

Review Article

Review on Homegarden Agroforestry and Its Contribution in Ethiopia

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Abstract: Agroforestry is an ancient practice and also the farmers are too much familiarized with it in Ethiopia. It contributes incredible benefits via socio-economic and environment. The main idea of this paper is to review Homegarden agroforestry practice and its contribution on woody species biodiversity conservation and improving the livelihoods of smallholder farmers in Ethiopia. The literature concludes that the high species diversity, multi-strata structures and complexity of structure are found in homegarden agroforestry. The presence diverse woody species of homegardens that serve different to fulfill a diversity of social, economic, cultural need, while providing a number of ecosystem services / environmental services (reduce soil erosion, increase soil moisture and fertility, coffee shade, and keep micro climate balance) and play a great role of biodiversity conservation. These could contribute to the sustainability of agricultural system. Homegarden agroforestry practice is highly recommended and acceptable than mono-cropping consequently it provides a socio-economic benefits like tree products (Timber, firewood, construction materials and fruit for food) and income. As result farmers were accounted it as a mainstay for maximizing their land productive capacity then improve the smallholder's livelihoods. Therefore, the government should encourage Home garden agroforestry practice for improving the livelihoods of farmer and smoothly to tolerate the variable of climate change.

Keywords: Agroforestry, Homegarden, Woody Species, Biodiversity, Livelihoods

1. Introduction

Agriculture is the dominant sector of the Ethiopian economy. It provides about 52 percent of the country's gross domestic product, 85 percent of its employment and 90 percent of its export earnings [5]. It is the main backbone of the economy and the major occupation of the Ethiopian population [42]. Population growth has a large impact on the livelihood of smallholder farmers [32]. Agroforestry is dynamic, ecologically based natural resource management system that involves the integration of trees in agricultural landscape and rangeland diversifies and sustains production for increased social, economic and environmental benefits [15, 33]. To meet the current diverse people's requirements application of agroforestry, this is more advantageous than mono-cropping

[40] because agroforestry can improve the livelihoods of smallholder farmers by providing various products and services. Due to rapid growth of population, farm size is declined. Land fragmentation and declining farm size is a critical problem that smallholder farmers are facing for maintaining the traditional farming practices [29]. Agroforestry homegarden is one, among the smallholder agriculture practices, that has been considered as an opportunity to contribute to feeding the estimated 9 billion people in the world by 2050 [11]. Farmers established and developed agroforestry as a livelihood strategy, to manage their agricultural systems by nurturing trees in their homesteads, farms and grazing lands, making crops and tree-farming practices as an efficient agricultural and natural resource production system [45]. A growing population has

resulted in an increasing demand for goods and services from forests and forest products including timber, medicines, wild edible plants, fuel, fodder, and play a critical role in watershed protection and land for agriculture and settlement [25]. Due to the ever-growing impact of human activities, this has resulted in decline, forest cover, land degradation, loss of forest ecosystem functions and loss of the biodiversity of natural habitats is rapidly being eroded at an alarming rate, which constrain human livelihoods in the tropics, including Ethiopia [20]. The loss of biodiversity in turn has a range of ecological, economical and societal consequences and in this, agroforestry with its woody species diversity, has a great potential for reducing deforestation and forest degradation, improving rural livelihoods and conservation of woody species [27].

To cope with the degradation of forest resources, and the consequent losses of biodiversity, alternative land use systems such as agroforestry are viewed as a viable option for conserving biodiversity in agro- ecosystems and improving livelihoods [41]. To meet the current diverse people's demands for goods and services with fixed land and enhance in biodiversity conservation in the world wide and in Ethiopia in general is through the application of agroforestry which is more advantageous than monocropping [63]. There are countless traditional land use systems known as "homegarden agroforestry" and has believed to be complex, multi-strata than other agroforestry system [26]. It is known to be ecologically sustainable and has been viewed as a remedy to the increasing well-being of human and ecosystem given the socio- economic and biophysical contribution it provides to land users [57, 46]. Ethiopia is one of the countries where homegardening is practiced. The agricultural practice is believed to be as old as agriculture in the country [4, 3]. Two broad categories of Ethiopian homegardens are recognized: small-sized gardens in cereal-crop-based farming areas and enset-based, medium-to-large-sized gardens of the southern and southwestern parts of the country [1, 4].

The environmental services that homegarden agroforestry practices include their potential contribution to the *in situ* conservation of biodiversity, which have only recently attracted wider attention among agroforestry and conservation scientists [26]. This new view is consistent with the ecosystem approach to natural resource management advocated by the Convention on Biological Diversity (CBD) [38]. This practice plays a significant role in conservation and maintaining woody species composition and diversity, ecological services, smallholders' food security and other several services.

There is a growing need of strengthening and intensifying food production in order to mitigate the adverse effect of global food shocks and food price volatilities. Agroforestry homegardens are considered as one of the major source of food and income in Africa to meet the needs and the wellbeing of the rural community [23].

Woody species are very important part of homegardens that contributes to the livelihoods diversification [59]. Conservation of woody species diversity within agricultural landscapes is therefore critical to farmers' livelihoods [6]. Farmers protect, plant, and promote woody species in their

homegardens to provide commonly both products and services. The productive benefits include fodder, fruit, timber, fuel wood, medicinal and other non-timber forest products. With regard to service benefits erosion control, maintaining soil fertility, improving the microclimate for crops, reducing the incidence of wind and providing shade are the most important ones. Woody species in general serve a wide range of economic, socio-cultural, and ecological functions within traditional homegarden agroforestry [6].

2. Definition and Concept of Livelihood Strategy

A livelihood "means of securing the basic necessities" is defined as the activities, the assets, and the access that together determine living gained by the individual or household [16]. Livelihood diversification is also defined as the process by which households construct a diverse collection of activities and social support capabilities for survival and in order to improve their standard of living [16]. A livelihood is sustainable when it can cope with and recover from stresses and shocks, and maintain or enhance its capabilities and assets, both now and in the future without undermining the natural resource base [9]. *Household livelihood security*: It is defined as adequate and sustainable access to income and resources to meet basic needs [22]. A range of assets is needed to achieve positive livelihood outcomes no single category of assets sufficiently provides all the many and varied livelihood outcomes that people seek [60]. *Livelihood strategies*: A holistic diagnosis attempts to identify the various strategies people use to make a living and how they cope with stress. These are also referred to as adaptive and coping strategies in the food security. So the livelihood strategies are composed of activities that generate the means of household survival, such as homegarden agroforestry is reviewed on this topic.

3. Concepts of Biodiversity and Its Conservation

The term biodiversity is used to convey the total number, variety and variability of living organisms and the ecological complexes in which they occur [52]. Biodiversity is defined as the variety of life and its process [50, 54]. It incorporates several surfaces, including genetic diversity, endemism, agro-biodiversity, species diversity, ecosystem diversity and the ecological processes of which they are part [12]. The various definitions of biodiversity are partly reviewed and a more comprehensive definition is given as diversity is "the variability among living organisms from all sources including *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species (genetic diversity), between species (species diversity) and between ecosystems (ecosystem diversity) [10]. In short, biodiversity refers to the variety of life on earth. Nevertheless, species diversity is a large part of the focus of biodiversity at the local and regional scale [10].

Richness of species in an area indicates the total biodiversity of that particular area. All species display genetic variation among individuals and populations. Diversity helps in the functioning of ecosystems and interactions between ecosystems. On the other hand; biologically diverse forests also contribute to the sustainability of the wider landscape and provide a range of other ecosystem service.

The conservation of biodiversity is a crucial part of sustainable forest management and help in the future realization of the potential values of species. Literatures shown that, conservation of biodiversity is directly significant to local residents, for whom biological resources often represent their main source of livelihood, medicine, and spiritual values [31, 58]. There are three global objectives of biodiversity conservation. These are: (1) to maintain essential ecological processes and life-support systems, (2) to preserve genetic diversity, and (3) to ensure the sustainable utilization of species and ecosystems [34]. In addition, biodiversity needs to be conserved as a matter of principle, as a matter of survival and as a matter of economic benefit.

A study conducted in Ethiopia stated that the conservation of biodiversity is fundamental to achieving sustainable development. It provides flexibility and options for our current (and future) use of natural resources [10]. Almost 85% of the populations in Ethiopia live in rural areas, and a large part of this population depends directly or indirectly on natural resources. Recently, conserving biodiversity in a wide variety of ecosystems has become a major environmental and natural resource management issue of national and international importance [37]. Conservation of biodiversity is crucial to the sustainability of sectors as diverse as energy, agriculture, forestry, fisheries, wildlife, industry, health, tourism, commerce, irrigation and power [10]. Farmers protect, plant, and promote woody species within and around their homegardens, fields, and communal pasture lands to derive a range of benefits, including provisions of food, fodder, construction materials, farm equipment, fuel wood, and medicines [6]. Ethiopia's development in the future will continue to contribution of homegarden agroforestry.

4. Homegarden Agroforestry and Its Contribution to Biodiversity

4.1. Definition and Concept of Homegarden Agroforestry

Homegarden agroforestry is commonly defined as a land use system involving deliberate management of multipurpose trees and/or shrubs in intimate association with annual and/or perennial agricultural crops and invariably livestock within the compounds of individual houses, the whole tree-crop animal unit being intensively managed by family labour' [35]. Furthermore [12] strengthens this definition stating agroforestry practice is a dynamic, ecologically based natural resources management system through integration of trees in farmlands, rangeland, diversifies and sustains production for increased social, economic and environmental benefits.

Homegarden agroforestry refers as, a small-scale,

supplementary food production system and for household members by imitating the natural, multilayered ecosystem [13]. Homegarden agroforestry are characterizes to near home, composed of a high diversity of plants, small, and an important source of household subsistence and cash needs. Tropical homegarden agroforestry consists of an assemblage of plants which may include herbaceous plants, vines, shrubs and trees growing in or adjacent to a homestead or home compound and these gardens are planted and maintained by members of the household [48].

4.2. Contribution of Homegarden Agroforestry

4.2.1. Livelihood Importance

Multiple social benefits of homegardens include enhancing food and nutritional security in many socio-economic and political situations, improving family health and human capacity, empowering women, promoting social justice and equity, and preserving indigenous knowledge and culture [43]. The most fundamental social benefit of homegardens stems from its direct contributions to household food security by increasing availability, accessibility and utilization of food products. According to study result conducted in Sothorn Ethiopia, describes that woody species are very important part of homegardens that contributes to the livelihoods diversification. They are managed to: i) provide shade for coffee and variety of commercially valuable spices as well as for livestock; ii) supply rural communities with fuel wood and timber, both for household consumption and for sale; iii) provide other products such as fodder, human and livestock medicine, food and they serve as bee forage; iv) play important ecological roles which could contribute to the sustainability of agricultural systems [57]. The economic and livelihood benefits of homegardens go beyond food and nutritional security and other social and cultural benefits, especially for resource poor families. A reviewed literature shown/describes that woody species of homegardens can contribute to income generation, improved livelihoods, and household economic welfare as well as promoting entrepreneurship and rural development in several ways [8]. Homegarden is an integrated system which comprises different things and helped to conserve many species in a small area that produces a variety of foods and agricultural products by providing diversified needs of the farmers [66]. Woody species diversity of homegarden is important for humans in several different ways. They provide to staple crops, vegetables, fruits, medicinal plants, nutrients, food for humans, fodder and so on, thus contributing to food security; provide building materials, fiber and fuel wood for cooking, poles for construction and wind breakers in different homegardens, medicine and other useful products for human beings is widely recognized [49]. The tend to have some tree output that can be used for long-term production and sale for profit [44]. Trees provide firewood, which is the major energy source in most developing countries [57]. Apart from their importance as a source of income for many farmers in rural areas the garden supply building materials, fiber, spices, cooking utensils, material for making mats, baskets, furniture

and hats. Trees also provide other products such as fodder, human and livestock medicine, food and they serve as bee forage [48].

The major functions of homegardens particularly in rural areas are subsistence production through diversification and income generation [36]. Because of high plant diversity in the homegardens, a wide spectrum of multiple-use plant products can be generated with relatively low labour, cash or other inputs [59]. Homegardens play an important part in the food security as they supply varied products throughout the seasons [66]. For instance, tubers, vegetables, fruit crops, like avocado and mango, and spices are serving as a source of income and food to household consumption [21].

Moreover, diversified benefits from the homegarden play an important role in reduction of different type of risks. This is particularly important in the context of rain fed agriculture in the tropics, where there is a high risk of crop failure. Homegardens also play considerable role in household nutrition. This is because the composition of crops widely produced and consumed in homegarden is dominated by energy producing food crops [43, 56]. The vitamin supply in the nutrition of the households is also expected to be sufficient, because vegetables are commonly present [56].

Homegardens are also one strategy for micronutrient deficiencies. Even though animal products are the best sources of micronutrients, vegetables and fruits may be the only source of micronutrients that are reliably available to poor households [7]. Although the extent of household dependency on homegardens varies considerably, its contribution is quite significant towards livelihood of the people because of low investment and easy accessibility [59]. Generally, it can be said that homegarden is the cornerstone of rural life. Conservation of woody plant diversity within agricultural landscapes is therefore critical to farmers' livelihoods [6]. Woody species diversity in homegarden agroforestry is a crucial role for biophysical and socioeconomic contributions and significant role in household food security strategy in south western Ethiopia [66]. Their assessment of food security status of the household, result showed that 88.8% of the household were found food secured throughout the year. Nevertheless, for 84.5% of the households (N = 98), the production they produced was sufficient only for 10 months to feed their family. The uses of homegarden agroforestry practices alleviate to biodiversity loss and provide opportunities for improving diversification and range of livelihood options for rural households [2]. Therefore, knowledge of key resource species and of traditional conservation practices of woody species can be valuable additions to sustainable development and conservation planning [49].

4.2.2. Importance of Biodiversity Conservation

The various woody species of homegarden agroforestry practices in Ethiopia provides multiple environmental and ecological benefits. They serve as the primary unit that initiates and utilizes ecologically friendly approaches for food production while conserving biodiversity and natural

resources [13]. This practice plays a significant role in conservation and maintaining biodiversity, ecological services; improve soil fertility, minimizing soil and water degradation, and several other services. Homegardens are contained usually diverse and a rich composition of plant and animal species, and characterized by the complexity of their species diversity, structure and multiple functions [26]. They are characterized by complex and diverse agro-ecosystems and this indicates their suitability to fulfilling ecological functions [57]. They stimulate nutrient cycles and sustain structurally complex and diverse plant communities. Commercial homegardens require cultural management: pest control, fertilization, irrigation, and so on. A case study in Vall Fosca, Catalan Pyrenees, North-eastern Spain highlights a number of ecosystem services provided by homegardens such as production of quality food, maintenance of land races, cultural services, pest control, and pollination [8]. They conclude that the most important ecosystem services provided by homegardens differ from large scale and commercial agriculture.

Moreover, the soil surface in the garden is almost completely shaded by the plant canopy. These functions make the system to play an important role in the conservation of soil fertility and erosion control [39] and help to regulate soil moisture and temperature, and improve the microclimate eventually contributing to the stability and resilience of the systems [57]. For instance, in Ethiopia some site specific scientific investigations on the effect of various agroforestry systems on ecological productivity particularly in soil improvement were analyzed. Most of the study results revealed that homegarden agroforestry systems are advantageous in improving ecological functioning [55, 64]. The environmental services that homegarden agroforestry practices provide include their potential contribution to the *circa situm* conservation of biodiversity [26]. These have only recently attracted wider attention among agroforestry and conservation scientists view is consistent with the ecosystem approach to natural resource management advocated [38]. This practice provides a place for species conservation and helpful for better ecological functioning in the meantime and proving alternative options of forest products to the local communities is the prime concern of service provide and donor communities to reduce the pressure on natural forests. The presences of woody species from homegarden to agricultural landscapes favor the survival of native woody species and play an important role in conserving biodiversity [28].

The realization that homegarden agroforestry is also an important reservoir of unique genetic diversity to obtain a better understanding of the role of homegardens in the management and conservation of genetic diversity *in situ*. Biodiversity is the totality of genes, species and ecosystems of a region. Biological diversity for food and agriculture can be managed to maintain or enhance ecosystem functions [53]. Through improved the management of genetic diversity in homegardens, resulting in a better and more sustainable production combined with the maintenance of high levels of genetic diversity.

5. Extent of Woody Species Diversity of Homegarden Agroforestry in Ethiopia

Diversity means different things to different people. Most often in natural or agricultural systems, species counts (species richness). Ongoing this judgment, diversification means adding more species. Species diversity, however, is a function of the number of species, and the evenness in the distribution of species' abundances. Thus, woody species diversity is the combination of species richness and species evenness. Woody species richness is the number of species per sampling unit while species evenness is the distribution of individuals among the species. Evenness is a maximum when all the species have same or nearly equal number of individuals. Species diversity can be expressed in single index number [59]. One of the typical features of tropical homegarden is the high diversity of their components. There is a great diversity in the types of trees, shrubs, vegetables and crop species, animals, as well as in the spatial arrangement of these components [40].

Homegarden agroforestry had conserved highest diversity of woody species in Ethiopia. For instance, the study reported the presence of 120 woody species in Sidama Ethiopia [57]; 64 species in central Ethiopia [47]; 59 species in West of Oromia Region Ethiopia [51]; 78 species in Wolayita zone south of Ethiopia [62]; 29 species around south of Tigray Ethiopia [65]; 57 species in southwest Ethiopia [26]; 59 species in Northern Ethiopia [24] and 69 species in west Gojam Zone Ethiopia [19]. The variation in density of woody species in the different homegarden agroforestry may be related to ecological, cultural and socioeconomic conditions.

6. Threats to Woody Species Biodiversity in Ethiopia

Woody species provides livelihoods for millions of people worldwide, through provision of different products and services. However, their diversity and area coverage is highly declined through time. Deforestation, land degradation, invasive species, overgrazing and over exploitation are the main threats accelerated rich biodiversity of the country and habitat / species diversity loss [18, 30, 61]. In most cases, the major destructive factor of species diversity is deforestation caused by agricultural land expansion and fuel wood scavenging. In current situations, Ethiopia is in the track of the high investment rate, agro-industry expansion and population migration to a fragile ecosystem like forests and related resources. However, almost all of these huge activities were done without prior environmental impact assessment [14]. The other threats to the species biodiversity of the country are unsustainable utilization of natural resources, forest fires, land degradation, habitat loss and fragmentation, extensive replacement of farmer's /local varieties/ breeds by improved ones, invasive species, wetland destruction, resettlement programs which cleared forest in the green belt areas of the country and climate change. But all

these are related to the root causes of poverty, which are lack of alternative viable livelihoods, increasing population pressure and inadequate awareness of the threats [17, 30]. These different threats are in rapid progress, threatening the conservation status of Ethiopia's plant diversity. The challenges to conserve and sustainable use of Ethiopia's biodiversity are very complicated and interlinked [14].

7. Conclusions

Agroforestry system is the oldest traditional practice in Ethiopia, but today it is accounted as the modern land use system. The farmers are more familiarized with practicing different types of agroforestry practice, which includes home garden, farmland, coffee farm and woodlot. It plays great role in diversifying production from a single land unit. Overall, the literature review supports the inclusion and promotion of homegardens as an eco-friendly, sustainable agricultural practice to improve livelihood diversification and enhance economic growth. The structure, functions, and contributions of homegardens vary in geographic regions. The literature concludes that the high species diversity, multi-strata structures and complexity of structure are found in homegarden agroforestry. The presence diverse woody species of homegardens that serve different to fulfill a diversity of social, economic, cultural need, while providing a number of ecosystem services, play a great role of biodiversity conservation. These could contribute to the sustainability of agricultural system. Agroforestry can mitigate climate change through various techniques. For instance, reduce the negative impact comes due to climate change to agricultural production. Because, mixing trees with annual a crop is an option for diversifying productions and increases the productivity. This consequence will enhance the rural farmer to cope with climate change. Generally, it is an option for improving the livelihoods of smallholder farmers in significant role in addressing household food security and biodiversity conservation.

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