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## Review of Multipurpose Fodder Trees and Shrubs of Different Agroforestry Practices of Ethiopia

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### Abstract

Agroforestry is a dynamic, ecologically based natural resources management system in which trees and/or shrubs are grown in association with agricultural crops, pastures or livestock either simultaneously or sequentially on the same unit of land. Shortage of feed supply in terms of both quantity and quality is the main constraint limiting the realization of exploitation of the full potential of the livestock resources. Fodder tree and shrub have always played a role in feeding livestock. They are increasingly recognized as important component of animal feeding; especially as supplies of protein in different parts of developing countries. In Ethiopia different scholars reported the importance of these fodder species at different time. In generally fodder trees have ecological and socioeconomic advantage to the society. To sustainably utilize these resources there should be management, conservation and standard tending systems.

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Agroforestry, fodder, animals, protein.

### Introduction

The existence of different trees and shrubs has a great potential for further development and the introduction of new Agroforestry systems and practices for human being so as to feed animals as fodder and for companion crops to increase the fertility of soil.

However, many and diverse Agroforestry practices that exist in Ethiopia doesn't represent an exhaustive list of systems and practices with diversity data (Yirefu *et al.*, 2016). Fodder trees/shrubs as one component of agroforestry practice can be diverse in certain landscape or farm land. farmers use these to overcome the shortage of feed, trees are pruned to feed animals and enhance fructification, and thus are a sort of food "storage", as

branches can be pruned when an especially dry summer appears (Etefa *et al.*, 2014).

Farmers in Africa have fed tree foliage to their livestock for centuries, by using wild browse or trees that grow naturally on their farm. However, new agroforestry systems for feeding livestock involving the planting of mostly exotic species, grown most frequently in hedges along field boundaries or along the contours to limit soil erosion and other ecological roles were widely grown in the East African, countries like, Kenya, Uganda, Tanzania and Rwanda, Ethiopia, Malawi and Zimbabwe and others primarily by dairy farmers (Franzel *et al.*, 2014). Different fodder tree/shrub species were reported by different scholars in agroforestry systems in Africa. As reported by Franzel *et al.*, (2014) in an area of eastern

Kenya ranging from sub-humid to semi-arid, it was identified 160 species that farmers used for fodder. Farmers' most preferred species were *Triumfetta tomentosa* Bojer ex Bouton, *Aspilia mossambicensis* (Oliv.Wild) and *Melia volkensii* Gürke. Most were scattered in crop land field as Parkland agroforestry practice and others appeared as a live fence.

For instance, in the Central Rift Valley of Ethiopia, the natural vegetation is mainly made up of *Acacia* dominated woodland, a highly fragile ecosystem adapted to semi-arid conditions with erratic rainfall, growing on a complex and vulnerable hydrological system. *Acacia* species serve as fodder for livestock as that of *Grewia mollis* (Juss.). They are most commonly utilized fodder tree species in the Rift Valley of Ethiopia (Abule, 2003; Hengsdijk and Jansen, 2006; Garedew *et al.*, 2009; Yemenezwork *et al.*, 2017). *Sesbania sesban* (L. Merr.) is the most important planted fodder tree in Ethiopia, and is generally grown in Homegardens (Hess *et al.*, 2006).

According to Belete *et al.*, (2012) most widely utilized browse species in central rift valley of Ethiopia are *Acacia tortilis* (Forssk.), *Balanites aegyptiaca* (L.), *Ficus gnaphalocarpa* (Miq), *Olea europaea* L, *Grewia bicolor* A. and *Dichrostachys cinerea* (L.). According to Fekadu (2009), *Rhus natalensis* Bernh C., *Bauhinia farea*, *Grewia ferruginea* Hochst, *Acacia seyal* Delile and *Deinbollia andscharica* (Taub.) are the common browse in the Gembella region.

Kindu *et al.*, (2006) reported 29 indigenous fodder tree species that are either planted or remnant on the field. Southern Ethiopia is among the remaining and most important niche for many kinds of indigenous plant species (Guinand and Lemessa, 2000).

There are fodder tree and shrub species in southern Ethiopia as reported by scholars in different land use. Takele *et al.*, (2014) identified 28 indigenous multipurpose fodder tree species having good fodder potential for supplementation to fill the gap feed scarcity and result to better animal productivity in Wolayta. Species in the authors list include *Acanthus pubescens*, *Buddleja polystachya* Fresen, *Celtis africana* Burm.f, *Clausena anisata* (Willd.) Hook.f. ex Benth, *Maesalanceolata* Forssk. *Combretum molle* R.Br. ex G.Don, *Cordia africana* Lam., *Dovyalis abyssinica* (A. Rich.), and *Erythrina abyssinica* (DC). *Erythrina brucei*, *Vernonia amygdalina*, *Ehertia cymosa*, *Cordia africana* and *Dovyalis abyssinica* which are among the fodder tree/shrub species in Wolayta are the potential source of

crude protein to supplement poor quality roughages to fill the gap especially in dry season (Takele *et al.*, 2014). This review is aimed to show the overview of the Importance of fodder trees and shrubs in agroforestry system of Ethiopia.

### Importance of fodder trees and shrubs in agroforestry system of Ethiopia

Interest in the use of tree/shrub legumes in agroforestry systems and livestock feeding systems offers promise for meeting the increasing demand for feed resources in worldwide. This is reported in number of literatures (e.g. Lefroy *et al.*, 1992; Shelton, 2000; Maselli *et al.*, 2011; Lira *et al.*, 2017) are outstanding examples particularly those providing fodder for livestock. This is because these species have a number of distinctive features and uses which set them apart from other trees that might be used in agroforestry.

Legumes fodder tree species in agroforestry have considerable potential in mixed crop livestock production systems, to supplement low quality feeds (Simbaya, 2002; Chriyaa, 2009), fix atmospheric nitrogen (Roshetko *et al.*, 1996), and provide, timber and firewood and shelter and to help in soil and water conservation to prevent degradation-rich mulch for cropping systems.

Moreover, the ability of most browse species to remain green for a longer period is attributed to deep root systems, which enable them to extract water and nutrients from deep in the soil profile and this contributes to the increased crude protein content of the foliage in livestock feed shade trees for plantation crops, and living trellises for climbing crops, and fruit and vegetables for human consumption (Le Houérou, 1980; Gutteridge and Shelton, 1993).

The mid and south Rift Valley of Ethiopia has mixed crop-livestock production systems with livestock production being dominated by the semi-arid to arid climatic conditions. Browse species can make a large contribution to livestock nutrition as they depend on such species during dry season (Belete *et al.*, 2012). It is obvious that trees in agroforestry have two or more function that is why we call them multipurpose trees.

According to Solomon (2003) the ecological and socioeconomic functions of diverse multipurpose fodder tree resources are crucial in safeguarding the quality of people's lives, providing support for national economies

in general and farmers or household in particular and protecting the environment as well.

### Ecological role of fodder trees and shrubs

Trees and shrubs either in natural setting or agroforestry can be used for Wind protection, protection from animal entry, and shade for crops animals and human, soil erosion control, soil enrichment and many others are ecological role of tree/shrubs. These benefits do not negate for multipurpose fodder trees and shrubs. Fodder Tree/shrub species in agroforestry provides various ecosystem services like soil conservation, watershed protection, pest control and sinks for atmospheric carbon and thereby contributing to the mitigation of climate change (Jose, 2009; Jose and Bardhan, 2012). Some of the ecological role of fodder tree and shrubs farmers could let to grow or plant in his farm or homestead are reviewed in section below.

### Windbreaks/shelterbelts

Fodder trees like other tree and shrub species can be windbreak in certain agroforestry setting. Windbreaks and shelterbelts are tree plantings with a single or multiple of trees and shrubs which are established in a variety of settings, like rangelands, cropland, roadside, in agroforestry for various objectives. Like protecting crops from physical damage, managing the effects of snow, by improving the efficiency of irrigation, and protect crops and pastures from drying winds, nitrogen fixing, increasing the productivity of agricultural crops in an organic way and by resulting higher yields, protect livestock from cold or hot winds by providing shelter (Richard and James, 2007; Jai, 2010; UM, 2012; Molla, 2016).

*Faidherbiaalbida* in Rift valley of south Ethiopia is one of the dominant tree species on farmlands in dry land ecosystem. The species used mainly for fodder, provides fuel wood, prevents soil erosion and promotes biodiversity. Apart from its unique reverse phenology of shedding leaves during the rainy season, it improves the soil structure, stability and permeability, thus providing microenvironment favorable for crops and animals by

protecting from wind blows in agricultural field (Adamu, 2012).

### Fodder tree/shrub species for soil enrichment

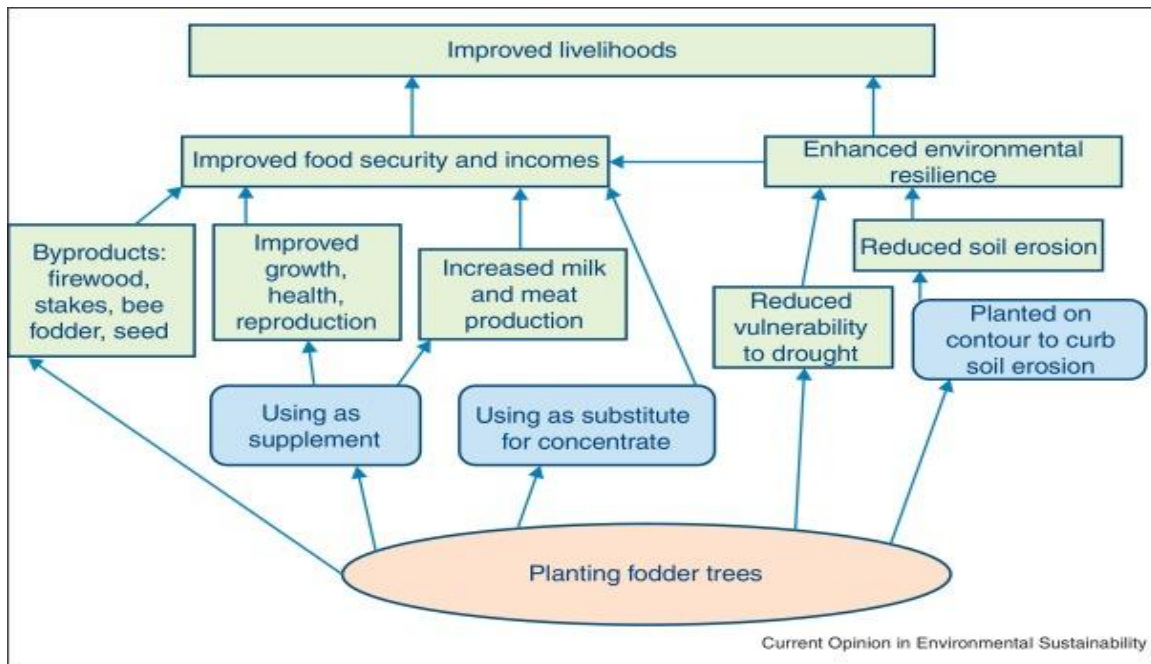
In addition to their role as animal feed, fodder tree/shrub species in agroforestry systems also have a great potential to increase nutrient levels in the soil (Pinho *et al.*, 2012).

There are evidences that show the trees have ability to enhance the physicochemical characteristics of soil. For example, according to Mugunga and Mugumo (2013) Soil pH, Soil N, SOC, and  $Ca^{2+}$  improved significantly under the canopy probably due to the presence of *Acacia sieberiana* trees which is potential fodder species. The potential fodder trees like *Erythrina abyssinica*, *Croton macrostachyus* Hochst and *Markhamia lutea* are reported as soil improvers which positively affect soil fertility from Uganda (Muzoora *et al.*, 2011).

It was reported by Adamu (2012) that *Acacia* improves the soil structure, stability and permeability either in agricultural or grazing land where the tree is grown, because of the highly decomposable leaf and pod in southern rift valleys of Ethiopia. Since this is a dry area where pasture is scarce, this tree species is the most suitable substitute as fodder species in livestock production. Tree/shrubs are intercropped with maize, cowpeas, beans and green grams with minimal competition for the water and nutrients. As reported by Luvanda *et al.*, (2016) the conservation of *F. albida* is limited by its perishable wood and susceptibility to pests and diseases which attack the tree. Therefore, it is recommended that local communities are encouraged to domesticate *F. albida* for improved livestock fodder needs.

Generally, legume tree and shrubs in agroforestry systems are important for Agro-ecological sustainability. Their capacity to support microbial  $N_2$  fixation can increase soil nitrogen (N) availability and other nutrients and therefore improve soil fertility, crop yields, and support long-term stewardship of natural resources (Rhoades, 1996; Nekesa *et al.*, 2007; Rosenstock *et al.*, 2014).

Fig.1 Socioeconomic importance of fodder tree/shrub species



(Source: Franzei *et al.*, (2014))

### Fodder tree/shrub species for soil water conservation

Vegetative barriers planted on the contour control soil erosion and provide organic material and nitrogen for the subsequent crops as well as fodder for livestock. Soil and water conservation through tree planting for water harvesting and soil fertility improvement is common drivers to planting or letting to grow of trees in the landscape of Ethiopia (Hachoofo, 2012).

### Fodder tree/shrub species for shading

One of the main components of agroforestry is Shade trees, which provide shade for crops and animals underneath; they modify radiation and wind regimes as well as other roles and productivity of agroforestry systems are influenced by intensity and distribution of shade (Rice and Greenberg, 2000; Zuidema *et al.*, 2005; Isaac *et al.*, 2007). Available fodder tree and shrub may be used for shading purpose. According to Takele *et al.*, (2014), fodder trees and shrubs can be used for shade for animals and humans, sustain agro-ecology; use to treat animal diseases in south Ethiopia.

### Socio economic role of fodder trees and shrubs

Fodder trees and shrubs as one of agroforestry component can have so many social and livelihood

benefits. Fodder trees contribute to improve livelihoods in various ways, as discussed in figure 1.

The diverse species in agroforestry practices like Home garden and Parkland have a wide socioeconomic roles including production of food and a wide range of other products such as firewood, fodders, spices, medicinal plants and ornamentals (Unofia *et al.*, 2012). Similarly socioeconomic functions of fodder tree and shrub in agroforestry systems and practices are all equally decisive in ensuring the quality of people's lives, providing support for national economies in general and farmers or household in particular (Solomon, 2003).

There were different socioeconomic roles of trees in agroforestry generally and fodder trees/shrubs particular were reported from different parts of glob. For instance, It was reported by Kiptot and Franzel (2012), as farmers engaged in fodder production (*Calliandra calothyrsus*) in the high potential areas of eastern Africa used leaf meal for sale to other farmers as a fodder supplement. It was also stated that *Leuceana leucocephala* producers, collect from the wild and then dry and crush the leaves into leaf meal sold to stall-fed dairy and poultry enterprises (Franzei *et al.*, 2007).

Access to home grown fodder and availability of firewood from the pruning, live fence against livestock

and wild animals, beauty of the soundings, reduction costs and offer multiple benefits and other socioeconomic and ecological roles would also improve the welfare of poor and women (Kiptot *et al.*, 2014). According to World Bank, FAO and IFAD (2009) women are known to be principal agroforestry practices such as domestication of indigenous fruit trees and production of dairy fodder for animals.

The other example is that it was reported by Abebe *et al.*, (2008) as the sale of products such as timber, fuelwood and fruit of fodder species serves as supplements in Ethiopia by contributing income sources for poor households. The authors for example mentioned that *Sesbania sesban* is a potential protein supplement fodder species for security of livestock and provides other socioeconomic importance (eg fuel wood, boundary/live fence etc) for smallholder farmers in the Ethiopian highlands.

In crop production from the agroforestry practice (multipurpose tree) in Europe were very important to sustain the system because in addition to providing a cheap feed resource for animals when grass is not available trees provide fuel wood, timber and even traditional medicines (Cañellas *et al.*, 2007). Thus low-cost system nature of Agroforestry conveyed minimal inputs and offers a diversity of products and services such as fodder, food, timber, fruits and Poles for construction, it offers immense opportunities to women who in most cases cannot afford to adopt high cost technologies due to their severe cash and credit constraints (Wambugu *et al.*, 2007).

Generally in addition to boosting animal products like milk production, meat there were other socioeconomic benefits from fodder trees and shrubs include improved animal health, fuel wood, timber, improved nutrition of the family (food), seedling sales, high quality manure, bee forage, fuel wood, poles and stakes for vegetable production (Franzel and Wambugu, 2007).

The multipurpose fodder trees (MPFTs) are woody perennials grown for several functions (for example, shelter, shade, land sustainability, erosion control, carbon dioxide and methane sinks and biodiversity) within the land-use system. So in broaden sense agroforestry, particularly fodder trees (multipurpose fodder trees) in agroforestry systems have Ecological, Nutritional and Socio-Economic functions such as controlling erosion, contribute to human quality of life, provide sinks for carbon dioxide and methane at the interface between the

decaying fallen leaves and the soil and are a source of biodiversity, animal productivity enhancement. Due to their multiple roles there should be careful management, conservation and experimental researches on their suitability.

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