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Opportunities and challenges of adopting home garden agroforestry practices in Ethiopia: A review

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Abstract: Home gardens enable farmers to secure their food availability, mitigate environmental change, increase consistency of social-cultural values and protect species provenance. On the other hands, they conserve biodiversity and sequester carbon, and improve a biogeochemical process even if the home garden has multifunctional values. The objective of this review is to identify the factors hindering the adoption of home garden agroforestry practices in Ethiopia and to show existing opportunities to scale-up the practice. The dominant species in various home gardens are economically appreciated as they fulfill a demand. Women are more engaged than men in home garden activities, which create job opportunities and foster social acceptance. There is also available indigenous and scientific knowledge that has to be managed and administered by concerned stakeholders. Many researchers found that there were high species diversity, suitable environments, good experience, available products, a willingness of women to participate and important component interdependence with flexible arrangements, but small farm size and discouraged tenure of land and tree were major impediments. The responsible bodies should undertake positive actions like promote community services, researchers on home garden agroforestry. awareness creation, scale-up of appropriate home garden components, provide support through cultivating good and multipurpose hybrid varieties, and formulate policies and strategies that encourage farmers to make home gardens an alternative to secure food stability.

Subjects: Agriculture & Environmental Sciences; Agricultural Development; Agriculture and Food; Agriculture

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Abay Bantihun Mehari is a lecturer and researcher in Debre Markos University. He obtained his BSc from Hawassa University Wendo Genet College, MSc from Bahir Dar University, and graduated in Farm Forestry and Land Resource Management. The author has concentrated in conducting a research regarding on the forest ecosystem and forest resources. The main activities that are initiated to make a project related to this research article are scaling-up the local knowledge and make an integration with scientific knowledge regarding the home garden agroforestry practices for the country of Ethiopia.

PUBLIC INTEREST STATEMENT

Home garden types of agroforestry practices are practiced throughout the country Ethiopia. However, the practiced has been well adopted in southern part and conveniently in other part of the country. In this beneficial review point, there has been elaborating the level of adopting of this practice in different area based on the prominent research findings and valuable personal interviews. The species diversity, socio economic, component interaction, structure and functions of the practices and classification of home gardens description help the students, researchers and policy makers.

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Keywords: home garden; carbon sequestration; socio-economy; gender; policy and strategy

1. Introduction

The definition, structure and function of home gardens vary from place to place according to the local physical environment, ecological characteristics, socioeconomic climate and cultural factors (Kumar & Nair, 2004).

Home garden agroforestry is a special category of agroforestry that deals with the cultivation of multipurpose and multi-storied trees and crops combined with animal husbandry around a homestead (Kabir & Webb, 2008; Galhena, 2013). The home garden helps to connect the livelihood income and conservation of natural ecosystems by linking marketable cultivated species with conservation of species diversity and genetic diversity (Galluzzi, Eyzaguirre, & Negri, 2010). Species found in home gardens do not have a pre-determined spatial arrangement and the locations of plants species are random and conveniently determined by the farmer's needs. Species density is variable depending on the household and market demand (Mengistu & Asfaw, 2016)C:\Users\MBSantos\Downloads\In Ethiopia\NR_2016102016442269.pdf.

Traditional knowledge is mainly utilized in the rural areas of Ethiopia, especially where agroforestry practices can be performed conveniently (Asokan, Chouhan, & Singh, 2015; Suryanto, Widyastuti, Sartohadi, & Awang, 2012; Zone, Ab, Mt, & Res, 2016). From those practices, home garden agroforestry practices are the one that farmers are using to sustain their livelihoods (Gebrehiwot, 2013; Kehlenbeck & Maass, 2005; Mattsson, Ostwald, Nissanka, & Marambe, 2013).

When we review the adoption level of the home garden in the country, almost all of the reviews are located in the southern part of the country (Abebe, 2013; Endale, 2014; Hailu & Asfaw, 2011; Linger, 2014; Mengitu, 2015; Molla & Kewessa, 2015; Plants, 2013). The home garden is well known in Ethiopia, in general, and in southern and southwestern parts of the country in particular. Since *Catha edulles*, coffee and enset are predominantly cultivated for their economic values (Haile, Lemenih, Senbeta, & Itanna, 2017), most research focuses on such species. Despite the fact that the practice has attracted researchers to study home gardens near Oromo and in the (SNNP) Southern Nation Nationalities Peoples regions, it has also been adopted in the Amhara, Benishangul gumuz, Gambela and Tigray regions of the country. Around the Amhara region only one study has been conducted that found appreciable value in species evenness (Linger, 2014), which indicates that the types of species occur in equal numbers. The other two regions have potential resources to adopt it. However, as yet, no provision for consideration for home gardens has been identified by the scientific community.

Generally, the main objective of this review is to show the contribution of home gardens and their socioeconomic importance especially relating to gender mainstreaming and climate mitigation strategies and hindrances to its adoption in different parts of Ethiopia.

1.1. Indigenous knowledge

In the tropical and sub-tropical countries many farmers have traditional knowledge and practices for conserving agricultural ecosystems and a means of integrating land use systems (Abebe & Bongers, 2012; Kunhamu, 2013). Traditional socio-cultural and ecological knowledge often permits the farmer to decide the species choice and the spatial and time sequence for growing these species (Kerala & Tripathi, 2016). Farmers manage the trees inside the home garden to reduce light competition by means of pruning. Farmers use the excrement of cattle and humans to keep the garden fertile and productive while they maintain sanitation (Hailu & Asfaw, 2011; Mesfin, Seta, & Assefa, 2014; Sebsebe, 2003).

Cordia africana, Erythrina brucei and *Millettia ferruginea* are species that the farmers preferred to promote fertile soil. Ninety-eight percent of respondents produced plants with different use values mainly for home consumption to be harvested whenever they needed to use throughout the year. The

prominent species that occurred in the SNNP region home gardens was *Ensete ventricosum*, which provided food at a steady rate as an appropriate management system (Bishaw & Abdelkadir, 2003).

In Southern Ethiopia, women were the only labor processing and preparing food from the plants which were dominant in the home garden, namely *enset*, while men performed, other harder work (Negash & Niehof, 2004; Tsegaye, 2002). This indicated that women were the only persons processing this food which could be eaten when food shortages occurred. The food takes a long time to prepare and requires care and experience or indigenous knowledge. Yet no research has been undertaken on how to prepare it from the point of view of human nutrition.

In different research, farmers identified and familiarized themselves with their preferred species which were used for food and other purposes (Endale, 2014; Kebede, 2010; Mengistu & Asfaw, 2016; Abebe, 2005) showed that, on average, 59 species were familiar to farmers; 25 species were preferred for the purpose of food, 21 species for medicine, sale, live fencing, building or home materials, shade and ornamental use, and 38 species for fuel purposes. Home gardens in the area produced a significant amount of the food needed by the family in addition to minor and supplementary products. Of the 60 households interviewed, 59 plant species were listed as most important food crops by the local people. These are listed in Table 3 in their order of preference. However, there was a loss of traditional knowledge of different management practices (Mekonen, Giday, & Kelbessa, 2015).

1.2. Marketed and marketable home garden products

Surplus product can be sold at market when the market distance is close to the farmers' gardens that help them to earn money from marketed products. The income which is obtained from the marketed products help them to purchase other types of food to satisfy their food needs. Some researchers found that the major cash crops grown in the country's home gardens are cabbage, enset, lumen, orange, papaya, mango and avocado. Some other, like *Coffe arebica, Catha edulis, Milletia ferruginea, Cordia africana, Croton macrostachy*, were trees that are useful for improving soil fertility and conserving soil moisture (Alemu, 2016; Mekonen et al., 2015; Rana et al., 2016). In the Mekonen et al. (2015) study, *Catha edulis, Rosmarinus officinalis* and *Rhamnus prinoides* were the preferred marketable plants in the Sebeta-Awas area.

They use powder obtained from *C. macrostachyus* as a preservation agent to store crop seeds and tubers that are buried under the soil for short periods for future use in times of shortage. Local markets (*qoccaa*) and markets close to towns have a great role in the selling of their products. Contrarily, species richness was negatively affected by proximity to markets and access to roads (Abebe, 2013).

1.3. Women participation

The country Ethiopia has different regions and nationalities, which have varied customs and cultures that result mainly from religious differences. Hence, usually, women are relegated to inferior positions and men to superior roles (Gebrehiwot, 2013; Gebrehiwot, Elbakidze, & Lidestav, 2018). In the home garden, women are frequently engaged in cultivation, while men need to farm the land used for cash crop production.

Agriculture is the main activity of men in the country. However, women play their own role in the management of home gardens and also of the farm fields. For instance, carrying animal manure to the farm lands, soil preparation, weeding and harvesting are some of the activities in which women had direct involvement (Galhena et al., 2013; Gebrehiwot, 2013; Gebrehiwot et al., 2018). Work division between males and females was one way that farmers managed their human resources for activities like crop selection. Despite the fact that women were aware of the use of the plants, the means of maintaining them and identifying local varieties, they managed mainly minor plants like vegetables, spices, tasty varieties and plants of medicinal value.

Home gardens are prevalent in the highlands of Ethiopia and accommodate supplementary fruits and vegetables as a principal means of livelihood for households. Such sites have been considered as a sign of prestige and pride (Hailu & Asfaw, 2011).

Women play great role in the management of home gardens and also of the farm fields. Aggregate data show that women formed about 43% of the agricultural labor force globally and in developing countries (Chayal et al., 2013). All aspects of women's participation were important for the development of the community particularly involvement in a broad range of home garden management activities beneficial for their own socio-economic well-being, but also important for sustaining the livelihoods of their communities and for preserving agro-biodiversity. Kumar (2015) recorded that in about 60% of total number of small home gardens (<0.4 ha) women contributed significantly to their management. Kumar and colleagues also reported that only in 22% and 12% respectively of the total number of medium-sized home gardens (0.41–0.12 ha) and large home gardens (>1.2 ha) the role of women in garden management was significant (Kerala & Kumar, 2015; Kumar & Tiwari, 2017; Tripathi, 2016). This marginalization process contributes to lost profits and cash to meet family needs. Women's contributions to cultural and traditional practices no longer evoke respect when the need is supplied by the market and the authority of women undercut (Robbins, Von Keyserlingk, Fraser, & Weary, 2016).

Research on home garden conducted in the Sidama zone (Gebrehiwot et al., 2018) revealed that women's access to land, markets, trading and the decision-making process had been restricted institutionally at the household and community levels. The reason was that the majority of farm women were illiterate, with little know-how about the techniques of farming. They faced domination by males and their mobility was restricted due to several cultural taboos (Chayal et al., 2013). But the proclamation, Ethiopian Rural Development Policy and Strategies, says that "Women, who want to engage in agriculture, shall have the right to get and use rural land" (Proclamation, No. 456/2005) ((FDRE) The Federal Democratic Republic Of Ethiopia, 2005).

1.4. Component interaction

In home gardens, animals, trees and crops have a symbiotic relationship between them which could attract farmers to adopt it around the homestead.

(1) Tree versus crops

Trees are the dominant component of the home garden that hold and tie different ecosystem components like soil, insects, microorganisms and leaf litter. So the trees are used as an input to enhance the production capacity of the soil by providing decomposition materials, their decomposer or soil fauna and habitats. Trees help to regulate microclimate, which is suitable for crops and reduce evaporation. The diversity of trees in home gardens provides fertile soil through supporting fixation of nitrogen (Alemu, 2016; Endale, 2014; Galhena et al., 2013). On the other hand, crop residues form a material input for decomposition.

(2) Animal versus crop/tree

Fodder for livestock can be made from remnant trees and farmers can use trees for construction materials that help to make animal shade. Livestock manure provides compost for crops and help trees get essential elements (Galhena et al., 2013).

2. Land holding

As the area of the gardens is limited, the activities undertaken inside the gardens could be minimal. Because of limited area, the number of species is lower. It is recommended to have a larger area in order to support a higher number of laborers, diversify tree and crop species and increase the numbers of products providing income. The proportionality of home garden size to the number of family members varies with various agricultural systems. The average size of a home

garden, in several tropical and sub-tropical regions, typically is much less than a hectare (Das, 2013; Kumar, 2015; Rana et al., 2016; Abebe, 2005).

Mesfin et al. (2014) stated that the maximum and minimum size of home gardens encountered was between 0.05 and 0.25 ha with the average size being between 0.06 (Abebe & Bongers, 2012) and 0.7 ha.(Tolera, Asfaw, Lemenih, & Karltun, 2008). In the south-central highlands of Ethiopia their size is 0.35, 0.27 and 0.12 ha for rich, medium and poor households, respectively. A study for the Food and Agriculture Organization of the United Nations (FAO) estimated that, to grow three to five trees, a household would need at least 167 m^2 of land. It may be mentioned here is that very often such small-sized land use systems with subsistence levels of mono-cropping is not viable, particularly in rural ecosystems (Geiger, 2014). The author's (Plants, 2013) study of Wolyta home gardens further suggested that the gardens providing for different practices is declining, including their use for shade as well as for suitable places for conducting ceremonies and get-togethers for the villagers during social gatherings and religious holidays when coffee and snacks (of roasted grains) and bread maybe served.

Gebrehiwot's (2013) study in the *Sedama* zone revealed that the incomes that were generated from the home garden in which women were the laborers had been governed by themselves. However, while the land use change from home garden to crop production that generated income will used by males since the labor force to produce crops is typically male. To encourage marriage, females show their ability to manage the home garden in their home.If they do not have a home garden, they will not have less opportunity for marriage (Gebrehiwot, 2013; Gebrehiwot et al., 2018; Tsegaye, 2002). Simultaneously, the species diversity in home gardens will be reduced as home gardens shift to monoculture crop production. Decision makers and other related stakeholders have to take this issue in to account when stating policies and devising strategies.

Even though the income from cash crop production contributes to spending for goods besides food, the household members may not have sufficient access to food. On the other hand, Plants' (2013) study describes the surplus product that was obtained from the home garden and sold at market can help to satisfy the need for a balanced diet among household members

Peoples' intention to have a larger farm size garden has not been yet studied. Even though in some parts of the country this agroforestry practice has been adopted well, dispersing it to other parts with similar potentials is limited. The way to adopt or scale-up this new technology for other areas can be facilitated by means of integrating it with other stakeholders' concerns and programs for dealing with the poor living status of farmers in Ethiopia (Tafere & Nigussie, 2018).

3. Conclusion

From the broad category of agroforestry activities, the one which is traditionally practiced in Ethiopia is agroforestry home gardening. There are prospects for the home gardens in the areas of climate change mitigation, gender participation in decision making, marketable product development, and food availability and accessibility for the wellbeing of the community. It means that it has socioeconomic, cultural importance and environmental role through conserving biodiversity. Moreover, farmers have indigenous knowledge to manage it, as the component interaction is very useful for sustainable productivity of the home garden.

On the other hand, hindrances that obstruct the scale-up of this type of land use are male superiority and female inferiority, which leads less participation of women in decision making or no gender equality, species are concentrate to one area of the country, and farmers do not need to balance their diets while they get marketable product because of no access of road. There are weak actions being undertaken to provide support through extension activities to disseminate new technologies, germplasm and ideas considering policies on the proportionality of farm size to the number of family members. In contrast, research has not been undertaken on home gardens across the country.

3.1. Recommendation

Almost in all parts of Ethiopia, the practice of home gardening is not well known since there is weak scaling up of knowledge from the experienced area of the country to other areas, where such activities are practicable based on the agro-climate of the country. Therefore, a good extension strategy for this agroforestry practice should be developed and adopted.

In other words, the indigenous knowledge should be shouldered by scientific knowledge. It is also recommended that both on-station and on-farm research should be encouraged. To improve sustainable home garden production systems in the country, there should be scaling-up of appropriate home garden components combined with identified appropriate agro-ecological zones through the country.

Mainly the infrastructures specially transport access and availability of market nearby the village.

The women's illiteracy and believing on cultural taboo ought to be developed by adult educations. Females have to be encouraged to participate in decision making on their land holds.

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