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Evaluation of Multifunctional Fodder Bank Trees and Shrubs in Meskan Woreda Enseno Usma Kebele

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Abstract
Agroforestry is a system and/or practices which incorporates different component in the same piece of land to produce forage, crop product, wood product and so on. Forage is the major limiting factor in tropical specially, in Ethiopia, feed source is depends on natural grazing (green grass). This research is design to evaluate the biomass production potential and nutritive value fodder tree and shrubs during dry season, planted as protein band. The research was done in experimental plot of 26m*19.5m with 4m*4m plot size. Five fodder trees,**susbania sesban, Moringa stenopetala, Morus alba, Lucenia luecocephala** and **Azandritcha indica** were selected for experiment based on their adaptability to the area. According to the research **Sesbania sesban** had shows high growth rate having height of 0.67m and 2.84m in the first and the second years followed by **Lucenia luecocephala** with heght of 0.21m and 1.05m in the first and the second year respectively. Similarly, **Sesbania sesban** had provide high leaf biomass in dry season for animals followed by **Lucenia luecocephala** with 4.5kg and 0.87kg of biomass respectively. On the other hand **Morrus alba** had show low growth rate, in height, leaf number, no. of branch and root collar diameter, and leaf biomass production. **Azandritcha indica** had no survived that means all most seedling were died and the remaining were not grow for measurable size with respect to others. The leaf chemical composition of those fodder tree were analyzed in laboratory. Dry matter content of all analyzed species were not show any significant differenc b/n them. **Moringa stenopetala, Morus alba** and **Leuceana leucocephala** have show high in crude protein, mineral matter and calcium relative to others. Based on this study we concluded that those tree species like Sesbania sesban, Moringa steopetala amd leuceana leucocephala were can provide enough forage during dry season having good chemical composition. Then farmers can plant those species as fodder source in piece of land.
Keywords: Agroforestry, dry season, farmers, fodder bank, fodder tree, enseno usma

Introduction

The livestock sector is important in Ethiopia for economic development and for poverty reduction; the current government has given great emphasis to a market-led livestock development policy and has allocated a large budget for this (MORAD, 2004). In tropical Africa, trees and shrubs occupy a significant niche in the life of the people and have many functions, fodder, firewood, poles for building and fencing, live fence, fiber, fruits, spices, fats, medicines, dyes, and tannins (McKell 1980; Wickens 1980; Adegbola 1985). Most of these uses are exploitative and compete, either in the short or long term, with the supply of fodders by the trees and shrubs.

Subsistence farmers usually include trees as an output product of their farm, whether it is for wood, shade, soil conservation, or fodder (Zomer et al. 2009). Herders rely on fodder trees in the dry season because the foliage retains sufficient crude protein, minerals and energy due to the deep root systems of these species (Speedy and Pugliese 1992; Paterson et al. 1998; Upreti and Shresta 2006). In arid and semi arid zones like those of the Sahel, tree feed resources growing near villages, roadsides and communal lands contribute up to 80% of the protein during the dry spells (Speedy and Pugliese 1992).

The major constraint to ruminant production and poor performance of livestock during the dry season in the tropics is feed. **F**odder tree and shrubs are important components to provide adequate diet for livestock in areas where few or no alternatives are available fodder tree and/shrubs (Van *et al.,* 2005). It support livestock such as-cattle, sheep, and goats in the dry season through producing protein content. plant parts such as new flush of leaves, flowers and fruits often produced in the dry season are rich in proteins, vitamins and minerals Such plants have deep root systems enabling the extraction of water and nutrients from deep in the soil profile (Teferi *et al*., 2008). In many rural areas, the available grazing is not generally sufficient to meet the maintenance requirements of grazing animals during dry periods (Matlebyane *et al*., 2010). Many farmers grow fodder trees to feed their goats and confirm their significant impact on milk yields. Numerous experiments have confirmed the effectiveness of fodder trees in increasing the productivity of sheep and goats for meat production. Sheep gained 79–90 g day^{-1} in live weight from being fed *calliandra* in Kenya (E.M. Kiruiro,1999). *Calliandra* leaf meal is a potentially valuable substitute for soybean meal in compound feeds for feeding goats raised for meat production (C. E. bong, 2009).

Fodder tree helps farmers to adapt and mitigate climate change by modifying temperatures, providing shade and shelter and acting as alternative sources of feed for livestock during the period of drought (Dawson *et al,*. 2013). They helps to adapt the dry season by providing high-quality feed when scarce, having deep rooted, resistant to drought and they maintain high protein levels (S. Franze 2011). By improve livestock productivity

and reduce methane emissions per unit of output that helps reduce carbon emissions by substituting for commercially manufactured concentrates fodder trees are important for climate change mitigation (Shelton, 2000).

The livestock production is constrained crucially by the shortage of forage in the country in general and in dry lowlands in particular. Hence, the activity is initiated to provide an optional fodder development technology via fodder bank trees and shrubs.

Objective

- ✓ To assess the performance of fodder bank trees and shrubs
- ✓ To estimate nutritive values and animals' preferences
- ✓ To reduce uncontrolled grazing

Expected out put

The performance and nutritive value of multifunctional fodder tree and shrub are known and fodder bank tree and/or shrub are established

Methodology

Description of the study area

This study was conducted at the Meskan District in the area called Enseno-usme in Gurage Zone, SNNP Regional State, Ethiopia. This area is 18 km east away from the Woreda (the district capital) Butajira town, which is 133 km south of Addis Ababa. In terms of topography, Meskan Wereda has diverse topography that consists of plain (55%), sloppy (35%) and mountainous (10%).

Climate and soil resources

The position of ITCZ (Inter tropical Convergent Convergence Zone), that divides the humid tropical air mass to the south from the dry northeast, highly determines the climate of Ethiopia. As part of the land escapes of Ethiopia, ITCZ can influence climate of the study area. The study area receives the small rains in Ma rch to May and the big rains during June to September with higher concentrations of the rain observed in July and August. According to climatic record near the study area, the mean annual rainfall in the district is 1058 mm (National Meteorology Services Agency, 2005). The main crop-growing season begins towards the end of June and continues up to the end of October. The District has altitude ranging from 1800-3500 m asl. study areas, received highest temperature during February and March while coolest in November and December. The soils of the area may closely relate to their parent materials and their degree of weathering. The study area is geographically located in Central Rift Valley of Ethiopia. The main parent materials are basalt, ignimbrites, lava, gneiss, volcanic ash, and pumice (Zewdie, 2004; Itanna, 2005). According to FAO, (1996) the dominant soil types of Meskan district includes eutric Cambisols, chromic Luvisols, pellic Vertisols chromic Vertisols, eutric Fluvisols and Leptosols.

Dominant land use /cover of the study area

The population density of Meskan district is approximately about 250 people's km-2. The average land holding per household head is less than 0.5 ha, which is one of the main factors exerting a profound influence on land use/cover changes and land use intensification, resulted in severe land degradation in the area. Farmers own 2 or more fragmented plots of land and they practice diversified land use types to diversify their products and as risk aversion strategies. The major land uses land/ cover in the study area includes cultivated land, natural vegetation, grazing land, *Acacia albida* dominated parkland/scattered tree agroforestry system and plantation forest of exotic species mainly eucalyptus are the dominant land use/cover in the area. Eucalyptus *camaldulensis* is dominantly growing in Weyna dega agro ecological Zone, whereas Eucalyptus globulus is most common in dega agro-ecological Zone. The common annual crops grown in the areas includes wheat (*Triticum spp*.), teff (*Eragrostis tef*) and barley (*Hordeum vulgare*) and maize (*Zea mays*), and perennial crops such as enset (*Ensete ventricosum*). **Teff** is a fine stemmed tufted endemic annual grass to Ethiopia, used as main ingredient in the Ethiopian traditional flat bread called injera. Enset is a perennial, banana-like crop which native to Ethiopia that produces psuedostem and a starchy belly corm pulped for food, feed and fiber. Enset based land use is one of the dominant agricultural practices used for feeding about 13- 15millions people in the Central and Southern Highlands of Ethiopia [Tilahun and Mulugeta,2005].

Fodder banks: Fodder banks are particularly intense gardens of fodder trees and shrubs planted at high densities and managed to provide fodder either on a continuous basis or for a particular period such as the dry season (Mohamed Saleem *et al.,* 1986; Atta- Krah and Raynolds, 1989). Fodder banks can be grazed directly by livestock or in used cut and carry systems where stock numbers are low.

Research Design

The experiment of four exotic and one indigenous fodder bank trees and shrubs were be established in **middle land** with the randomized complete block design that having three replications. The experimental fields were laid down having the total area of 507m^2 with plot size 4m*4m. Each plot was contained 25 seedlings.

Treatments:

- T1 *Moringa stenopetala*
- T2 *Morus alba*
- T3 *Leucaena luecocephala*
- T4 *Sesbania sesban*
- T5 *Azadrachta indica*

Replications: Three

Data collected

Trees and Shrubs:

- Tree/Shrub height, diameter, crown length and width, crown area
- Branch diameter and branch number
- Leaf biomass/leaf fodder
- Leaf sample to estimate nutritive value

Statistical Analysis

The mean of four sub-samples tree species were analyzed for each fodder tree and shrub for DM, CP, MM and Ca were calculated to estimate nutritional value. The data were analyzed using analysis of variance in a group balanced block design (Gomez and Gomez 1984) and the means were compared by least significant difference (Steel and Torrie 1982).

Result and discussion

Growth characteristic of fodder tree

The growth characteristic of fodder trees the major component to evaluate feed production. Height, root colar diameter, number of branch and biomass of leaf were parameters that were used to measure the growth characteristics of evaluated fodder tree.

The height all experimental fodder trees were measured and recorded to compare in the two years. Then, the range of height was lies b/n 13.7-67 cm in the first year and 30.8-283.7cm in the second year. *Susbania susban* is the outstanding fodder tree from others in the two year according to measured parameters. It shows very fast with the average height of 67 cm and 283.7 cm in the first and the second year respectively. The lower height was in the two attained *morus alba* 13.7 and 30.8cm respectively.

When we see the others, they have approximately the same growth performance in the first year and have significance difference on the second year. *Moringa stenopetala* and *Morus alba* shows significantly lower in their growth compared to the other two. *Susbania susban* still shows highly significant from the other in the second year. Similar results have show on other parameters that attain significantly higher in branch number and leaf biomass at second year. On the other hand, leaf number in first year and root collar diameter in the second year does not show significant difference among the fodder tree species. In general, susbania susban have best performance over other. *Morus alba* is significantly lower than other in most parameters at the second year, height, branch number and leaf biomass.

Leaf biomass is an important part of fodder tree/browses species to quantify the amount of feed or forage they produced.

	First year		Second year			
Species name	height	leaf	height	branch number	leaf biomass(kg)	RCD(cm)
Susbania susuban	67±19.9a	16.5±2.9	283.7±28.4a	5±0.6a	4.50±0.7a	3.48±0.6
Moringa stenopetla	22.1±2.2b	3.2±0.2	47±4.9c	2±0.01c	0.46±0.2b	1.08±0.4
Lucenia luecocephala	21.9 ±7.5b	5.7±1.6	105±12.6b	3±0.6b	0.87±0.1b	1.13±0.1
Morus alba	13.73±4.3b	2.3±0.7	30.8±9.2c	1±0.01d	0.18±0.1c	2.02±2.9

The leaf number count done to know their difference in accordance with leaf production this because of the leaf help to measure the biomass of tree that use as fodder. As we have see below fodder trees show a significance difference on leaf no. of 16. Susbania susban have show highly significance difference from others all i.e. *moringa stenopetala, morus alba* and *lucenia luecocephala* have no significance difference among them.

The present study also agree with the research done in Botswana on three different fodder tree, *Acacia galpinii, Feidherbia albida, Leuceana leucocephala* and *leuceana divesifilia*, and the research done in Kenya on three fodder trees, *Calliandra calothyrus*, *Sesbania sesban* and *Leucaena leucocephala.* According to Keitirele (2007), the foure species have no significance difference in their growth rate the first 6(six) month but there

highly significance difference after 2.5 (two and half) year. *Acacia galpinii,* which is native to the area have high performance 5.86m and 6.08m at high density and low density respectively. Similar work was done in Keneya highland area that compared more promising fodder tree, *Calliandra calothyrus*, *Sesbania sesban* and *Leucaena leucocephala.* According to this work, the first two fodder tree species have poor performance and *Leucaena leucocephala* have provide produced excellent fodder (Pye-Smith C., 2010).

The crown coverage of fodder tree

The crown of tree can predict the biomass of tree provide for fodder, fuel wood and others. According to this study still *susbania suban* have significantly higher crown width and crown diameter followed by *leucaenia leucocephala* (table)

		Means of crown width and diameter in centimeter	
species	N	crown width	crown diameter
Leucaena luecocephala	3	44.85±7.28b	35.96±6.51b
Moringa stennopetala	3	22.8±1.14c	24.87±16.51bc
Morus alba	3	12.72±3.37c	12.04±1.28c
Sesbania sesban	3	122.92±10.14a	103.78±8.75a

Steinmueller (1995) has evaluated the performance of *Sesbania sesban* in three locations of the Ethiopian highlands (semi-arid, subhumid and sub-moist central highlands). The three-year experimental output indicate that *Sesbania Sesban* is provide product under vertisols and saline soils of the highlands above 2000 m a.s.l. *Sesbania sesban* have an advantages of high cold tolerance, adapted to water logging, high nutritive value, and easy establishment through both seedling and direct sowing.

Chemical composition of fodder tree species

Trees and shrubs are increasingly recognized as important components of animal feed, fodder tree leaves were found to be rich in protein, soluble carbohydrates, minerals and vitamins, and showed great potential as an alternate feed resource (Bakshi and Wadhwa, 2007; Atiyaazim*et al.,* 2011). Especially were found more profitable during alternative options were expensive (Hamer *et al.,* 2007). This is due to their deep root enables to maintain high protein especially during the dry season (Wambugu*et al.,* 2011).

Average nutrient composition profile of fodder trees derived from laboratory analysis shown below in Table. The most important aspect of fodder trees as a source of feed for farm animals is the high protein content, which ranges from 14-29%. According to the present study, the crude protein (CP) content of individual samples of fodder tree in the study area was ranges from 21.11 to 40.75%. The highest CP content was found in *Moringa setnopetala* followed by *Susbania susban* and *Leuceania leucocephala* and the lowest was recorded in *Morus alba.* This is unusual because most scholars reveal that *Leuceania leucocephala* the most known protein fodder plant among browse species.

		Nutrient content of fodder trees (%)			
treatment	N	dry matter	mineral matter	crude protein	calcium
Leuceana leucocephala	3	95.28±1.52	14.91±2.10b	28.45±2.97ab	4.49±1.27
Morus alba	3	94.86±0.04	22.41±0.73a	21.22±2.77b	3.87±0.46
Moringa stenopetla	3	96.06±1.09	13.43±0.82bc	40.75±2.09a	3.011±3.01
Susbania susuban	3	94.95±2.56	9.37±3.58c	33.61±8.90a	3.35±0.83

Fodder legumes are also an important source of minerals such as sulphur, calcium, copper and iron even though they have been shown to be a poor source of manganese, zinc and phosphorous. *Moruas alba* have highest mineral matter content followed by *Leuceania leucocephala* and the lower mineral matter recorded on S*usbania susban*.

Dry Matter (DM) is the actual amount of feed material leaving water and volatile acids and bases if present. On other hand, dry matter and calcium have no significant difference among species but *Moringa stenopetala* and *Leuceania leucocephala* have advantage over others respectively.

These tree leaves have the ability to greatly increase growth rates and milk production, because they have high levels of protein. An average herd of dual-purpose cattle needs a ration of about 11-12% protein. Local grasses have about 6% in the rainy season and 4% in the dry season. Leaves of the Leucaena tree have about 27.5% protein, high levels of Vitamins A and D, and are palatable to the animals (National Research Council, 1984).

Conclusion and recommendation

This research is design to provide feed shortage solution for farmers in dry season. Therefore, based on the result we concluded that the evaluated fodder tree species, *Sesbania sesban*, *Moringa stenopetala* and *Leuceania leucocephala* have potential to provide enough biomass for livestock. According to their chemical, they can

provide enough nutrients for livestock. As result, those species were recommended for feed source of livestock in the study area and other related agro ecologies.

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