herded grazing | 29.45 | 58.74 | 44.09 | 0.001 |
| | Other | 0 | 0 | 0 | |
| **Wet** | Free grazing | 46.05 | 17.79 | 28.92 | 0.001 |
| | Tethering | 5.25 | 11.75 | 8.5 | 0.001 |
| | Herded grazing | 48.25 | 70.25 | 59.25 | 0.001 |
| | Other | 0 | 0 | 0 | |
| Where n= number of respondents | | | | | |

## Conflict of interests

Authors declared that they have no conflict of interests.

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