CME LIVE OPEN ACCESS

Journal of
Veterinary Research and Clinical Care

Review Article

ISSN: 3065-9000

Review on Improved Forage Production Opportunities and Challenges in Ethiopia

Chala Duguma Olika*

Department of Animal Science, Ambo University, Ambo, Ethiopia.

Corresponding Author: Chala Duguma Olika, Department of Animal Science, Ambo University, Ambo, Ethiopia.

Received: 2026 May 17 **Accepted:** 2026 June 05 **Published:** 2026 June 16

Abstract

There are several factors that hinder the productivity of livestock in Ethiopia of which nutrition contributes the largest share. The quality and quantity of feed are poor challenging livestock production. Now a days, due to the rapid increase of human population and increasing demand for food, grazing lands are steadily declining by being shifted to arable lands for crop production. As a result, food crop residues are providing a considerable quantity of dry season feed in most farming areas of the country. However, the feeding value of crop residues is very poor. One way to alleviate this problem is supplementation of crop residue through the use of improved forage and fodder trees. Seminar and development agents have been testing and identifying promising forages that are suitable for pasture rehabilitation in a wide range of agro-ecological zones besides animal feeding. The use of forage legumes have a paramount role resulted in increasing soil nitrogen available for food crops because of their ability to fix nitrogen. Moreover, multipurpose browse trees and shrubs serve as fuel wood resource. Improved forage legumes and browse species provides protein which enhances the feed resources available for livestock. The major challenges of improved forages production in different parts of the country are ecological deterioration, overgrazing, land tenure, border conflict, drought, weed and bush encroachment, lack of seed and planting materials. The diverse topography coupled with environmental heterogeneity offers favorable environments for pasture species, herbaceous legumes and browse trees/shrubs. Hence, review the conditions, challenges, opportunities and recommendations of improved forage production is very imperative for effective and efficient utilization of these feed resources to boost the productivity of the livestock sector in the country.

Keywords: Challenges, Improved Forages, Nutrition, Utilization

1. Introduction

Ethiopia's economy depends heavily on the livestock industry and which feed supplies are essential to cattle productivity [1]. According to CSA 2016/17, Ethiopia is home to an estimated 59.5 million cattle, 30.7 million sheep, 30.2 million goats, 8.4 million donkeys 0.4 million mules, 1.2 million camels' 59.5 million poultry and 5.9 million beehives. Livestock is an integral component for most of the agricultural activities in the country. Moreover, those livestock play a significant role in rural livelihoods and the economies of developing countries. Despite this, they are a vital resource and safety net for the poor, especially for women and pastoralist groups, and they are an important source of nutritious food for billions of households in both rural and urban areas [2]. The countries varied AGRO-climatic situation makes it ideal for the production of wide range of livestock [3]. Despite their large number and status, their productivity is low due to a lack feed of sufficient quantity and quality to meet the annual demand for livestock population that the country builds upon [4]. Consequently, grazing lands are reduced significantly and the possibility for expanding and retaining available grazing areas is restricted as the best pasture lands are lost to cultivated land expansion, investment, and urbanization, resulting in critical feed shortages [5]. According to the crop remains and standing straw are the country's major feed components during the dry season. Due to this challenge the country has very little likelihood of establishing green feed for livestock [6]. The ruminant's diet must include green fodder in order to improve its reproductive and productive capabilities [7]. The low yield or low digestibility of many Ethiopian native fodder species reduces their use to feed livestock [8]. Thus, according to the aim of improved forage production in Ethiopia was to year-round feed availability through increase feed supply and improve the intake and digestibility of the poor-quality hay and the crop residues through green feed supplementation [9]. Furthermore, increased urbanization and the of cultivable land for housing reaction and industrial development displace a significant amount of grazing lands. In the high land crop livestock mixed farming system were

about 80% of both the human and livestock population of the country are concentrated, the area of available grazing lands has been estimated to be only about 5.7 million hectares [10]. The review forecast those improved forage opportunities they have and the common challenges related with forage improvement in Ethiopia along with recommendations for the future.

2. The Overview of Improved Forage Production

2.1. The Perception of Farmers Towards Improved Forage Production

Various studies indicated that the majority of farmers in Ethiopia recognized the potential for cultivating and utilizing enhanced forages, as well as the associated benefits [11]. Over several years Ethiopia has cultivated different enhanced fodder plants species including Sesbania, Leucaena, Calliandra, and tree Lucerne for the additional nourishment of livestock and soil enhancement [12]. In addition to this shows that those farmers have a good perception of the importance of improved forage but face several challenges, including land shortage and inadequate extension services [13]. The efforts to increase agricultural productivity through technology are often hindered by farmer's limited awareness and resources. In order to, increase the adoption of improved forage technologies the stakeholders should focus on strengthening the research-extension-farmers linkage and capacity building. According to Zakarias, improved forage adoption refers to a firm's or farmers deliberate choice to integrate a novel forage technology into the agricultural production process, or to embrace a new technology and approach for utilizing superior forages. The purposive of the forage production accounted the highest portion of all purposes in Ethiopia. Thus [12], found that farmers' preferences in Ethiopia's Lay-Armachuho and Sidama districts extend beyond feed value and soil restoration. Providing farmers with access to improved forage seeds is essential. However, farmers rarely adopt complete packages due to various factors such as awareness problems, capital scarcity, and risk considerations [14].

2.2. Improved Forage Production Status

2.2.1. Selected Types of Forage Species for AGRO Ecology of Ethiopia

Due to improvement of forage production the introduction, compilation and evaluation of superior fodder is the primary objective in order to encourage its broader use mainly for fodder and resource conservation in an agro-ecological setting. Accordingly, the soil fertility can be maintained and enhanced through soil conservation. Additionally, it reduces the amount of grazing grasslands that are lost for crop cultivation [15]. According to suggested that by increasing livestock production and productivity requires a simultaneous increase in feed production using improved or cultivated forage crops in addition to natural pasture and crop residues [16]. Several useful forage crops have been selected for different agro-ecological zones of the country (Fig1). Because of their beneficial effects on animal production and contribution to economic and environmental sustainability those improved forage crops have a variety of purposes and play crucial role to farmers' livelihoods [17].

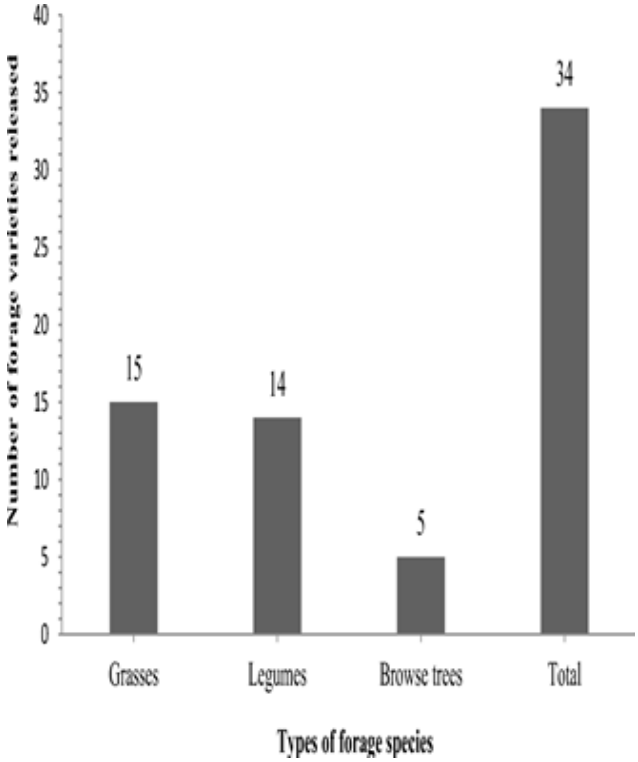

Figure 1: Number of Released Forage Crops to Different Types of AGRO-Ecology in Ethiopia (Source: *Holetta Agricultural Research Center Progress Report 2017/18 Varieties*)

2.2.2. AGRO-Ecological Zones for Forage Production

Forage species were assessed for their adaptability, ease of establishment, productivity, resistance to pests and diseases, quality, multi-purpose uses, and suitability for farming systems [7]. More than 10 promising forage species (including herbaceous legumes, grasses and browsing trees) have been recommended for each of the highland, mid-altitude and lowland agro-ecologies and the major ones are listed in (Table1). In highland agro-ecology, it is recommended to plant forage seeds, primarily perennials, during the light rains from March to May. This timing takes advantage of the favorable environmental conditions, allowing for better establishment of the plants. Conversely, in the arid and semi-arid lowlands, environmental factors such as erratic rainfall, periodic drought, and short growing seasons significantly limit the adaptation of forage species [11]. The indigenous Desho grass (*Pennisetum pedicellatum*) which has originally well adapted in southern Ethiopia and being introduced to other parts of the country is also a potential candidate for future evaluation and variety release activities [18].

Agro-ecology	Forage crop category	Annuals	Perennials
Highland (>2000 m.a.sl)	Grasses	Oats(*Avena sativa*) – different cultivar	*Phalaris aquatica, Phalaris tuberosa, Phalaris arundinacea, Festuca arundinacea, Setaria sphacelata, Dactylis glomerata (Orchard grass) Lolium perenne* (perennial ryegrass) (Chloris gayana, *Panicum coloratum, Pennisetum Purpureum)**
	Herbaceous legumes	*Vetches(Vicia dasycarpa, Vicia villosa, Vicia atropurpurea), Clovers(T. quartini anum, T.tembense, T. rueppellianum, T. decorum)*	*Lotus corniculatus,Medicago sativa,T. pretense* (red clover), *T. repens*(white clover)
	Tree legumes	___	Tagasaste/tree lucerne(*Chamaecytisus palmensis*)
	Root crop	Fodder beet (*Beta vulgaris*)	___
Mid altitude (1500-2000 masl)	Grasses	Oats(*Avena sativa*) different cultivars, Sorghum Sudanese	*Chloris gayana, Panicum coloratum, Panicum maximum, Pennisetum purpureum, Andropogon gayanus, Cenchrus ciliaris, Melinus minutiflora*
	Herbaceous legumes	Vetches(Vicia dasycarpa, Vicia villosa, Vicia atropurpurea) Lablab purpureus	*Stylosanthes guianensis, Desmodium unicinatum (Silver leaf),Desmodium intortum* (Green leaf), *Medicago sativa, Macroptilium atropurpureum, Centrosema pubescens, Neonotonia wightii*
	Tree legumes	Pigeon pea (*Cajanus cajan*)	*Leucaena spp., Sesbania sesban,Gliricidia sepium, Calliandra spp.*
Lowland (<1500 masl) Usually with supplementary irrigation	Grasses	*Sorghum Sudanese*	*Cenchrus ciliaris, Chloris gayana, Panicum coloratum, Panicum maximum, Panicum antidotale, Pennisetum purpureum*
	Herbaceous legumes	*Lablab purpureus*	*Stylosanthes guianensis, Neonotonia wightii, Clitoria ternatea, Medicag sativa*
	Tree legumes	-	*Leucaena spp., Sesbania sesban, Atriplex canescens*

* - not suitable in areas >2400 m.a.sl in altitude and with high intensity of frost

Table 1: The Important Forage Species Recommended for the Different AGRO-Ecological Zones of Ethiopia

2.3. Common Types of Forage

Potential forage crops can be grown in Ethiopian AEZs are presented in this section based on experiences from Ethiopia and Kenya [19]. The former author has presented forages which have proved successful in the FLDP, this information provides smallholder dairy farmers an opportunity to use these materials as a useful starting point for improved forage programs because of their adaptability and proven forage value. Some forages grown in East Africa and Ethiopia along with their, among other, suitable climatic conditions and soil characteristics for their cultivation.

2.3.1. GRASSES

Most ruminant livestock in Ethiopia rely on local grasses for their roughage and much of their nutrition. A review of published and unpublished literature revealed that a total of 59 indigenous forage species 9 grass varieties have been registered/released [20]. Many of these species have low adaptability, poor productivity and inadequate nutrients to maintain animals, especially during the dry season. However, improved grasses, many of them selected from other parts of Africa, have better productivity, adaptability and nutrient characteristics that make them desirable for inclusion in improved forage production programs.

2.3.2. Forage Legumes

A review indicates that there are 59 indigenous forage species and 6 legume varieties that have been released. Hence, forage legumes offer livestock highly nutritious forage, being rich in protein, vitamins, and minerals. Moreover, they remain highly digestible even during the later stages of growth, thereby ensuring that livestock receive well-rounded and balanced diets [20]. Forage legumes with a sprawling or climbing habit can also be used in backyard forage plots. Establishment is always by direct seeding.

2.3.3. Fodder Tree/Browse Legumes

Tree legumes are extremely important elements in improved forage production programs because of their productivity and multi-purpose uses (including fuel wood, construction timber, seeds, and bee products) [21]. Being perennial trees or shrubs, they have a three-dimensional root system and crown, which greatly increases the productivity of systems where land area is limited. Apart from large quantities of quality forage, browse legumes have deep rooting systems to increase their productivity during the dry season.

2.4. Challenges of Improved Forage Production

Different studies conducted to identify factors influencing the adoption of these technologies indicate that both the highlands and lowlands face similar constraints in embracing forage technologies. In Ethiopia, forage development strategy have been practiced long ago, but its adoption by the farming community has been very low because of various factors such as lack and unadoptable forage technologies, poor extension services, lack and high cost of planting materials, reluctance of most smallholder farmers and size of livestock ownership and farm size [19]. According to finding showed the land shortage is one of the major factors to adoption of improved forage crops in the Ethiopian farming system [22]. Similarly, [1], also reported that the main reason for not establishing improved forage was shortage of land on which to graze livestock or produce forage, absence of nearby adaptable improved forage seeds/seedling, insufficient extension provision service supplies, shortage of human labor targeted in the production and use of improved forages, lack of access to credit, occurrence of forage pests, weeds invasions, deficiency of fertilizers, scarcity of animal labor and forages plant diseases. Moreover, according to, reviewed that shortage of land, lack of awareness and the increased price of forage seed were the highest limitations that delay the adoption of improved forage in Shashogo Woreda of Hadiya zone [23]. In addition to this, finding showed that the primary determining factor influencing the adoption of advanced forage technology in Wolaita zone, SNNPR of Ethiopia included household size, agricultural land extent, terrain characteristics, and proximity from farmers' residences to agricultural training facilities [24]. Similarly, the gender of the household head, the scale of the farm, and the agricultural income had a negative impact on the adoption of advanced forage technology in the Debre Libanose district which is located in North Shewa, within the Oromia region of Ethiopia [25]. As farmers exhibit a notable hesitation to embrace and utilize advanced forages [26].

3. Opportunities for Improved Forages Adoption

Farmers with larger farm size also prepares private grass land by their own and have access to get crop residue and store it for the next drought periods in order to overcome feed shortages [27]. The improved forage crops present significant opportunities in contributing to soil and water conservation and the natural restoration of degraded lands. They play a crucial role in maintaining the ecological balance of the ecosystem by facilitating nitrogen fixation. Additionally, these crops serve as vital shelters for livestock, particularly during arid seasons [16]. Due to this higher yield and nutritional value gained from cultivated pastures, they have longer length of productive season, which provides an opportunity for dairy and fattening production to develop and use pasture and forage on a large scale [28]. According to, reported that the introduction and incorporation of pasture and forage crops into the existing agricultural system present a valuable opportunity for the cultivation of superior forage crops and the implementation of zero grazing practices [29]. Forage legumes not only provide high quality and quantity feed for livestock but by fixing nitrogen they could maintain and improve soil fertility and reduce the cost of chemical fertilizers, in which prices are increased rapidly in recent years and their use will be limited in the long term [30]. Thus, due to the chance for forage production by irrigation access it offers the farmers to have good access to practice forage growth three times a year [31-42].

4. Conclusion and Recommendation

Generally, the opportunity of improved forage plays a great role by improving the shortage of livestock feed in crop livestock production system. Also, it was important for farmers to integrate forage production in the farming system. The improved forage crops are very important to soil and water preservation activities, natural restoration of the degraded areas and maximize and sustain productivity of livestock in diverse methods. However, the adoption of improved forage technology in the farmers was very low. Even if they are useful in order to exploit and sustain output of livestock. There is challenges due to production of improved forages in Ethiopian farmers due to land shortage, shortage of input/forage seed and planting materials, shortage of capital, little awareness or technical know-how, poor extension services, free grazing, poor coordination among stakeholders and little support from governmental and non-governmental organizations on what these technologies are how to cultivate the plants and where to find the planting materials. On other hand, due to the increasing of livestock production in Ethiopia there is scarcity of feed for different animals those predominantly graze on natural grasslands, agricultural remnants, and crop residue. Therefore, increasing availability of forage seed and making awareness on importance and possible means of incorporation in farming system is important for wide adoption of improved forage technology in Ethiopia. Because of the using the improved forage may help farmers by enhancing the soil fertility as well as reduce the cost of chemical fertilizers in which prices are escalating rapidly currently. The improved forages are also they have no expiration they have long term

uses.

Recommendation

In general, even though the use of improved forages has been known for several years, adoption has been associated with challenges, including a lack of land, inadequate extension services, the reluctance of the majority of farmers, and the prevalence of cattle ownership. Therefore, it is recommended that effective extension service in terms of seed supply, awareness building and regular technical back-ups is important and should be emphasized to ensure sustainable production and utilization of improved forage crops in the study areas. Hence, production and utilization of improved forage to animal feed is low educating the extension workers, training the farmers and the government should aware them by limiting factors those challenge the improved forage production.

References

1. Bekele, M., Mengistu, A., & Tamir, B. (2017). Livestock and feed water productivity in the mixed crop-livestock system. *Animal, 11*(10), 1852-1860.
2. Herrero, M., Grace, D., Njuki, J., Johnson, N., Enahoro, D., Silvestri, S., & Rufino, M. C. (2013). The roles of livestock in developing countries. *animal, 7*(s1), 3-18.
3. Asresie, A., Zemedu, L., & Adigrat, E. (2015). The contribution of livestock sector in Ethiopian economy. *A Review Advances in Life Science And Technology, 29.*
4. Bahilu Bezabih, B. B., Abebayehu Aticho, A. A., Tadesse Mossisa, T. M., & Bayu Dume, B. D. (2016). The effect of land management practices on soil physical and chemical properties in Gojeb sub-river basin of Dedo district, southwest Ethiopia.
5. Feyissa, F., Assefa, G., Kebede, G., Mengistu, A., & Gelti, D. (2015). Cultivated forage crops research and development in Ethiopia. *Pasture and Rangeland Kesearch and Development, 89.*
6. Birhan, M., & Adugna, T. (2014). Livestock feed resources assessment, constraints and improvement strategies in Ethiopia. *Middle-East Journal of Scientific Research, 21*(4), 616-622.
7. Hazra, C. R. (2014). Feed and forage resources for sustainable livestock development. *Range Management and Agroforestry, 35*(1), 1-14.
8. Feyisa, T., Tolera, A., Nurfeta, A., Balehegn, M., Yigrem, S., Bedaso, M., ... & Adesogan, A. (2022). Assessment of fodder resources in Ethiopia: Biomass production and nutritional value. Agronomy Journal, 114(1), 8-25.
9. Dey, B., Notenbaert, A., Makkar, H., Mwendia, S., Sahlu, Y., & Peters, M. (2022). Realizing economic and environmental gains from cultivated forages and feed reserves in Ethiopia. *CABI Reviews,* (2022).
10. Abera, O. (2006). Indigenous common grazing land management in gamo highlands: In the case of Chencha Wereda. *South Ethiopia*, 13-20.
11. Fekade, M. (2019). Improved Forage Production in Ethiopia: Utilization, Challenges and Prospects for Adoption: A Review. *Journal of Biology, Agriculture and Healthcare, 9*(21), 5-11.
12. Mekoya, A. K. (2008). *Multipurpose fodder trees in Ethiopia: farmers' perception, constraints to adoption and effects of long-term supplementation on sheep performance* (pp. 207-pp).
13. Zenebe, M., & Mebratu, T. Assessment of Constraints and Farmers' Perception in Production and Marketing of Improved Forages in the Southern Ethiopia.
14. Bassa, Z., & Woldeamanuel, T. (2015). Value chain analysis of the cattle trade in Moyale, southern Ethiopia. *An economic assessment in Oromiya Regiona l State. IIED Country Report. IIED, London*.
15. Bezabih, B., Aticho, A., Mossisa, T., & Dume, B. (2016). The effect of land management practices on soil physical and chemical properties in Gojeb Sub-river Basin of Dedo District, Southwest Ethiopia. *Journal of Soil Science and Environmental Management, 7*(10), 154-165.
16. Tesfaye, M., & Tessema, L. (2023). An overview of the status, productivity and determinants of improved forage technology adoption in Ethiopia: a review. *CABI Agriculture and Bioscience, 4*(1), 47.
17. Feyissa, F., Kebede, G., Geleti, D., Assefa, G., & Mengistu, A. (2025). Improved forage crops research and development in Ethiopia: major achievements, challenges and the way forward. *OMO International Journal of Sciences, 8*(1), 14-42.
18. Gadisa, B., Dinkale, T., & Debela, M. (2019). Evaluation of desho grass (Pennisetum pedicellatum Trin) lines for their adaptability at Mechara Research station, Eastern Oromia, Ethiopia. *Journal of Ecology and The Natural Environment, 11*(3), 26-32.
19. Alemayehu M and Getnet A. (2012), "Evaluation of forage seed production in Ethiopia" In: Getnet Assefa, Mesfin Dejene, Jean Hanson, Getachew Anemut, Solomon Mengistu And Alemayehu Mengistu (eds), Forage seed research and development in Ethiopia. Ethiopian institute of agricultural research, Addis AbabaEthiopia. Pp 15-32.
20. Ekule, M., Wamatu, J., & Mengistu, S. (2022). Indigenous Forage Species Evaluation and Variety Development in Ethiopia: A Historical Perspective.
21. Capstaff, N. M., & Miller, A. J. (2018). Improving the yield and nutritional quality of forage crops. *Frontiers in Plant Science, 9*, 535.
22. Gebremedhin, B., Ahmed, M. M., & Ehui, S. K. (2003). Determinants of adoption of improved forage technologies in crop-livestock mixed systems: Evidence from the highlands of Ethiopia.
23. Assefa, F., Ano, T., Aba, T., & Ebrahim, Z. (2015). Assessment of improved forage types and their utilization in Shashogo Woreda, Hadiya zone, Southern Ethiopia. *Global Journal of Animal Science, livestock production and animal breeding, 3*(6), 227-230.
24. Bashe, A., Bassa, Z., & Tyohannis, S. (2018). The determinants of probability in improved forage technology adoption in Wolaita zone: The case of Sodo Zuria district, Southern Nations and Nationalities Peoples state of Ethiopia. *Open Access Journal of Science, 2*(4), 228-231.
25. Tesfaye, M., & Gutema, P. (2022). Impact of improved

forage technology adoption on dairy productivity and household income: a propensity score matching estimation in Northern Ethiopia. *Advances in Agriculture, 2022*(1), 6197119.

26. Mekonnen, K., Duncan, A. J., Kefyalew, D., Bekele, T., Wubet, A., & Amede, T. (2013). Enhancing communities' adaptive capacity to climate change in drought-prone hotspots of the Blue Nile Basin in Ethiopia.
27. Gebremedhin, B., Hoekstra, D., & Tegegne, A. (2006). C*ommercialization of Ethiopian agriculture: Extension service from input supplier to knowledge broker and facilitator*. International Livestock Research Institute.
28. Alemayehu M. (2006), "Country pasture/forage resource profiles, Ethiopia".
29. Gebreyohannes, G., & Hailemariam, G. (2011). Challenges, opportunities and available good practices related to zero grazing in Tigray and Hararghe, Ethiopia. Drylands Coordination Group (DCG) Report, 66.
30. Kebede, G., Assefa, G., Feyissa, F., & Mengistu, A. (2016). Forage legumes in crop-livestock mixed farming systems: A review. *International Journal of Livestock Research, 6*(4), 1-18.
31. Shiferaw, M., Asmare, B., Tegegne, F., & Molla, D. (2018). Farmers perception and utilization status of improved forages grown in the natural resource areas of northwestern Ethiopia. *Biodiversitas Journal of Biological Diversity, 19*(4), 1568-1578.
32. Addisu- Endalew, Firew –Tegegne, Getnet -Assefa (2016), "Constraints and Opportunities on Production and Utilization of Improved Forages in East Gojjam Zone, Amhara Region, Ethiopia: In the Case of Enebsie Sar Midr District". Journal of Biology, Agriculture and Healthcare. 6(9).
33. Adugna, T. (2008). Feed resources and feeding management. A manual for feed operators and development workers. Ethiopia sanitary and phytosanitary standards and livestock and meat marketing program (SPS-LMM). Addis Ababa, Ethiopia, 38.
34. Berhanu Gebremedhin; and Azage Tegegne (2006), "Improving Productivity and Market Success of Ethiopian Farmers Project (IPMS)". Commercialization of Ethiopian agriculture: extension service from input supplier to knowledge broker and facilitator. IPMS Working Paper 1. Nairobi(Kenya): ILRI.
35. Beshir, H. (2013). Factors affecting the adoption and intensity of use of improved forages in North East Highlands of Ethiopia. *American Journal of Experimental Agriculture, 4*(1), 12-27.
36. Central Statistical Agency (CSA). (2017). Agricultural sample survey. Volume II: Report on Livestock and livestock characteristics (Private Peasant holdings), statistical Bulletin 570.
37. Endalew, A., Tegegne, F., & Assefa, G. (2016). Constraints and Opportunities on Production and Utilization of Improved Forages in case of Enebsie Sarmidr District, East Gojjam Zone and Amhara Region, Ethiopia (Doctoral dissertation, Thesis. Woldia University, Woldia).
38. Heliso, M. F., Hibebo, D. K., Atumo, T. T., Tunkala, B. Z., & Dula, M. G. (2019). Evaluation of desho grass (Pennisetum pedicellatum) productivity under different fertilizer combinations and spacing at Gamo Gofa zone, Ethiopia. *Journal of Agriculture and Environmental Sciences, 4*(1), 50-59.
39. Mengistu, A. (2002). Forage production in Ethiopia: a case study with implications for livestock production.
40. Mengistu, A., Kebede, G., Feyissa, F., & Assefa, G. (2017). Review on major feed resources in Ethiopia: Conditions, challenges and opportunities. *Academic Research Journal of Agricultural Science and Research, 5*(3), 176-185.
41. Shiferaw, M., Asmare, B., Tegegne, F., & Molla, D. (2018). Farmers perception and utilization status of improved forages grown in the natural resource areas of northwestern Ethiopia. *Biodiversitas Journal of Biological Diversity, 19*(4), 1568-1578.
42. Thomas, D., & Sumberg, J. E. (1995). A review of the evaluation and use of tropical forage legumes in sub-Saharan Africa. *Agriculture, ecosystems & environment, 54*(3), 151-163.