SJIF IMPACT FACTOR (2015): 5.416 CRDEEP Journals
International Journal of Environmental Sciences Ewuketu Linger Vol. 6 No. 1 ISSN: 2277-1948
International Journal of Environmental Sciences. Vol. 6 No. 1. 2017. Pp. 1-4

Full Length Research Paper

Assessment of Home garden tree species, their uses and Vertical Structure in Chirawenze Micro-Watershed, North-Western Ethiopia.

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Article history
Received: 13-12-2016
Revised: 23-12-2016
Accepted: 04-01-2017

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Abstract
A survey of forty five (45) home gardens in farmers of chirawonze micro-watershed, north-western Ethiopia was conducted to assess tree species grown and maintained by household members , the diversity(richness and abundance), their uses and structure. Semi-structured questionnaire and structured interviews in addition to 10mx10m main plots were used to collect useful information. A total of 20 plant species belonging to 16 botanical families were documented. From the data, Mimosoideae, Rosaceae (in order of decreasing number of species) were the most frequent families. The household members cited most of the plants as fuel wood; others as medicinal and ornamentals. Species composition, vertical structure as well as plant uses are discussed. Homegarden products serve alimentary purposes and represent promising base materials for poverty alleviation and may also help to augment household's income. Some plant species are frequent. This may suggest uniformity in plant use and could contribute to the conservation of local species like Cordia africana and acts as a refuge for the species. Home gardens can also be regarded as 'humble' germplasm bases; diverse in terms of vertical structure hence, the need to reenergize the productive capacity of home gardens.

Key words: *Home garden, structure, diversity.*

Introduction

Most often in natural and agricultural systems, species counts are provided as the measure of diversity. Species diversity, is both a function of the number of species, and the evenness in distribution of abundances of species (Magurran,1988) and mostly occur in agricultural land in the form of agro forestry.

A wide range of agro forestry practices and systems are found in the tropics in general and mostly southern parts of Ethiopia (Zemede A. & Ayele N., 1995). Of all the agro-systems, home garden is the one, which is conceptualized and defined as land-use systems involving deliberate management of multipurpose trees and shrubs in intimate association with annual and perennial agricultural crops and invariably livestock within the compounds of individual houses (Fernandes and Nair, 1986) and are the central points of agrobiodiversity conservation. Home gardens form a dominant and promising land use system in many parts of the tropics (Michon et al.,1983; Singh, 1987) and are viewed as an alternative to the ever increasing demand for food (Soemarwoto et al., 1985) now a days. Hoogerbrugge and Fresco (1993) defined home garden as "a small scale, supplementary food production system by and for household members that mimics the natural multilayered ecosystem" in addition to its source for different medicinal plants (Agelet et al., 2000). Tree diversity in home gardens act as prototype for sustainable ecological systems (Padoch and De Jong, 1991; Lamont et al., 1999; Albuquerque et al., 2005) through closed nutrient cycling from the tree through litterfal.

Species diversity in tropical home gardens is very high due to species having different life forms, height and canopy structure (Babu et al., 1982; Soemarwoto and Conway, 1991). The species diversity in home garden agricultural landscapes provides resources for food, fodder,fuelwood, decoration, construction, medicinal uses , flood control and protection against soil erosion (Soemarwoto, 1987). Recently, just as in agro-forestry, ethno-botany (as a discipline) has dedicated increasing attention to the theme of conservation of home garden biodiversity.

The tree diversity and other microorganisms in home gardens is a source of genetic variability which is influenced by peoples management experience, constituting a valuable patrimony for food security and even a source of genetic material for the improvement of species for commercial purposes (Soemarwoto et al., 1985). Structure and floristic composition vary in home garden establishment. Since nothing is done and reported about tree species condition in the stated study area, this assessment is designed to contribute to existing knowledge about the tree species diversity(richness and abundance), vertical structure, usage and floristic composition of home gardens in the micro watershed level called chirawonze at northern parts of Ethiopia.

Materials and Methods

Study area

This study was carried out in a place called chirawonze micro watershed, sinan district in north-western Ethiopia characterized by moderately wet and roughed topography. There are two distinct seasons: rainy season (May to October/November) and dry season (October/November to April/May). The climate favors the cultivation of a wide range of food crops such as sorghum, maize, wheat, potato, barley, oil palm, vegetables, fruit trees and extensive Eucalyptus tree species dominance in the form of woodlot.

Tree diversity, use and structure study

Field work was conducted between April, 2016 to August, 2016. A total of 45 home gardens were surveyed through laying 10mx10m sample main plots making a total of 45 plots in order to capture species abundance with their height structure and owners household heads interviewed using semi-structured questionnaire to gather information on the uses of the species present in the gardens. plant species nomenclature was done by using flora of Ethiopia and Eritrea (Edwards et al., 1995; Hedberg et al., 2004; Hedberg et al., 2006).

Data analysis

Data obtained from the questionnaires were entered into the computer and analyzed using Microsoft-excel 2010.

Results

Tree species richness, Abundance, Vertical structure and their use

Species richness refers to type/variety of species and abundance refers the number of individuals, both of them mostly used to determine tree diversity. Vertical structure is important as a major indicator of farmer's species selection to maximize productivity from different strata and all of the results are presented (Table 1).

Table 1. Tree species richness, Abundance, Vertical structure and their use

No	Species name(Richness)	Family	Abundance (mean/plot)	Vertical structure(mean/plot)		Use/function
				<=2m	>2m	
1	Eucalyptus globuls	Myrtaceae	30	12	18	fu,c,fe,
2	Acacia abyssinica	Mimosoideae	6	2	4	sh, fu, fe,fo,sf
3	Rosa abyssinica	Rosaceae	5	0	5	Fd,fo,fe,fu
4	Cordia africana	Boraginaceae	12	6	6	sh, fu, fe,c,sf
5	Mangifera indica	Anacardiaceae	19	6	13	fd,fu
6	Olea africana	Oleaceae	2	0	2	fu,c,fe
7	Sesbania sesban	Papilionoideae	36	36	0	Fu,fo,sf,fe
8	Grewia ferrugenia	Tiliaceae	4	1	3	De,sf,fo,fe
9	Croton macrostachyus	Euphorbiaceae	4	0	4	sh, fu, fe,sf
10	Azadirachta indicia	Meliaceae	2	2	0	fe
11	Albizia gummefira	Mimosoideae	3	1	2	sh, fu, fe, sf
12	Albizia lebbeck	Mimosoideae	2	2	0	sh, fu, fe, sf
13	Acacia nilotica	Mimosoideae	2	2	0	fe
14	Bersama abyssinica	Melianthaceae	2	2	0	fe
15	Rhamnus prinoides	Rhamnaceae	32	32	0	Le,sf,fu
16	Juniperus procera	Cupressaceae	1	0	1	Fe,fu,c
17	Hagenia abyssinica	Rosaceae	1	0	1	medicinal
18	Enseteventricosum	Musaceae	5	5	0	fd
19	Citrus sinensis	Rutaceae	11	9	2	fd
20	Capparis tomentosa	Capparidaceae	2	2	0	fe

Key: fu= fuel wood , c=construction, fe= fence, sh = shade, fo = fodder, fd = food, sf = soil fertility, de = detregent , lb = local beverage

From the 45 home gardens surveyed, 20 different species of plants were found and these are distributed among 16 families (Tables 2). The most represented families are Mimosoideae which represents four species and Rosaceae represents two species. Two groups of plants were found in the studied sites. Group 1: plants purposefully grown and maintained by the household member. Group 2: naturally regenerated plants but maintained. In the latter case, plants cited were *Hagenia abyssinica, Capparis tomentosa, Bersama abyssinica, Acacia nilotica,* and *Azadirachta indica* and others are purposefully grown through taking germplasm from the government or private nursery.

The survey shows that trees in home gardens provide mainly for food, fodder, construction, and soil fertility improvement role and occupied an area between 50 and 600 m^2. The shape, size and number of species varied for each home garden but were most commonly rectangular (49%), square (9%) (Not perfect) and the rest irregular shapes. Vertical strata were also encountered for different species (table 1). All the species sighted were reported to be most useful for several purposes reported by the interviewed respondents as indicated in the table.

Discussion

The species composition of the study homegarden confirms to the general floristic composition reported elsewhere in the tropics including Ethiopia. The 45 studied home garden was composed a total of 20 species, both less and greater than other reports. for instance 69 species from Jabithenan district, Ethiopia (Ewuketu et al, 2014), 32 plant species (n=81) from semiarid environment of central Sudan (Gebaur, 2005); and 162 plant species (n=111) from the four directions in Ethiopia (Zemede Asfaw and Ayele Nigatu,1995), Erinoso and Aworinde (2012). The difference in species richness from place to place could be attributed to income difference, Altitude, personal preference of species, soil type, and homegarden size. farmers that experience income constraint tends to focus on few selected species which generate money to satisfy immediate needs and so richness becomes low (Motuma et al., 2008). Farmers may focus on integrating and maintaining on tree species that have high ecological, socio-economic and social roles. for example, *Rhamnus prinoides* in the studied is primarily served to prepare local beer called *"Tela"* and is also another source of cash income that are responsible for higher abundance than others. *Sesbania sesban* is also highly valuable for livestock forage based on its high coppicing ability and so farmers integrate and maintain with high extent number of individuals (abundance). Apart from its construction purpose primarily for farm households, *Eucalyptus globulus* is highly planted on the boundary of farm plots and sold to the nearby market called *"Debremarkos"* for its straight and fast growth attribute for fuel wood and construction purpose. Farmers are highly motivated to plant these species, since its income value is higher than other tree species.

In general, the diverse uses of plants indicated in this study point to the fact that home gardens have been used to cultivate not only vegetables, but also medicinal and other miscellaneous plants. The gardens studied are subsistence in nature based on their mean size and according to the classification of Fernandes and Nair (1986). Home gardens have the function of guaranteeing subsistence as well as complementing the household income.The most representative families in this study have also been cited in previous studies that were focused on old urban home gardens by Eichemberg et al. (2009) and Albuquerque et al. (2005).

The physical appearance of home gardens which is known by *Yegwaro-atkilit* or *Tegane* in Amharic is depend on the species composition. The name signifies not only their position but also their proximity to the house. Most of the studied HGAF was a rectangular shape, which is in line with Survey results of Zemede Asfaw and Ayele Nigatu (1995) in most parts of Ethiopia. Since for easy movement of livestock, social and cultural functions front yard is open and most of the studied homegarden was positioned in back yard. Study results from 111 HGAF of Ethiopia from different agro-ecological zone, confirms that most of the homegardens were positioned in the backyard of an individual house (Zemede Asfaw and Ayele Nigatu, 1995) and Fentahun Mengistu (2008) also found this reality from western Amhara of Ethiopia.The vertical arrangements of species are in line with other studies like structural components of home gardens (Millat et al., 1996). A systematic distribution pattern was not recognized in this study in line with the pattern reported by Zebene A. et al (2015) as some gardens have plant species haphazardly distributed; typical of random pattern. The lack of unified methodology in the study of home garden (Albuquerque et al., 2005) makes home garden structure to vary in different regions (Soemarwoto et al., 1985). Women play a significant role in home garden maintenance, although the idea of establishment is solely that of men. home garden vertical structure is haphazard because, some species established naturally but were later maintained when the use value was discovered. These plant species may have been introduced by agents of dispersal such as birds, wind and explosive mechanism. This study has once again proved that home gardens are useful sources of plant germplasm and center of bilogical diversity which mimics the natural forest even its structure/age.

The presence of multi-layer helps for efficient rainfall interception and reduces impact of raindrops in the soil. A relatively constant moisture and temperature level at ground level reduces water stress in period of low rainfall and maintains production. The structure and number of strata is mainly determined by the management and knowledge of the farmer (Clereck and Negreros-Castillo, 2000). The presence of shade tree is important for effective grain production through reducing temperature and helps for climate change adaptation especially for shade tolerant species (Helton et al., 2012).

Conclusion

The studied home garden is characterized by moderate species diversity, which are valuable for the local ecological system enhancement and farmers income. Species are maintained by farmers around their home in a varying degree with their ecological preference. Different species are also dominated in different canopy strata vertically.

Acknowledgements

The authors would like to thank all the people interviewed in the rural community of chirawonze for the opportunity to use their home gardens as study sites; for information given as well as hospitality and accommodation.

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