

# Management and Environmental Contribution of Woody Species Diversity Parkland Agroforestry System in Ethiopia

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**Abstract:** Parkland agroforestry practices have placed greater emphasis on improving the climate, improving fertility, protecting water, and improving biodiversity. The objective of this paper is therefore to review the management and its ecological contribution to the diversity of wood species in agroforestry in Ethiopia in parklands. The practice is known by growing isolated trees on arable land by incorporating annual plants; that preserves biodiversity. Parkland agroforestry, a system practiced by many local populations, encompasses most of the agricultural landscape in Ethiopia and is very important in several aspects such as: for food security, microclimate improvement, economic benefits, environmental protection, household energy, household appliances, cultural values, traditional medicine and animal feed. There are many indigenous multipurpose tree species scattered across farmland in Ethiopia, and some of the most popular include: *Millettia ferruginea*, *Cordia africana*, *Ficus vasta*, *Ficus sur*, *Croton macrostachyus*, and *Faidherbia albida*. Parkland tree management is a process for controlling arboriculture competition in agricultural fields, so the selection and management of the species involved affects the success of the system. Management of the trees is essential to ensure the continued return of mulch or leaf forage and light shade through the use of heading, pruning and pruning measures, which should be done in early summer.

**Keywords:** Management, Diversity, Parkland, Environmental Contribution

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## 1. Introduction

Agro-forestry is outlined as a dynamic, environmentally-based resource management system that, by group action trees into cultivable land and pasture, diversifies and sustains production so as to extend the social, economic and environmental edges for land users the least bit levels [31]. key reason for the employment of agroforestry land use systems is that the domestication of soil-improving trees to extend soil productivity through a combination of selected trees and food crops within the same field [27]. Isolated trees that are full-grown in cultivable land characterize an outsized a part of the Ethiopian agricultural landscape and are the predominant agroforestry within the semi-arid and sub-humid zones of the country [30].

Parklands Agroforestry is characterised by well-grown isolated trees on cultivated and of late fallow land [19]. This method is additionally called a litter tree. These park landscapes arise once cultivable farming becomes additional permanent on a bit of land. The trees are wide scattered so

they are doing not contend with their neighbors. Piece of land trees have the subsequent properties: they need deep roots and preferentially reach the geological formation [51]. They need the power to mend nitrogen. Manufacture litter that decomposes well and add the maximum amount to the soil organic matter as potential. Parkland agroforestry, a system practiced for several native populations, is extremely vital for food security, microclimate improvement, financial gain generation and environmental protection and is found in several corners of the globe, primarily within the semi-arid and subhumid zones of Africa [14]. [30] reported that agroforestry is Associate in Nursing ancient observe within the Ethiopian agricultural systems, of that piece of land trees form up most of the agricultural landscape, and it's additionally the foremost dominant agroforestry within the semi-arid and sub-humid zones of African nation. Piece of land trees are used to fulfill menage wants and demands. A number of the most roles they play include: heating, cooking, menage appliances, cultural values, providing spore and nectar for honey production, building homes and handles

agricultural implements [42], ancient drugs [13, 18], economic edges, feed values, employment opportunities, and contribution to regional and national economies [1]. Standard agroforestry practices in piece of land systems facilitate conserve multifariousness through in place conservation of tree species on agricultural land, reducing pressure on remaining forests, and providing appropriate habitats for a spread of plant and animal species on agricultural land [24, 7, 34, 3]. This diversity can create agroforestry additional property and productive and can facilitate preserve native multifariousness by serving to farmers create selections and serving to them with their bread and butter strategy [4]. In the highlands of Eastern Ethiopia, for instance, the existence of tree albida on cultivable land will increase the yield of maize (*Zea mays* L.) and sorghum (*Sorghum bicolor* L. Moench) plots beneath tree albida mulch and also the plots within the open; a median increase in harvest yield of fifty six percent was found [43]. Different studies in southern country, in parklands with karite (*Vitellaria paradoxa*) and nere trees (*Parkia biglobosa*) showed higher soil fertility (organic matter and potassium) and soil wetness and lower daylight intensity than the center field. Grain and biomass production was higher at the sting of medium-sized karitic crowns than either beneath the capitulum or at a medium distance between the trees. Millet production may be improved a minimum of within the short term by pruning the crown of those trees [9]. Likewise in keeping with [28] in southern Burkinafaso, temperature changes and soil fertility of nere (*Parkia biglobosa*) and karite (*Vitellaria paradoxa*) might outweigh the negative impacts of those tree species on shade on millet (*Pennisetum glaucum*) production. The objective of the study was to review the management and environmental contribution of the wood species diversity of the agroforestry system in parklands.

## 2. Literature Review

### 2.1. Concept of Parkland Agroforestry System

A parkland agroforestry practice is that the constant existence of well-grown trees unfolded in cultivated or late ploughed fields [53]. Parklands, conjointly called scatter trees in farmland, square measure a awfully common reasonably agroforestry system within the tropics on cultivated and late fallow land that's developed as a results of tillable farming [44]. Agro-forestry is that the art and science of growing woody and non-woody plants along on identical unit of land for a profit [38]. It's the applying of land for the mixture of agriculture and biological science. In alternative words, the follow is to grow agriculture or alternative quick growing trees alongside the most crops. It's conjointly one in every of the vital property land management strategies that involves a combination of assorted agricultural, husbandry, forestry, and placental mammal farming practices [17]. The role of agroforestry in achieving the aims of protective diversity has gained increasing attention in recent years [40]. In tract practices, the most objective of the employment of

agroforestry systems is that the domestication of hand-picked trees to boost soil productivity through a combination of hand-picked multi-purpose trees and food crops on identical farmland [47].

### 2.2. Woody Species Diversity of Parkland Agroforestry System in Ethiopia

Diversity is one in every of the foremost vital community attributes, encompassing primarily two completely different aspects of vegetation; Species richness and uniformity accustomed calculate species richness [54]. Species richness is that the variety of species in an exceedingly given space and is that the simplest live of diversity and doesn't take into consideration variations within the relative abundance of species. The relative abundance in an exceedingly community is that the relative abundance of species to any or all species or a good distribution of individual species [54]. Numerous studies on tree species diversity in parkland agroforestry have been carried out in different locations in Ethiopia. For example, a study in the Abreha Weatsebeha watershed of the Tigray region, which yielded 1.12 and a result of 2.43 and 0.31 of the Shannon diversity or flatness, one in the Rift Valley near Beseku, Arsi Negelle, conducted study that reported a Shannon diversity of 2.22 and a flatness of 0.64 [50]. Additionally, [16] found 570 and 420 trees per area unit, severally in Dirama and Dobi of Meskan District, [26] on a study conducted at Tigray region recorded fifteen tree species on croplands, [21] found seventy seven tree species on farmlands on the study conducted at semi-arid east Shewa, [25] rumored on sixteen tree species on parklands of Hawassa zuria, [50] recorded thirty two tree species on tillable land on Arsi Negelle and plenty of a lot of. This complained that the operate of agroforestry systems in park landscapes with relevance the preservation of diversity is extremely vital and is very relevant for the preservation of native tree species.

Trees found in agricultural fields don't produce forests [6], however they are doing contribute to landscape- based diversity [15], as is that the case in most components of Federal Democratic Republic of Ethiopia. Specific properties of tree species square measure vital for the choice of the species to be planted on the tillable land in line with sure criteria, that vary between quality, drought resistance of the species, compatibility with cultural parts and therefore the capability to boost soil fertility [8, 46]. The selection is additionally influenced by a mixture of biophysical factors and social goals [33]. Additionally, it rests on home characteristics, ethnic variations within the population [14] and native perceptions of the values of trees. In general, however, multi-purpose trees (multi-purpose trees square measure those species of tree that square measure adult to supply over one important product or service that square measure practiced on the farmland) [44] square measure usually hand-picked as a result of they'll meet multiple needs whereas investments square measure low overall [16]. In general, the Ethiopian tract includes exotic and native trees, of that the common native tract trees on farmland include: tree *Ferruginea*, *Cordia africana*, *Dicot genus vasta*, *Ficus*

*sur*, *Croton macrostachyus*, and *Faidherbia albida*, that vary in density and neck of the woods looking on factors, and

beneath numerous management choices in order that it contributes to the cereal crops below.

**Table 1.** Diversity of woody species in parkland agroforestry.

Place of study	Shanno diversity	Species richness	Evenness (j)	Names of authors
Arbegona District, highlands of Southern Ethiopia	2.25	108	0.58	Muktar Reshad 2006
Libo kemkem Zone, Ethiopia	2.53	34	0.9	worku Melese 2017
Semi-Arid West Africa, Burkina Faso	1.947	56	0.856	Nikiema 2005

Source: Melese W (2017) Woody Species Diversity of Parkland Agroforestry in Ethiopia.

### 2.3. Environmental Contribution of Parkland Agroforestry System

In addition to maintaining diverseness, trees area unit vital on farms for his or her role in ecological or ecological conservation. In several parts of the planet, analysis has indicated that some scattered trees / shrubs in ancient agroforestry land use systems improve soil fertility, improve the microclimate, maintain soil wetness, and conjointly improve the yields of the crops below. Planting multipurpose trees to extend soil productivity through a combination of hand-picked trees and food crops on cultivable land is one amongst the motivations for active parcel of land agroforestry [37] that could be a nice example of ancient land use systems for defense of diverseness. Agroforestry systems like tree species scattered on farmland even have the power to take care of diverseness whereas promoting agricultural production [29] and may be used to extend resilience to temperature change [35] in reducing the natural surround. Therefore, parcel of land systems play a positive role within the conservation of diverseness by providing perennial surround for species, the conservation of germplasm for sensitive species, corridors between surround remnants that area unit required for the conservation of area-sensitive plant and animal species, and conjointly for erosion management and water quality used protection [52]. Part Interaction in parcel of land Agroforestry normally, the interaction between farming and therefore the elements of eutherian will be positive, negative, or neutral. Within the case of complementary results, this leads to a rise within the catch of a limiting resource and a bigger total production than if the two elements had been adult one by one. If the two elements overlap in their resource consumption, negative interactions will cause competition and so lower productivity than if the elements area unit adult one by one. wherever there are not any direct interaction between system elements, information superhighway impact of their combination is neutral [47], normally true of the part interactions of agroforestry practices in parklands is given within the following sections: Microclimate balance and animal welfare - trees balance microclimatic conditions like temperature, water vapour content and wind speed, which might have a positive impact on plant growth and animal welfare [21].

The decrease in wind speed will be thirty times the peak of tree belts on the to leeward [12, 44]. The wind speed will be reduced attributable to the existence of trees on cultivable land, that function wind protection and protection belts. The ensuing

reduction in wind erosion effects will have many advantages for crops, together with exaggerated rate of growth and quality, protection from wind-blown soils, wetness management and soil protection, in distinction, the acute temperatures and wind speeds negatively have an effect on agricultural production and forest resources on farms and therefore the same is true for animal resources [32]. Multipurpose tree species on cultivable land even have multifunctional examples. Trees give resources for animals like the variety of fodder resources; it offers protection from rain and wind in addition as shade from the sun that is primarily the case in semi-arid and arid areas. Trees provide resources for animals such as the diversity of fodder resources; it offers protection from rain and wind as well as shade from the sun, which is primarily the case in semi-arid and arid areas.

Pest and unwellness management - Fewer gadfly issues were found in agroforestry systems than in monoculture systems attributable to bigger niche diversity and quality [22, 23]. This could be ascribed to many mechanisms [49]. The various distributions of the host plants make it troublesome for pests to seek out the plants. A species of plant that's terribly enticing to pests will act as a lure crop and defend close valuable species from animate being attack. A species of plant that repels pests also can deter them from others. The presence of high interspecies competition between gadfly and non-pest species is meant to limit the unfold of pests. With a manageable arrangement of the agroforestry elements, the systems may lead to bigger structural and microclimatic diversity, increase stability, and produce a lot of biomass and stable refuge areas for useful insects [52, 2].

Negative interactions in components of agroforestry the components (perennial tree crops and livestock / pasture) in agroforestry in parklands overlap in terms of their resource use (nutrients, water and light) and then compete, resulting in a reduction in the output of the components compared to a monoculture farming system. The competitive situation for the respective resource varies from region to region, for instance in northern temperate regions the most important limiting resource for plants is usually light and studies have demonstrated that shading has reduced yields in temperate agroforestry systems [25, 39] and also the competition for water between tree and plant components will likely reduce productivity in semi-arid regions, although it is hard to separate the competition for water from that for nutrients [29] and in fact, reduced evapotranspiration owing to tree shade impacts on understory plants can increase the soil water content compared to open pastures [39]. Completion between

plants and microorganisms is also common in component interaction systems, although this is the overlooked area in agroforestry. Chemicals that affect germination, growth, development, reproduction, and spread of other organisms, these allelic chemicals can be released into the rhizosphere via plant root exudates [29]. Preservation of biodiversity as a component interplay of agroforestry park landscape - agroforestry is one of the sustainable methods to land use management, in which both agriculture and forestry are combined into an integrated production system in order to achieve maximum benefit; Accordingly, the conservation of biodiversity is one of the positive impacts of the ecological interaction among the components of agroforestry in parklands. Agro-forestry helps reduce biodiversity loss by providing a protective canopy of trees along agricultural fields. The existence of trees further increases diversity by providing shelter and habitat for a variety of other flora and fauna. It also helps conserve the genetic diversity of landraces and trees that are threatened with loss and in demand of priority conservation [21]. In addition, it also helps in maintaining traditional information about the conservation of wild tree species and other plants. Studies have also revealed that AFS has higher biodiversity and biodiversity than in stand-alone cultivation systems. The components in agroforestry contribute to the conservation of biodiversity in a number of ways, mainly: by providing secondary habitats for species; reducing the rate of conversion of natural habitats and creating a permeable matrix between habitat remnants [45]. At a given location, AFS has a greater diversity both above and below ground than the sole cultivation system; it also provides a home for species in the event of a catastrophic fire than from the primary forest. Their rich diversity makes them ecologically resilient and thus gives them the ability to provide more and better ecological functions, as they also employ low-input strategies that have led to greater biological interactions and are therefore richer in biodiversity, i.e. the component interaction in AFS is an excellent land use practice for the conservation of biodiversity and sustainable development, and also helps to reduce the dependency of local farmers on the natural resources of protected areas such as national parks and protected areas.

#### **2.4. Management of Woody Species Diversity Parkland Agroforestry System**

Agricultural situations are widely acknowledged as a vital issue influencing tree care practices of trees that area unit incorporated into agricultural fields [6]. Trees have a distinct standing in numerous management systems, be they primarily subsistence or free enterprise operations, and area unit thus integrated into the agricultural fields to completely different degrees. The management system is that the key issue influencing the employment and management of trees [16]. Compared to what's celebrated regarding the plant and placental parts of agroforestry systems and practices, little or no is understood regarding existing piece of ground management practices, farmers' perceptions of the operate of

piece of ground trees and therefore the varied yields of piece of ground trees in meeting their wants and their production area unit celebrated goals and regarding the challenges farmers face that limit their capability to develop piece of ground tree resources in their farming systems.

Parkland tree management could be a method for dominant agriculture competition in agricultural fields, therefore the choice and management of the species concerned affects the success of the system. Management of the trees is crucial to make sure the sustained come of mulch or leaf forage and lightweight shade through the employment of heading, topping and pruning measures that ought to be tired early summer or at the top of the time of year [30]. Understanding tree care practices in a very space (forest) (woodland) (jungle) (tree-plant) and on non-public farm fields is incredibly necessary so we are able to attempt to improve cowl in a very given area. To do this, it's crucial to know management practices within the context of social unit keep ways and farmers' views on the values of trees [55].

Tree management practices area unit typically supported years of farmers' expertise [46] that should be understood terribly rigorously, and it's a region wherever the interaction between trees and folks is clearly seen. Tree management practices area unit conducted to enhance and secure the operate of trees currently and within the future, and area unit associated with tree use, that is that the final goal. Analysis by varied scientists like [5, 41, 1] showed that tree management practices have 2 goals, specifically reducing the sunshine competition with the brushwood and providing usable merchandise to farmers. the dimensions of the farm, the age and therefore the prosperity standing of the farmers area unit factors that impact tree planting activities [48], likewise because the environmental conditions that impact the particular growth and survival of trees in respect to specific tree characteristics [20, 6], that conjointly applies to Ethiopia.

There area unit varied alternatives to agroforestry piece of ground management practices, and therefore the main one is pruning, facet branch cutting [42], pruning [25], watering, plant protection, and fertilization [26], root cut [10]. Pollarding helps scale back excessive shading while; by pruning, the mother trees ought to be able to grow taller while not heavily shading the plants below [11]. Thinning was also carried out in parklands when the canopy of two or more neighboring trees began to close and cast heavy shadows; however, it is not a common practice. The pruning of agroforestry species in parklands that are retained on arable land is intended to reduce the effect on crops, gain fodder for animals, and collect wood for fences and firewood [26]. Overall, the key reason for managing parkland trees is to maximize the advantages of the system. Otherwise, parkland trees can compete with plants for various resources, such as for light, water and nutrients and reduce crop yield, especially with high tree density and size [36].

### **3. Conclusion**

Parkland trees, which are very common practices, are vital

resources for production, productivity, biodiversity conservation, and other related benefits that depend on the presence of the system. Parkland tree management is a process for controlling arboriculture competition in agricultural fields, so the selection and management of the species involved affects the success of the system. Eliminating / reducing agro-forestry difficulties in parklands has positive contributions to local livelihoods in terms of income, crop production and soil fertility. In general, the practice of agroforestry in parklands is important for the preservation of biodiversity, the uptake of carbon and the mitigation of climate change.

## 4. Recommendation

The farmers know their environment and have described and listed the advantages of different tree / shrub species on the farm for the socio-economic development of their households and the improvement of soil fertility. Shade trees are very important where sunburn is a serious problem, whereas trees that generate money are more critical where environmental factors are favorable and access to markets and road networks is also readily available. Typically, farmers deliberately keep tree / shrub species on their holdings for multiple uses and to optimize crop and livestock production, primarily to improve livelihoods. To ensure sustainable utilization of the trees on the farm, they employ a broad range of management practices. For example, logging is a common practice in all agroecological zones, while other management practices vary from site to site and from tree to tree. Tree planting practices are very important to improve tree cover in agricultural fields. Therefore, policy to increase tree cover should not only focus on large wooded areas, but also take into account isolated trees and small classes of trees in agricultural fields. Therefore, there are only extremely limited studies of parkland trees in Ethiopia so far; there is a requirement for a more comprehensive examination of the multiple benefits and services that parkland trees provide on farmland.

## List of Acronym

AFS	Agroforestry system
CIFOF	Center for International Forestry research
CTA	Technical center for Agriculture and Rural cooperation
FAO	Food and Agricultural Organization

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