Research Article

# *Pentas schimperiana* Utilization Practices as Livestock Feed in Mareka District, Ethiopia

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**Abstract** | The objectives of the study were to assess utilization practices and biomass yield of *Pentas schimperiana*. Purposive sampling technique was used to select two agroecology (midland and highland) and five representatives (two from midland and three from highland) kebeles based on the coverage of *P. schimperiana*. A total of 100 respondents, 58 from three high land peasant associations and 42 from two midland peasant associations, were purposely selected for an interview who had at least one livestock. Secondary data sources, field observation, and semi-structured questionnaire interviews were employed to generate data. The descriptive data were analyzed by percentages, means, and standard errors of the mean. At the same time quantitative data were subjected to ANOVA. *P. schimperiana* leaves and twigs were used as animal feed, traditional medicinal value, and source of income as indicated by 100, 59.4, and 44.6% of respondents, respectively. As animal feed, about 100, 80.2, 69.3, 58.4, 50.5, 42.6, 30.7, 19.8, and 5.9% of them utilized to supplement their milk cow, dry cow, heifers, calves, oxen, bull, sheep, goat, and equine, respectively. The drinking mixture of *P. schimperiana* in milk, and water was higher during the dry season and lowered during the wet season. The estimated biomass yields were 4.34±0.13 kg and 5.56±0.119 kg in the dry and wet seasons, respectively. Further feeding trial experiments should be conducted on live animals especially on a dairy animal for studying the response, for optimal production, productivity, and economic efficiency.

**Keywords** | Agroecology, Biomass yield, Drinking mixture, Livestock feed, *Pentas schimperiana*

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## INTRODUCTION

Ethiopia has immense potential for increasing livestock production, with 70 million cattle from this Dairy cows are estimated to be around 7.5 million and milking cows are about 15 million heads, 43 million sheep, and 52.4 million goats (CSA, 2021) that contribute both for local use and for export purposes. However, limited feed supply and poor quality of the available feeds are significant constraints for optimal livestock productivity in tropical and sub-tropical countries (Boufennara et al., 2012).

Also feeds and inadequate nutrition are critical constraints for livestock production across all ecological zones in Ethiopia (Solomon and Teferi, 2010). Like other parts of Ethiopia, one of the significant problems facing Maraka district livestock producers is inadequate feed supply, both in quantity and quality, especially during the dry season when pasture and cereal residues are limiting in quantity and nutritional quality.

Therefore, the use of locally available indigenous fodder species enables to boost livestock production and

productivity and increase the livestock producer's income. *Pentas schimperiana* is one of the locally available livestock feeds. However, there is little information about its utilization and nutritive value. Therefore, this study was conducted to assess the production, perception, and utilization practices and also to analyze the chemical composition and dry matter digestibility of the *P. schimperiana*.

## MATERIALS AND METHODS

### Study area description

The study was conducted at Maraka districts of Dawuro zone, Southern Nation Nationalities, and People Region (SNNPR). The district is located 544 km southwest of Addis Ababa and 17 km from the Dawuro zone. It lies between $6^0$ 56' 00" to $7^0$ 04' 00"N and $37^0$ 02' 00" up to $37^0$ 16' 00"E, with an altitude range of 1000-2400 m.a.s.l/ meters above sea level with an annual mean temperature range between 15.1$^0$C to 27.5$^o$C and the annual mean rainfall range from 1314 mm to 1516 mm. The area is categorized into three agro-ecological zones; high land, midland, and lowland, with their total coverage of 53, 30, and 17%, respectively. The total land coverage of the district is 44050 ha of which, 2000 ha (4.5%) is covered by forest, 11500 ha (26.1%) is grazing land, 28140 ha (63.9%) is cultivating land, and the remaining 2410 ha (5.5%) comprises bushes, savanna, rivers, springs, stagnant waters, and hills (MWOA, 2015).

The total human population of the district is 126022, of whom 65321 are men and 60701 women. The livestock population consists of 122,084 cattle, 47,438 sheep, 18,854 goats, 4,860 horses, 2,759 mules, 1,699 donkeys, and 63,042 poultry (MWOA, 2015). Mixed crop-livestock production systems are the predominant farming system practice in the study area.

### Sample size and sampling technique

Multi-stage purposive sampling procedures were employed at three different stages. In the first stage, two distinctive agroecology that are namely highland (>2300 m.a.s.l) and midland (1500-2200 m.a.s.l) was selected based on coverage of *P. schimperiana*. In the second stage, based on the coverage of *P. schimperiana*, three *kebeles* from the highland, two *peasant associations* from the midland were selected. In the third stage, individual respondents were selected purposively who have at least one livestock. The appropriate sample size for survey data is determined according to Yamane's (1967) formula. Then, a hundred respondents were sampled from five Peasant associations, and the selection was according to the proportion of the population in each Peasant Association.

### Method of data collection

Primary data were collected through interviews using a semi-structured questionnaire. The questionnaires were pre-tested before the actual survey. The data were collected focused on feeding calendar, the purpose of feeding, utilization practices, palatability, and preferable stage of maturity as livestock feed, types of animals they feed, methods of feeding, planting method, growing seasons of *P. schimperiana*, the major constraints of livestock production and other necessary information. Also, group discussions were taken to identify the significant major constraints and opportunities in the study areas. Secondary data were collected from published literature and unpublished documents from various governmental and non-governmental offices.

### Potential foliage yield estimation

Four locations were chosen in each of the two agroecologies, with approximately 4-5 km between them. Transects were drawn at random over the ground containing *P. schimperiana* by holding the two ends of a 40m length tape separated into around 4 m intervals. Petmak's (1983) equation was used to calculate the potential yield of each *P. schimperiana* sample.

$$Log\ W=2.62logDS-2.46$$

Where; W=leaf DM yield in kg; DS = diameter of the stem (cm) at 30 cm height.

Biomass yield was determined by measuring the initial situation of each sample around 30cm above ground where it is available in the transect's specified interval, and then the total circumstance $=\Sigma C_nS_m+C_nS_m+C_nS_m\ldots.\ (CS)_n$, where $C_1, C_2 \ldots C_n$ circumstance at sample 1, 2, 3…n, $S_m=S_1, S_2 \ldots S_m$, where m= sample number. The total diameter of all samples (DS) = $(\Sigma\ ((\Sigma C_nS_M{*}0.63))$ then total biomass yield (TB) = (ΣLogW-2.62logDS-2.45). Petmak's (1983) equation was used to estimate biomass yield per sample.

$$Mean=(\Sigma TB/N)\ where\ n=number\ of\ samples$$

### Statistical analysis

All the survey data were organized, summarized, and analyzed using statistical procedures for social science (SPSS) version 20. Descriptive statistics such as Rank, frequency, mean, percentage, and standard deviation were used to present the results. ANOVA procedure was followed using the general linear models (GLM) procedures to determine biomass yield.

## RESULT AND DISCUSSION

### Production and management practices of *Pentas schimperiana*

Production, management, and utilization practices of

*P. schimperiana* were shown in Table 1. Most of the respondents 79.2% did not practice the plantation of *P. schimperiana* in their backyard; instead, they collected it from the naturally grown forest. In contrast, only 2.4 % of them have practiced stem-splitting methods in midland agroecology. The respondents practiced two planting seasons, spring (83%) and summer (17%) and they reported that *P. schimperiana* required repeating trials to acclimatize in the backyard since it dried in the first planting steps. However, there was no preparation of land for the planting *of P. schimperiana* in both agroecology. The unique advantage of this locally available livestock feed did not require any excessive amount of water to grow up throughout the year. The result revealed that *P. schimperiana* has grown averagely about 2.5m in height and has mostly oblong twinkle broad leaf structure Figure 1. It stayed green throughout the year, which was served as potential feed supplements for livestock, especially during severe feed scarcity, and as a source of income for poor farmers.

**Table 1:** Production and management practices of *Pentas schimperiana (%).*

| | | Agroecology | | |
|---|---|---|---|---|
| **Variables** | | **Midland (N=42)** | **Highland (N=58)** | **Overall (N=100)** |
| Respondent planting | Yes | 21.4 | 20.7 | 20.8 |
| | No | 78.6 | 79.3 | 79.2 |
| Source of planting | Naturally grown | 100 | 100 | 100 |
| | Other | 0 | 0 | 0 |
| Planting methods | Transplanting | 98.6 | 100 | 99.9 |
| | Stem splitting | 2.4 | 0 | 0.1 |
| Planting season | Spring | 78.6 | 87.4 | 83.0 |
| | Summer | 21.4 | 12.6 | 17.0 |
| Source of water | Irrigation | 0 | 0 | 0 |
| | Rainfall | 100 | 1000 | 100 |

**Figure 1:** *Penta schimperiana* plant.

## Methods of Pentas schmimperriana utilization

*P. schimperiana* are utilized in two forms. The first one is the twigs and leaves which are utilized through cut and carry system which were fed directly to their livestock (80%), and secondly, they made a drink by mixing with other ingredients (20%) as shown in Table 2. The study on collecting and harvesting methods was corresponding to Bekele (2006), who reported that *Grewia bicolor* leaves and young stem were harvested and collected through a cut and carry system to feed livestock during the dry season.

About 54% of *P. schimperiana* for utilization was collecting from the forest and 25.2% purchased from the local market. Whereas the rest was grown around the homestead. All respondents based on their feeding experience, the leaves and twigs part of *P. schimperiana* was favored by all different livestocks group in terms of palatability. This study corresponds to the report of Gaiballa (2012) on the utilization of *Ficus browse species* leaves and twigs by livestock. Most respondents in the study area offered to their selected livestock individually (82.7%) based on age, purpose, and sex to reduce the wastage and prevent fighting of powerful animals.

## Use of *P. schimperiana* as livestock feed

*P. schimperiana* was used for milking cows to increase milk yield along with quality and quantity of butter as shown in Table 3. Thus, it was named "milk feed" which made the milk had good quality and delicious tastes. The current findings corresponding to Belete et al. (2012) reported the same observation on the feeding of *Vernonia amygadalina*.

Approximately 43.6 % of responders use a mixed drinking form of *P. schimperiana* that was prepared for heifers/ cows to readily bring into heat. This study corresponded with the findings of Belete et al. (2012), who stated that *Acacia tortilis* feedings had caused cows to go into heat. In addition, 71.4 % and 56.9 % in the midland and highland, respectively, were utilized for providing milk to calves with limited calving ability when the mother ceased suckling during the dry season. This study was similar to Belete et al. (2012) work on *Combretum melle*, which was utilized to replace milk in calves and was fed throughout the dry season. *P. schimperiana* supplementation caused calves to grow quickly, have an appetite, become vigorous for traction, and have good physical condition for sale. Similarly, supplementing *P. schimperiana* by drinking it to old oxen aids in regaining better body condition for fattening and selling.

## The other purpose of *P. schimperiana*

The other purpose of *P. schimperiana* was used as traditional medicine (59.4%), source of income by selling on the local market for other farmers (44.6%), bee forage (30.7%), and soil conservation (10.9%) as shown in Table 4.

**Table 2:** Methods and ways of *Pentas schimperiana* utilization.

| | Agroecology | | |
|---|---|---|---|
| **Variables** | **Midland (N=42)** | **Highland (N=58)** | **Overall (N=100)** |
| Methods of utilization (%) | | | |
| Feeding | 88.1 | 74.1 | 80.0 |
| Drinking & directly feeding of leaves & twigs | 11.9 | 25.9 | 20.0 |
| Harvested and collected part (%) | | | |
| Stems | 0 | 0 | 0 |
| Leaves | 0 | 00 | |
| Leaves and twigs | 100 | 100 | 100 |
| Flower and fruit | 0 | 0 | 0 |
| Harvesting and collecting methods (%) | | | |
| Cut-and-carry system | 100 | 100 | 100 |
| Other | 0 | 0 | 0 |
| Source of harvesting and collecting (%) | | | |
| Naturally grown in the forest | 33.3 | 75.9 | 54.6 |
| Naturally grown and planted in the backyard | 21.4 | 19.0 | 20.2 |
| Purchasing from a nearby market | 45.2 | 5.2 | 25.2 |
| Parts utilized by livestock (%) | | | |
| Stem | 0 | 0 | 0 |
| Leaves | 0 | 0 | 0 |
| Leaves and twigs | 100 | 100 | 100 |
| Ways of feeding (%) | | | |
| In individual | 83.3 | 82.2 | 82.75 |
| In group | 16.7 | 17.8 | 17.25 |
| Conservation methods used (%) | | | |
| Yes | 0 | 0 | 0 |
| No | 100 | 100 | 100 |

**Table 3:** The indigenous knowledge on utilization of *Pentas schimperiana* in drinking form and as a feeds ingredients.

| **Important (%)** | Agroecology | | |
|---|---|---|---|
| | **Midland (N=42)** | **Highland (N=58)** | **Overall (N=100)** |
| Increase milk yield & quality | 100 | 100 | 100 |
| Fast and good physical growth of calves | 85.7 | 70.8 | 76.2 |
| Make cow and heifers come heat easily | 38.1 | 48.3 | 43.6 |
| Placental drop | 33.3 | 39.7 | 36.6 |
| Replace milk for calves and feed during dry times | 71.4 | 56.9 | 63.0 |
| Initiate feed appetite | 57.1 | 53.4 | 54.5 |
| Kill internal parasite | 40.5 | 50.0 | 45.5 |
| Fattening cattle | 47.6 | 56.9 | 54.5 |

**Table 4:** Other utilization of *P. schimperiana.*

| **Utilization (%)** | Agroecology | | |
|---|---|---|---|
| | **Midland (N=42)** | **Highland (N=58)** | **Overall (N=100)** |
| Bee forage | 45.2 | 20.7 | 30.7 |
| Source of income | 47.6 | 43.1 | 44.6 |
| Soil conservation | 7.1 | 13.8 | 10.9 |
| Traditional medicinal value | 64.4 | 56.9 | 59.4 |

This study revealed that *P. schimperiana* has a potential medicinal value in additional to nutritional value that recognized in the study area.

The respondents explained that *P. schimperiana* is used to care for broken bones for both cattle and humans. According to Jimmal et al. (2016), statement indicated that medicinal plants and browse species plants are both highly nutritious.

**Table 5:** Types of ingredients mixed with *Pentas schimperiana.*

| | | | Agroecology | | |
|---|---|---|---|---|---|
| Local name | Scientific name | Used part | Midland (N=42) | Highland (N=58) | Overall (N=100) |
| Axturiyaa | - | Salty soil | 100 | 100 | 100 |
| Metsinyaa | - | salt | 100 | 100 | 100 |
| Hattaa | - | Water | 100 | 100 | 100 |
| Kanfara | Grewia | Leaves and twigs | 69.0 | 41.4 | 52.5 |
| Chachawa | - | Leaves and twigs | 59.5 | 46.6 | 51.5 |
| Gaaraa | - | Leaves and twigs | 59.5 | 41.4 | 48.5 |
| Aydamiya | - | Leaves and twigs | 50.0 | 37.9 | 42.6 |
| Chayishash | - | Leaves and twigs | 45.2 | 37.9 | 40.6 |
| Gashiya | Eragrostis tef | Flour | 21.4 | 10.3 | 15.0 |
| Bunaa | Coffea | Leaves | 14.3 | 13.8 | 14.0 |
| Badala | Zea mays | flour | 31.0 | 8.6 | 18.0 |
| Busaa | - | leaves | 16.7 | 15.5 | 29.6 |
| Jenjeloo | - | flour | 28.6 | 29.3 | 29.0 |
| Mitimittaa | Capsicum annuum | flour | 35.7 | 32.8 | 34.0 |
| Kanbara | Avena sativa | Flour | 11.9 | 10.3 | 10.9 |
| Cayshiyaa | - | Leaves and twigs | 42.9 | 13.8 | 25.7 |
| Bursaa | - | flour | 35.7 | 22.4 | 28 |
| Esssaa | - | Honey | 21.4 | 10.3 | 19.8 |

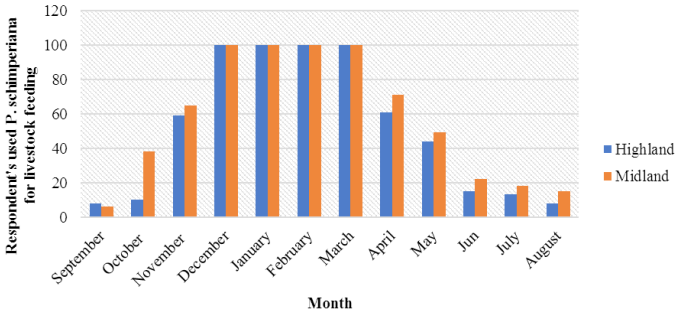


**Figure 2:** Drinking practices of *P. schimperiana* across different months of the year.

The interviewed respondents have used *P. schimperiana* as a source of income. This study was corresponding with the finding of Jimmal et al. (2016), who reported that, medicinal plants, weeds, grasses and browse plants were a source of daily income for households in the Kembta Tembaro zone, Ethiopia. The respondents suggested that *P. schimperiana* flowers were important for beekeeping as bee forage. This observation was similar to Thijssen et al. (1993), findings where browse trees and shrub flowers were used for beekeeping. Also, *P. schimperiana* was used to increase soil fertility and act as an erosion barrier. This was corresponding to Devendra (1993), indicated that browse species have a role in soil conservation.

## Preparation of *P. schimperiana* as livestock feeds

The respondents explained that leaves and twigs of *P. schimperiana, Kanfaraa, Gaaraa, Ayidamiya, Chachewa, Chayishash (Dawuregna),* enset, coffee were harvested and collected from the available area and chopped, dried, and ground. The ground materials were mixed and shattered with salt, water, "*Axuriyaa*", *Essaa,* flour from obtained *Capsicum annuum* (Pepper), *Avena sativa* (Oats), *Zea maya* (Maize) and *Eragrostis tef* ("Tef") then provided to livestock through basal diets as presented in Table 5.

This study disagreed with Gaiballa (2012), study who reported that the utilization of the leaves and twigs of browse species were fed directly through cut and carry system. To feed the newborn calves, only *P. schimperiana* leaves and young stem were chopped and pressed with hand to collect sticky liquid part later mixing only with water and milk, which were collected from other milking cows, followed by drenching through the tin.

A study indicated that practices of mixing and preparing other feed types with *P. schimperiana* leaves and twigs were used mostly in midland agroecology that might the on experience. However, respondents explained that the mixing of all types of feed with *P. schimperiana* has no known rules, simply mixing and balancing was based on their long-term experiences of livestock keepers. All respondents explained that chopped *P. schimperiana* was kept dried before grinding. Similarly, Andualem et al. (2015) reported that *P. schimperiana* leaf and stem were chopped, dried, and mixed with salt and water and given mainly to milking cows and fattening animals. In both agroecology,

different types of feeds were collected and harvested to mix with *P. schimperiana* leaves and twigs for preparation were varied due to their practices and availability. *Axuriyaa* (salty soil), salt, water, and *Kanfaraa (Dawuregna)* leaves and twigs were dominantly mixed with *Pentas schimperiana* for preparation. However, mixing of flour obtained from *Capsicum annuum*, *Jenjeloo (Dawuregna),* and *Coffea* leaves were applied only when cows suffering with retained placenta. All other feeds increased the potential palatability as well as nutritional values to livestock by increasing the quality and the quantity of the combined form of feed.

The mixing of *Axuriyaa* (salty soil) is used to increase the milk yield in terms of quality and quantity, initiating the cow and heifer to be heat and enhanced feed consumption. Similarly, Andualem et al. (2015) reported that *Axuriyaa* was used to increase the quantity and quality of milk. This was probably due to the high content of sodium in mineral soil in Essera District, Dawuro zone Southern Ethiopia. Furthermore, Farmers reported using a combination of *Gaaraa (Dawuregna) leaves and twigs, Capsicum annuum*, *Jenjeloo (Dawuregna),* and *Coffee* were used for placenta drop in cows that have problems of retained placenta when it was provided immediately after giving birth.

The mixing of "*Kanfaaraa*, *Cayshiyaa, Chachewa, Chyishash, and Ayidamiyaa" (local name)* in the animals feed showed increase disease resistance. To be sure that, the respondents confirmed that "*Essaa" (Dawuregna)*, enset leaves and flour from *Bursaa (Dawuregna), Zea mays*, *Avena sativa,* and *Eragrostis teff* ("teff") were mixed with *P. schimperiana* leaves and twigs as alternative feeds during the dry season which used to increase the preferable potential of combination form of the feeds.

## Utilization practices of *P. schimperiana* or different livestock groups

During group discussion, farmers indicated that *P. schimperiana* used as potential feed supplements to a different type of livestock, which was corresponding with the finding of Solomon (2001), who reported that indigenous browse species was used for supplementing feed during the dry season that can keep animals in better body condition. Utilization of *P. schimperiana* priory given to milking cows, dry cows, heifers, calves, oxen, bulls, sheep, goats, and equine (Table 6). This study was comparable with Gaiballa (2012), study which reported that browse species are dominantly utilized by goats in Western Bahr El Ghazal State, Sudan. The utilization of *P. schimperiana* depended on the significant contribution of each livestock to the household.

## Utilization practices of *P. schimperiana*

Table 7 shows a *P. schimperiana* utilization practice. According to the responders, when this is fed by 4-month pregnant cows, the neonates become excessively fat, causing dystocia and other problems, and the cow and calves may die as a result, according to the respondents. Most respondents said they started feeding their calves two months after calving because they thought the newborn wouldn't be able to tolerate the *Axuriyaa* and salt levels before that time. During the calving season, however, they administer *P. schimperiana* to the newborn calves by combining it with milk and water. As indicated in Figure 2, during the dry season, when the calving cow was unable to provide enough milk for her calves, the practice of drinking newborn calves was used. *P. schimperiana* is given to animals in the middle of the day. Because the *P. schimperiana* mixture has a large amount of water, the animals devoured more after spending time in the sun. The drinking technique differs from that of other browsing species in that it feeds the edible component to cattle directly by cut and carry (Mulugeta and Gemechu, 2016).

**Table 6:** Types of an animal offered *Pentas schimperiana.*

| | Agroecology | | |
|---|---|---|---|
| **Livestock types** | **Midland (N=42)** | **Highland (N=58)** | **Overall (N=100)** |
| Milking cow | 100.0 | 100.0 | 100.0 |
| Dry cow | 83.3 | 79.3 | 80.2 |
| Heifers | 64.3 | 74.1 | 69.3 |
| Calves | 64.3 | 55.2 | 58.4 |
| Oxen | 54.8 | 48.3 | 50.5 |
| Bull | 38.1 | 46.6 | 42.6 |
| Sheep | 28.6 | 32.8 | 30.7 |
| Goat | 21.4 | 19.0 | 19.8 |
| Equine | 9.5 | 3.4 | 5.9 |

## The fallout of feeding *P. schimperiana*

The problems of *P. schimperiana* mostly occurred due to the mixing of Axuriyaa and salt, for the offering of newborn calves and pregnant cows are shown in Table 8. As respondents reported, when the content of *Axuriyaa* and salt was very high, it causes excessive drinking of water that cause diarrhea and subsequently leads to death. Also, excessive consumption of mixture had led to bloat related issue. This study corresponds with Gaiballa (2012), who reported that when goats consumed more browse components, their rumen had reached a bloat status and subsequently died. Therefore, the drinking practices of *P. schimperiana* required careful management when providing for different livestock groups, especially for newborn calves and pregnant cows.

## Feeding calendar of *P. schimperiana*

In the study area, the drinking of *P. schimperiana* drink mix was dominantly practiced during the dry season in December, January, February, and March as shown in

Figure 2. This study was in line with Andualem et al. (2015), who reported that Browse species were mainly utilized in the dry season. In midland and highland agroecology, the utilization practices were lower in September, October, June, July, and August. This study indicated that the drinking capacity of livestock depends on the amount of environmental temperature and water content of the feeds. In another way, the utilization of *P. schimperiana* drink mix was low during the rainy season; since they feed green feeds, which have a higher water content that reduces drinking capacity. This result corresponds with Jimmal et al. (2016) findings that livestock were more utilized natural grasses and weeds during the rainy season.

**Table 7:** Utilization practices of livestock (%).

| Utilization practices | Agroecology | | |
|---|---|---|---|
| | Midland (N=42) | Highland (N=58) | Overall (N=100) |
| Frequency of drinking | | | |
| One time per day | 7.1 | 5.2 | 6.15 |
| Two times per weeks | 11.9 | 10.3 | 11.1 |
| Three times per weeks | 81.0 | 84.5 | 82.75 |
| **Drinking period of pregnancy cow** | | | |
| For about the first four-month | 71.4 | 69.0 | 70.2 |
| For about the first five-month | 19.0 | 20.6 | 19.8 |
| For about the first six month | 7.2 | 5.2 | 6.2 |
| The whole pregnancy period | 2.4 | 5.2 | 4.0 |
| **Drinking ages of newborn calves** | | | |
| After one month of calving | 4.8 | 6.9 | 5.9 |
| After two months of calving | 85.7 | 87.9 | 86.8 |
| After three months of calving | 9.5 | 5.2 | 7.35 |
| The whole calving period | 0 | 0 | 0 |
| Drinking duration in a day | | | |
| Moring | 0 | 0 | 0 |
| Midday | 100 | 100 | 100 |
| Afternoon | 0 | 0 | 0 |

### Estimated potential biomass yield

As shown in Table 9, there were variation (P<0.05) in total circumstance and diameter of stem and biomass yield between agroecology in the dry and wet seasons. The estimated biomass yields were 4.34±0.13 kg and 5.56±0.119 kg in the dry and wet seasons, respectively. The biomass yield had a positive relationship with the circumference and diameter of the stem. As the circumference and diameter of the stem increased (P<0.05) the biomass also increased, which confirmed the principle of Petmak (1983).

**Table 8:** Livestock feeding-related problem of *P. schimperiana.*

| Problems (%) | Agroecology | | |
|---|---|---|---|
| | Midland (N=42) | Highland (N=58) | Overall (N=100) |
| Bloat | 4.8 | 3.4 | 4.0 |
| Diarrhea | 9.5 | 13.8 | 11.65 |
| Abortion | 2.4 | 1.7 | 2.05 |
| Bloat and diarrhea | 45.2 | 36.2 | 40.7 |
| Diarrhea and abortion | 35.7 | 39.2 | 37.5 |
| No drinking problem | 2.4 | 5.2 | 4.0 |

The biomass yield obtained both in the dry and wet season in midland and highland were greater than the report of Ararsa et al. (2018) where the biomass yield of shrubs ranged from 1.18-2.36 kg/plants in Weliso District Southwest Shoa Zone Central, Ethiopia and lower than the report of Takele et al. (2014) as biomass yields of selected indigenous fodder tree/shrubs ranged from 24.55 kg/tree/shrubs to 958.76 kg/tree in Wolaita zone, southern Ethiopia. The difference could be due to variation among species in biomass yield may be associated with differences in the growth of the species. Also, Upreti and Devkota (2017) reported that the biomass yields of browse species were increased in the wet season than dry season due to the increased number of branches and other morphological traits (tree size and tree height). Similarly, biomass yield difference (P<0.05) appeared between agroecology, which may be related to spatial differences and associated variation in climatic factors and soil fertility.

**Table 9:** Estimated biomass yield.

| Parameter | | Agroecology | | | | P-value | | |
|---|---|---|---|---|---|---|---|---|
| | | Midland | Highland | Mean | SEM | Agro. | Season | Agro*season |
| TC (cm) | dry season | 5.27[a] | 6.12[b] | 5.69 | 0.43 | | | |
| | wet season | 6.33[a] | 6.60[b] | 6.46 | 0.703 | 0.041 | 0.009 | 0.263 |
| TD (cm) | dry season | 3.34[a] | 3.89[b] | 3.61 | 0.21 | | | |
| | wet season | 4.03[a] | 4.20[b] | 4.11 | 0.191 | 0.038 | 0.07 | 0.229 |
| TB (kg) | dry season | 3.47[a] | 5.25[b] | 4.34 | 0.13 | | | |
| | wet season | 4.36[a] | 6.77[b] | 5.56 | 0.119 | 0.007 | 0.087 | 0.635 |

[a, b] rows means with different superscripts are significantly different (P<0.05). N: number of sample, TC: total circumstance, TD: total diameter, TB: total biomass yield, Para: parameter and Agro.: Agroecology effect (P<0.05), Season: Season effect (P<0.05) and Agro.*season: interaction effect of Agroecology * Season.

## CONCLUSIONS AND RECOMMENDATIONS

Most farmers did not involve much in planting and growing due to a lack of knowledge on plantation and production systems, lack of support of extension workers, and intensifies deforestation. Therefore, there is a need to provide complete extension services and training on productions and management practices. Further, there is a need for live animal feeding experiments especially on dairy animals, to enhance their utilization in the future for livestock production and rural household development.

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## NOVELTY STATEMENT

*P. schimperiana* is one of the locally available livestock feeds in Ethiopia. However, there is no single study about its utilization and nutritive values, biomass yield. The current study has revealed that *P. schimperiana* has potential nutritional and as well as medicinal values that are recognized in the study area. *P. schimperiana* was used for milking cows to increase milk yield along with the quality and quantity of butter. Also, it is used to bring heifers/cows to readily bring into heat in a mixed drinking form. However, a mixture of locally known as 'Axuriyaa' and salt with *P. schimperiana* for newborn calves and pregnant cows causes excessive drinking of water that causes diarrhea and subsequently leads to death.

## AUTHOR'S CONTRIBUTION

All authors collect the necessary data and write up the article.

### Conflicts of interest

The authors have declared no conflict of interest.

## REFERENCES

Andualem T, Berhanu T and Gebeyehu G (2015). Assessment of cattle feeds resources; chemical composition and distribution of major feeds in Essera district, southern Ethiopia. Sci. Technol. Arts Res. J., 4(2): 89-98. Retrieved March 21, 2021 from https://www.ajol.info/index.php/star/article/view/133451

Ararsa D, Kassahun D and Meseret M (2018). Assessment of livestock feed resources in Weliso District South West Shoa Zone Central, Ethiopia. Am. Eur. J. Agric. Environ. Sci., 18(3): 145-167. Retrieved March 15, 2021, from http://idosi.org/aejaes/jaes18(3)18/5.pdf

Bekele A (2006). Cattle milk and meat production and marketing systems and opportunities for market orientation in Fogera woreda, Amhara region, Ethiopia. IPMS (Improving Productivity and Market Success) of Ethiopian farmers project working paper 19. Int. Livest. Res. Inst. Nairobi, Kenya. pp. 65. Retrieved April 1, 2021, from https://cgspace.cgiar.org/bitstream/handle/10568/1686/WP?sequence=1

Belete S, Hassen A, Assafa T, Amen N and Ebro A (2012). Identification and nutritive value of potential fodder and shrubs in mid rift valley of Ethiopia. Ethiopia dairy and meat technology institute, Debrezait, Ethiopia. J. Anim. Plant Sci., 22(4): 1126-1132. Retrieved March 20, 2021, from https://www.semanticscholar.org/paper/Identification-and-nutritive-vale-of-potential-and-Shenkute-Hassen/c16582619c295ae92b01228dead0d5630786f310

Boufennara S, Lopez S, Bousseboua H, Bodas R and Bouazza L (2012). Chemical composition and digestibility of some browse plant species collected from Algerian arid rangelands. Spanish Journal of Agricultural Research, 10(1): 88-98. Retrieved March 12, 2021, from https://academicpublishingplatforms.com/downloads/pdfs/sjar/volume1/201203251759_SJAR_Vol10_No1_2012_11.pdf, https://doi.org/10.5424/sjar/2012101-134-11

CSA (Central Statistical Agency) (2021). Agricultural Sample Report on Livestock and Livestock Characteristics. Volume II. Pp.199. March, 2021, Statistical Bulletin 589. Addis Ababa, Ethiopia.from https://www.statsethiopia.gov.et/wp-content/uploads/2021/05/REVISED_2013.LIVESTOCKREPORT.FINAL-1.pdf

Devendra C (1993). Trees and shrubs as sustainable feed resource. Proceeding's 7th World Conference on Animal Production, Edmonton, Alberta, Canada June 28 - July 2, 1993. 1: 119-136. Ref. 47 Retrieved April 3, 2021, from https://www.cabdirect.org/cabdirect/abstract/19931467217

Gaiballa AK (2012). Importance of indigenous browse species in improvement of livestock feeds in western Bahr El Ghazal State (Sudan). J. Sci. Technol. Agric. Vet. Sci., 13(2): 39-51. Retrieved April 2, 2021, from http://repository.sustech.edu/handle/123456789/16856

Jimmal A, Tessema F, Gemiyo D and Bassa Z (2016). Assessment of available feed resources, feed management and utilization systems in SNNPRS of Ethiopia. J. Fish. Livest. Prod., 4: 183. Retrieved April 21, 2021 from https://www.omicsonline.org/open-access/assessment-of-available-feed-resources-feed-management-andutilization-systems-in-snnprs-of-ethiopia-2332-2608-1000183.php?aid=76757

Mareka Woreda office of Agriculture (MWOA) (2015). Basic data of Mareka woreda agricultural department.

Mulugeta K and Gemechu L (2016). Wild edible plant bio-diversity and utilization system in Nech Sar national park, Ethiopia. Int. J. Bio-Resour. Stress Manage., 7(4): 885-896. Retrieved April 1, 2021, from http://pphouse.org/ijbsm-article-details.php?article=746, https://doi.org/10.23910/IJBSM/2016.7.4.1628

Petmak MV (1983). Primary productivity, nutrient cycling and organic matter turnover of tree plantation after agricultural intercropping practices in northeast Thailand. PhD thesis, University of the Philippines, Los Baños, Philippines, pp. 228.

Solomon M (2001). Evaluation of selected multipurpose trees as feed supplements in teff (*Eragrotis tef*) staw based feeding of Menz Sheep. a Ph.D thesis. Berlin, Germany.

Solomon M, Teferi A (2010). Chemical composition, *in vitro*

dry matter digestibility and in Sacco degradability of selected browse species used as animal feeds under semi-arid conditions in Northern Ethiopia. Agro For. Syst., 80: 173-184. Retrieved April 1, 2021, from https://link.springer.com/article/10.1007/s10457-010-9295-x

Takele G, Lisanework N and Getachew A (2014). Evaluation of potential yield and chemical composition of selected indigenous multi-purpose fodder trees in three Districts of Wolayta Zone Southern Ethiopia. World Appl. Sci. J., 31(3): 399-405. Retrieved April 1, 2021, from http://idosi.org/wasj/wasj31(3)14/22.pdf

Thijssen HC, Murithi FM, Nyaata OZ, Mwangi JN, Aiyelaagbe IO and Mugendi DN (1993). Report on an ethnobotanical survey of woody perennials in the coffee zone of Embu District, Kenya. AFRENA Report no. 62. Int. Center Res. Agrofor. (ICRAF), Nairobi, Kenya.

Upreti S, Devkota NR (2017). Ranking of fodder tree species and their biomass production in the hills and mountain of Nepal. J. Agric. For. Univ., 1(2017): 171-179. March 23, 2021, from http://afu.edu.np/sites/default/files/Ranking_of_fodder_tree_species_and_their_biomass_production_in_the_hills_and_mountain_of_Nepal_S._Upreti_and_N._R._Devkota.pdf

Yamane T (1967). Statistics, An Introductory Analysis, 2nd Ed., New York: Harper and Row. April 3, 2021, from https://www.tarleton.edu/academicassessment/documents/samplesize.pdf