International Journal of Forest, Animal and Fisheries Research (IJFAF)
ISSN: 2456-8791
[Vol-10, Issue-2, Apr-Jun, 2026]
Issue DOI: https://dx.doi.org/10.22161/ijfaf.10.2
Article DOI: https://dx.doi.org/10.22161/ijfaf.10.2.2

On-Farm Performance Evaluation of Legume Forage Species under Rain-Fed Conditions at Pinkiyo District, Angiak Zone, Gambella Region, Ethiopia

Tesfamicheal Fissha[1]*, Amino Kiru [2] and Obang Ojulu[3]

[1]Department of Livestock Production, Gambella Agricultural Research Institute, Gambella, Ethiopia
[2]Food System Resilient Program, Gambella, Ethiopia
[3]Ethiopian Institute of Agricultural Research, Abobo Agricultural Research Center, Abobo, Ethiopia

Received: 25 Feb 2026; Received in revised form: 28 Mar 2026; Accepted: 03 Apr 2026; Available online: 03 Jun 2026

Abstract-- *This study was conducted in Pinkiyo kebele of Gambella Zuria woreda, Gambella Region, Ethiopia, to evaluate the adaptability, biomass yield, and utilization potential of improved legume forage species under rain-fed conditions. Three improved forage legumes, namely Lablab-11640, Lablab-147, and Desmodium, were evaluated using a Completely Randomized Design (CRD) with two replications under participatory on-farm conditions. Three agro-pastoral households allocated 0.5 ha of land for the experiment. Agronomic parameters including plant height, survival rate, number of leaves per plant, fresh biomass yield, and dry matter yield were collected and analyzed using SPSS version 21. Significant differences ($P < 0.05$) were observed among treatments for most agronomic parameters. Lablab-11640 showed superior performance with the highest plant height (148.5 ± 4.2 cm), survival rate (93 ± 2.0%), fresh biomass yield (12.10 ± 0.65 t/ha), dry matter yield (3.65 ± 0.18 t/ha), and number of leaves per plant (45.2 ± 2.1). Lablab-147 ranked second, while Desmodium recorded the lowest performance across most parameters. The study concluded that improved forage legumes, particularly Lablab-11640, have strong potential to alleviate livestock feed shortages and improve livestock productivity in the rain-fed lowland areas of Gambella Region. Therefore, scaling up and dissemination of the demonstrated forage technologies are recommended in similar agro-ecological areas.*

Keywords— Agro-pastoralists, biomass yield, Desmodium, dry matter yield, forage adaptation, Gambella Region, Lablab purpureus.

I. INTRODUCTION

Ethiopia possesses one of the largest livestock populations in Africa, with approximately 56.71 million cattle, 29.33 million sheep, 29.11 million goats, 1.16 million camels, and 56.87 million chickens (CSA, 2015). Despite the large livestock population, productivity remains low due to several constraints, among which feed shortage in both quantity and quality is the most critical.

In pastoral and agro-pastoral production systems such as Gambella Region, livestock largely depend on natural pastures, which account for 80–90% of feed resources. During the dry season, the availability and nutritional quality of natural pasture decline

significantly, resulting in reduced livestock productivity and body weight loss.

Improved forage species play an important role in alleviating feed shortages and improving livestock productivity. Leguminous forage species such as *Lablab purpureus* and *Desmodium* species are recognized for their high biomass yield, adaptability, drought tolerance, and high crude protein content. However, their adaptability and productivity under the rain-fed lowland conditions of Gambella Region had not been adequately evaluated.

Livestock production plays a significant role in the livelihood, food security, and income generation of pastoral and agro-pastoral communities in Gambella Region. However, livestock productivity in the area remains low due to severe shortages of quality feed, especially during the dry season. Natural pasture, which is the major feed source in the study area, is characterized by poor nutritional quality, seasonal fluctuation, and low biomass yield.

Although Gambella Region possesses favorable climatic conditions and vast grazing land suitable for forage production, the introduction and evaluation of improved forage technologies have received limited attention. Most pastoral and agro-pastoral communities continue to depend on traditional grazing systems with little knowledge and access to improved forage species that could improve livestock productivity.

Therefore, this study was conducted to evaluate the agronomic performance and adaptability of selected legume forage species under participatory on-farm conditions in Pinkiyo kebele of Gambella Zuria woreda.

1.1 Objectives

General Objective

To evaluate the performance of improved legume forage species under rain-fed conditions in Gambella Region.

Specific Objectives

1. To evaluate the agronomic performance of selected forage species.
2. To demonstrate improved forage technologies to agro-pastoral communities.
3. To assess farmers' perception and feedback on forage technologies.

II. MATERIALS AND METHODS

2.1 Description of the Study Area

The study was conducted in Pinkiyo kebele of Gambella Zuria woreda, Gambella Region, Ethiopia. The area is located about 763 km southwest of Addis Ababa. The region lies between 7°N–8.17°N latitude and 33°E–35.02°E longitude with an altitude range of 300–2300 meters above sea level.

The area receives an average annual rainfall of 800–1200 mm with average temperature ranging from 30.7°C to 37°C. The region has two distinct seasons: a wet season from May to October and a dry season from November to April.

2.2 Research Design and Experimental Treatments

The experiment was conducted using a Completely Randomized Design (CRD) with two replications under participatory on-farm conditions.

Three forage legume species were evaluated:

- T1 = Lablab-11640
- T2 = Lablab-147
- T3 = Desmodium

Three agro-pastoral households participated in the study and each allocated 0.5 ha of land for the experiment. Experimental plots measured 4 m × 2 m. The forage species were planted with spacing of 25 cm between plants and 50 cm between rows using a seed rate of 15 kg/ha.

2.3 Data Collection

The following agronomic data were collected:

- Plant height (cm)
- Number of leaves per plant
- Survival rate (%)
- Fresh biomass yield (kg/plot and t/ha)
- Dry matter yield (kg/plot and t/ha)

2.4 Statistical Analysis

Collected data were analyzed using SPSS Version 21. Descriptive statistics and analysis of variance (ANOVA) were used to compare treatment means.

III. RESULTS AND DISCUSSION

3.1 Socio-demographic Characteristics of Participants

A total of 20 agro-pastoralists participated in the study. Among them, 75% were male and 25% were female.

Table 1. Socio-demographic characteristics of participants

Variable	Category	Frequency	Percentage (%)
Sex	Male	15	75
	Female	5	25
Age	25–35	6	30
	36–45	8	40
	>45	6	30
Education	Illiterate	7	35
	Primary	9	45
	Secondary	4	20

3.2 Training and Field Demonstration

Training was provided to agro-pastoralists, development agents, and kebele administrators on forage production and management practices. Field visits and practical demonstrations were organized to create awareness and improve farmers' knowledge.

3.3 Plant Height

Table 2. Plant height performance of forage species

Treatment	Mean ± SD (cm)	P-value	Significance
T1	148.5 ± 4.2	<0.05	*
T2	132.0 ± 3.8		
T3	118.3 ± 5.1		

Significant variation ($P < 0.05$) was observed among treatments. T1 (Lablab-11640) showed the highest plant height.

3.4 Survival Rate

Table 3. Survival rate of forage species

Treatment	Mean ± SD (%)	P-value	Significance
T1	93 ± 2.0	<0.05	*
T2	88 ± 2.5		
T3	82 ± 3.1		

Lablab-11640 showed significantly higher survival rate, indicating better adaptation to the study area.

3.5 Fresh Biomass Yield

Table 4. Fresh biomass yield of forage species

Treatment	Mean ± SD (kg/plot)	Mean ± SD (t/ha)	P-value	Significance
T1	14.52 ± 0.78	12.10 ± 0.65	0.001	**
T2	11.82 ± 0.60	9.85 ± 0.52		
T3	8.64 ± 0.85	7.20 ± 0.70		

Lablab-11640 produced significantly higher fresh biomass yield than the other tested species.

Fig. 1: maturity Stage

3.6 Dry Matter Yield

Table 5. Dry matter yield of forage species

Treatment	Mean ± SD (kg/plot)	Mean ± SD (t/ha)	P-value	Significance
T1	4.38 ± 0.22	3.65 ± 0.18	0.002	**
T2	3.60 ± 0.18	3.00 ± 0.15		
T3	2.64 ± 0.20	2.20 ± 0.20		

Dry matter yield showed significant variation ($P < 0.05$), confirming the superiority of Lablab-11640.

3.7 Number of Leaves per Plant

Table 6. Number of leaves per plant

Treatment	Mean ± SD	P-value	Significance
T1	45.2 ± 2.1	<0.05	*
T2	39.8 ± 1.9		
T3	33.5 ± 2.5		

3.8 Discussion

The study revealed that Lablab-11640 significantly outperformed the other forage species in terms of plant height, survival rate, fresh biomass yield, dry matter yield, and leaf number.

The superior performance of Lablab-11640 may be attributed to its better adaptation to rain-fed lowland conditions and vigorous vegetative growth. Farmers also preferred Lablab species because of their high biomass yield, palatability, early maturity, and drought tolerance.

IV. CHALLENGES ENCOUNTERED

1. Weak linkage between district agricultural offices and farmers.
2. Frequent turnover of development agents.
3. Limited follow-up and technical support.

V. CONCLUSION

The study demonstrated that improved forage legume species, especially Lablab-11640, performed well under rain-fed lowland conditions of Gambella Region.

Lablab-11640 produced the highest fresh biomass and dry matter yields and showed better adaptation and survival rate than the other tested species. Participatory forage technology demonstration was effective in improving awareness and adoption among agro-pastoralists.

The study suggests that scaling up improved forage technologies can contribute significantly to reducing livestock feed shortages and improving livestock productivity in lowland agro-ecologies of Ethiopia.

RECOMMENDATIONS

1. Scale up and disseminate Lablab-11640 in similar agro-ecological areas.
2. Conduct further evaluation on forage quality, seed production, and feeding value.
3. Strengthen extension support and farmer training on forage production practices.
4. Evaluate additional forage species under different management conditions.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the Gambella Agricultural Research Institute, participating agro-pastoral farmers, development agents, and district livestock experts for their valuable support during the implementation of the study.

REFERENCES

[1] Alemayehu, M. (2003). *Country pasture/forage resource profiles: Ethiopia*. FAO.
[2] Allen, D.J. (1983). *The pathology of tropical food legumes*. Wiley, New York.
[3] CSA (Central Statistical Agency). (2015). *Agricultural Sample Survey Report*. Addis Ababa, Ethiopia.
[4] Denbela, H., et al. (2015). Evaluation of forage legumes under lowland conditions of Ethiopia.
[5] FAO. (2009). *Livestock sector review*. Rome, Italy.

[6] Mengistu, A. (2006). *Country pasture and forage resource profiles*. FAO.

[7] Adeshina, D. A., Chuwang, P. Z., Odoh, N. C., & Adeboye, S. E. (2024). Effect of rhizobial inoculation on the nodulation, growth and yield of Soybean in the Savannah regions of Nigeria. International Journal of Horticulture, Agriculture and Food Science, 8(2), 10–17. https://doi.org/10.22161/ijhaf.8.2.2

[8] Poppi, D.P. and McLennan, S.R. (1995). Protein and energy utilization by ruminants at pasture. *Journal of Animal Science*, 73, 278–290.

[9] Liu, J., & Wang, R.-Y. (2024). Analysis of Spatial and Temporal Changes in Land Use in Lushan City over the Past 20 Years. International Journal of Rural Development, Environment and Health Research, 8(2), 75–85. https://doi.org/10.22161/ijreh.8.2.9

[10] Mijena, D., Getiso, A., & Felecho, J. (2024). Assessing Artificial Insemination Service Effectiveness and Evaluation of Semen Quality in West Arsi Zone of Oromia Region, Ethiopia. International Journal of Forest, Animal And Fisheries Research, 8(3), 01–18. https://doi.org/10.22161/ijfaf.8.2.1