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The Role of Parkland for Conservation of Useful Plant Species Diversity in Arba Minch, Southern Ethiopia

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Abstract

This study was conducted in parkland of Arba Minch paradise lodge, Southern Ethiopia from February 2018 to May 2018 with the aim of documenting the plant species diversity; identify major use categories and major factors affecting the parkland of paradise lodge plant composition. Techniques used were focus group discussion, semi-structured interviews, lodge tour and free listing. A total of 124 useful plant species were documented, of which 68 (39.08%) were ornamental plants, 49 (28.16%) food plants, and 24 (13.79%) firewood plants. Fabaceae was the dominant family represented by 10 species, followed by Euphorbiaceae with 8 species each. Parkland of Paradise lodge host a number of endemic and threatened plants in Ethiopia. Species such as *Aloe gilbertii, Aloe otallensis, Enset ventricosum* were the endemic plant species and *Cordia africana, Juniperus procera, Podocarpus falcatus* and *Olea europea* were indigenous plants species which highly treated in the forest. The study indicates that parkland of paradise lodge are contributing to conservation of useful plant species through production of ornamental, food plants, fodder, medicinal, timber and construction. Knowledge gap in plant breeding, lack of planting materials and seeds, lack of agricultural support system, destruction by animals, disease infestation and lack of access to land were among the main factors that affect parkland of paradise lodge plant species diversity. The study recommended that the management of useful plant species in parkland of paradise lodge will be scaled up and further expanded and assisted by agricultural extensions.

Keywords: Parkland, paradise lodge, diversity, useful plant, Ethiopia

1. Introduction

Urbanization is recognized as one of the greatest threats to biodiversity throughout the World. However, the vegetation within an urbanized landscape is diverse and includes a variety of native and exotic plant species (Lerman and Warren, 2011). Green spaces within residential and lodge areas provide important contributions to the sustainability of urban systems. Researchers worldwide are beginning to recognize the potential contribution of residential and lodge landscapes and yards to overall urban sustainability (Goddard et al., 2009; Owen, 2010). In the past, these were often ignored, primarily because of their small scale but this view is quickly changing (Shackleton et al., 2008, Goddard et al., 2009). Even though the major benefits of residential and lodge yard vegetation may be variable, in terms of providing ecosystem services such

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as food supplies, mitigation of urban heat island and urban fragmentation effects, runoff reduction, and above-ground carbon storage; as well, residential and lodge vegetation may have positive effects on the quality of human life, health, and well-being (Davies et al., 2011; Cameron et al., 2012; Vila-Ruiz et al., 2014, Melese and Daniel, 2015).

The structural diversity of the vegetation in residential and lodge yards can be a good predictor of biological diversity in the urban environment (Müller et al., 2010; Vila-Ruiz et al., 2014). In fact, more scientists are now recognizing that green spaces in urban areas may have positive effects not only on the quality of life and wellbeing of humans, but also on overall urban biodiversity and ecological richness (Dunnett and Qasim, 2000; Müller et al., 2010).

Many studies confirmed that the floristic information from private residential and lodge spaces can provide valuable information about the quality of private gardens as resources for urban biodiversity (Smith et al., 2006, Thompson et al., 2003). It can also offer information about the functionality of yards based on the services that plant species may be providing by being ornamental, nutritional, or medicinal (Akinnifesi et al., 2010, Vila-Ruiz et al., 2014, Melese and Daniel, 2015).

Additionally, as commented by many authors, private residential and lodge are important for conservation of plant genetic resources (Abiyot and Zemede, 2014; Mekonnen et al., 2014; Zemede, 2002). Feleke (2000) and Solomon (2011) discussed the role of gardens for conservation in preserving traditional agricultural systems, plant species and the indigenous knowledge from severe exploitation. It is pointed out by Agelet et al. (2000) that gardens are useful mechanisms for conserving non-crop species and based up on the diversity present, can be considered as gene banks for primitive cultivars with potential values. In addition, as mentioned by Zemede and Ayele (1995) and Zemede (2001), gardens are being used as informal experimentation plots for new varieties and exotic species.

Arba Minch is a growing resort town in Southern Ethiopia, situated by two large lakes (Abaya and Chamo Lakes) that are separated by a land bridge. Lodges and hotels with a surrounding garden are a very common feature. However, no information is available about plant species diversity and its significance for plant biodiversity conservation and sustainability of urban systems. To gather information a survey was conducted on plant species diversity management practices and their contribution for plant diversity conservation in parkland of Arba Minch paradise lodges.

2. Materials and Methods

2.1. Description of the study area

Arba Minch is the capital town of the Arba Minch Zuria district; about 500 km from capital city of Ethiopia called Addis Ababa. The district has a latitude and longitude of 06°2'N 37°33'E with an altitude ranges from 1200 to 1285 meters above sea level (Mulugeta and Gemechu, 2016). The temperature of the area ranges between (17-30 °C). Rainfall distribution is bimodal mostly occurring in March, April and May and between September and November. Annual rainfall averages around 900 mm. The wet season includes March, April, May, September, October and November and the dry season includes December, January and February (Mulugeta and Erchafo, 2017). According to 2012 national census reported a total population for this woreda of 95,373, of whom 47,687 were men and 47,686 were women. Arba Minch is known as a source for fruit, including mango, banana, orange, apple, guava and pineapple, and is also known for its fish farms. Indicating its richness of fish a local singer named Abile Chedo sang the song "Nu Dere Gamo Gofa Oycha Arbaminche muziri kalsi yedes Abaya-Chamo mole".

2.2. Data collection

The study was carried out in the parkland of Arba Minch Paradise lodge in 2018. Field work was conducted during the period from February 2018 to May 2018. The site was visited three times including the reconnaissance survey. Techniques used were lodge tour, complete plant inventory, focus group discussion, semi-structured interviews and free listing (Reta, 2016). The interview and discussions was conducted in Amharic language and translated into English language during data analysis. Ethno botanical techniques were employed to collect data on knowledge and management of lodge plants in Arba Minch city as described in Martin (1995) and Cotton (1996). From total lodges in Arba Minch city, only one was selected purposely. The choice of the lodge was based on their proximity to Abaya campus, Arba Minch University, and the lodge garden practices, in which many plant species were dominated. During the different visits to the lodge semistructured interviews with both lodge gardener were conducted on different aspects: Categories of use of plants in the lodge; preferred useful plant species by lodge, planting material, challenges and constraints. Information obtained was recorded and coded for latter analysis. The collected materiel was indentified using the Flora of Ethiopia/ and Eritrea books (volumes 1-8), internet and botanist and assistance from the technical stuff of the Arba Minch university.

2.3. Data analysis

Data were analyzed using Microsoft Office Excel spreadsheet (2010). The Excel was used to calculate sum, percentages, tabulate and draw graphs. A descriptive statistic procedure like percentage and frequency distribution were employed for analyzing plant diversity, plant habit, and major use categories.

3. Results and Discussion

3.1. Taxonomic diversity of plants species in the parkland of paradise lodge

In the surveyed lodge a total of 124 plant species were

observed and identified (Appendix I - V). Among the total plant species recorded, 81 (65.32%) species were indigenous while the rest 43 (34.68%) were exotic useful plants managed to various degrees in the lodge. This result showed that parkland of Arba Minch paradise lodge is rich in plants species as shown by the presence of 124 species exhibiting wide taxonomic diversity. The relative high number of plant species in the study area may be due to the management of lodge includes tree planting, watering, weeding and fencing.

The plant species observed and identified belongs to 102

Appendix I: List of ornamental plants, their local name, family, status, duration

No	Scientific name	Family	Local Name	Habit
1.	*Acalypha wilkesiana* Mull. Arg.	Euphorbiaceae	Abeba	Shrub
2.	*Agave americana* L.	Agavaceae		Shrub
3.	*Agave americana var marginata*	Agavaceae		Shrub
4.	*Alcea rosea* L.	Malvaceae	Abeba	Herb
5.	*Aloe otallensis Baker*	Aloaceae	Rate	Herb
6.	*Aloe gilbertii* Reynolds	Aloaceae	Rate	Herb
7.	*Alocasia macrorrhizos* (L.)G.Don	Araceae	Elephant ears	Herb
8.	*Araucaria heterophylla* (Salisb.) Franco	Araucariaceae	Yeferejitid	Tree
9.	*Azadirachta indica* A.Juss.	Meliaceae	Neem	Tree
10.	*Boswellia neglecta* S.Moore	Burseraceae	Yebereha lomi	Tree
11.	*Bougainvillea glabra* Choisy	Nyctaginaceae	Yeserge abeba	Shrub
12.	*Bougainvillea spectablis* Willd.	Nyctaginaceae	Yeserge abeba	Shrub
13.	*Brugmansia×candida* Pers.(Pro.sp)	Solanaceae		Shrub
14.	*Canna indica* L.	Cannaceae	Enset abeba	Herb
15.	*Canna x generalis* L. H. Bailey	Cannaceae	Enset abeba	Herb
16.	*Chrysanthemum coronarium* L.	Asteraceae	Abeba	Herb
17.	*Casuarina cunninghamiana* Miq	Casuarinaceae	Shewshewe	Tree
18.	*Catharanthus roseus* (L.) G.Don	Apocynaceae	Abeba	Herb
19.	*Codiaeum variegatum* (L.) A.Juss.	Euphorbiaceae		Shrub
20.	*Combretum collinum* Fresen	Combretaceae		Tree
21.	*Cordyline fruticosa* (L.) A.Chev.	Agavaceae		Herb
22.	*Cupressus lusitanica* Mill.	Cupressaceae	Tsid	Tree
23.	*Cyperus rotundus* L.	Cyperaceae		Herb
24.	*Delonix regia* (Boj.ex Hook.) Ref.	Fabaceae	Yedirezaf	Tree
25.	*Dianthus caryophyllus* L.	Caryophyllaceae	Abeba	Herb
26.	*Dracaena afromontana* Mildbr	Dracaenaceae	Abeba	Tree
27.	*Dracaena steudneri* Engl.	Dracaenaceae		Tree
28.	*Duranta erecta* L.	Verbenaceae		Shrub
29.	*Epipiremnum aureum* (L.) Engi.	Araceae		Climber
30.	*Euphorbia antiquorum* L.	Euphorbiaceae		Herb
31.	*Euphorbia milii* (Bojerex Hook.) Ursch & Leandri	Euphorbiaceae		Shrub
32.	*Euphorbia tirucalli* L.	Euphorbiaceae	Kinchib	Shrub
33.	*Ficus benjamina* L.	Moraceae	Ornamental fig	Tree
34.	*Ficus elastica* Roxb.	Moraceae	Yegoma zaf	Tree
35.	*Grevillea robusta* R.Br.	Proteaceae	Temenjazaf	Tree
36.	*Hibiscus acetosella* Welw. ex Hiern	Malvaceae	Abeba	Shrub

Appendix I: Continue...

No.	Scientific name	Family	Local Name	Habit
37.	*Hibiscus rosa-sinensis* L.	Malvaceae	Abeba	Shrub
38.	*Hibiscus* spp.	Malvaceae	Abeba	Shrub
39.	*Hippeastrum puniceum* (Lam.) Kuntze	Amaryllidaceae	Abeba	Herb
40.	*Ipomoea purpurea* (L.) Roth	Convolvulaceae	Abeba	Climber
41.	*Jacaranda mimosifolia* D. Don.	Bignoniaceae	Jacaranda	Tree
42.	*Juniperus procera* Hochstex Engl.	Cupresaceae	Yabesha tsid	Tree
43.	*Lantana camara* L.	Verbenaceae	Yewof kolo	Shrub
44.	*Melia azedarch* L.	Meliaceae	Neem	Tree
45.	*Moringa oleifera* Lam.	Moringaceae	Halako	Tree
46.	*Nerium oleande* L.	Apocynaceae	Abeba	Shrub
47.	*Olea europaea* L. ssp. Cuspidata (Wall.ex G.Don) Cif.	Oleaceae	Weyira	Tree
48.	*Passiflora caerulea* L.	Passifloraceae	Yareg Abeba	Climber
49.	*Phalaris arundinaceae* L.	Poaceae	Sar	Herb
50.	*Phoenix reclinata* Jacq.	Arecaceae	Zembaba	Tree
51.	*Pelargonium zonale (L.)L'He'r. ex Aiton*	Geraniaceae	Abeba	Herb
52.	*Pinus patula* L.	Pinaceae		Tree
53.	*Plumeria alba* L.	Apocynaceae		Shrub
54.	*Plumeria rubra* L.	Apocynaceae		Shrub
55.	*Pyrostegia venusta* (Ker Gawl.) Miers	Bignoniaceae	Yareg Abeba	Climber
56.	*Rosa richardii* Hart.	Rosaceae	Tsigereda	Shrub
57.	*Sansevieria trifasciata* Prain.	Asparagaceae		Herb
58	*Schefflera arboricola* (Hayata) Merr.	Araliaceae	Umberella tree	Shrub
59.	*Solenostemon scutellarioides* (L.) Codd	Lamiaceae	Abeba	Herb
60.	*Spathodea campanulata* P. Beauv. ssp. nilotica.	Bignoniaceae		Tree
61.	*Tecoma capensis* (Thunb.) Spach	Bignoniaceae		Shrub
62.	*Tecoma stans* (L.) Juss ex kunth	Bignoniaceae		Shrub
63.	*Terminalia brownii* Fresen.	Combretaceae	Woybeta	Tree
64.	*Terminalia mentalis* (T. Mantaly)	Combretaceae		Tree
65.	*Thevetia peruviana* Luckey Nut (Eng.)	Apocynaceae		Shrub
66.	*Tradescantia pallida* (Rose) D.R.Hunt.	Commelinaceae	Abeba	Herb
67.	*Washigtonia robusta* (Lindl.) H.Wendl.	Arecaceae		Tree
68.	*Zamioculcas zamiifolia* (Lodd.et al) Engl.	Araceae		Shrub

genera and 58 families. Family wise distribution shows that the maximum plant species recorded in the lodge were for family of Fabaceae with 10 species followed by Euphorbiaceae with 8 species, Lamiaceae and Solanaceae each with 6 species, Apocynaceae, Araceae, Bignoniaceae and Poaceae each with 5 species, Meliaceae and Moraceae each with 4 species were found to be the most species rich families but some of the families like Agavaceae and Combretaceae each with 3 species, Aloaceae, Arecaceae, Asteraceae, Cannaceae, Cucurbitaceae, Cupressaceae, Dracaenaceae, Malvaceae, Moringaceae, Musaceae, Myrtaceae, Nyctaginaceae, Rutaceae and Verbenaceae each with 2 species and the rest of the families (32) were found to be the least species rich families (1 species each) (Figure 1). In the present study the majority of Arba Minch lodges even though they have large access of land, they contain low number of species diversity due to lack of knowledge gaps on cultivation, management and conservation of plant species.

3.2. Growth habit of plant species in the parkland paradise lodge

The results of growth form analysis of useful plants showed that trees made up the highest proportion being represented

Appendix II: List of food plant species documented in parkland of paradise Lodge

No.	Scientific name	Family	Local name	Habit	Parts Used
Vegetables					
1.	*Amaranthus hybridus* L.	Amaranthaceae		Herb	Leaves & Seed
2.	*Brassica carinata* A.Br.	Brassicaceae	Gomen	Herb	Leaves
3.	*Lycopersicon esculentum* Mill.	Solanaceae	Timatim	Herb	Fruit
4.	*Moringa stenopetala* L.	Moringinaceae	Shifera/Halako	Tree	Leaves
5.	*Solanum tuberosum* L.	Solanaceae	Dinchi	Herb	Root
Root Crops					
1.	*Colocasia esculeta* (L.) Schott	Araceae	Godere	H	Root
2.	*Dioscorea* spp.	Dioscoreaceae	Boyena	Climber	Root
3.	*Enseteventricosum* (Welw.) Cheesman	Musaceae	Enset	Shrub	Root
4.	*Manihot esculenta* Crantz	Euphorbiaceae	Casava	Shrub	Root
5.	*Solanum tuberosum* L.	Solanaceae	Dinchi	Herb	Root
6.	*Xanthosoma sagittifolium* (L.) Schott	Araceae	Godere Tukuru	Herb	Root
Fruit crops					
1.	*Annona squamosa* L.	Annonaceae	Gishta	Tree	Fruit
2.	*Carica papaya* L.	Caricaceae	Papaya	Tree	Fruit
3.	*Citrullus lanatus*	Cucurbitaceae	Habab	Climber	Fruit
4.	*Citrus aurantifolia* (Christm.) Swingte	Rutaceae	Lomi	Shrub	Fruit
5.	*Cucurbito pepo* L.	Cucurbitaceae	Duba	Climber	Fruit
6.	*Balanites aegyptica*	Balanitaceae	Bedena	Tree	Fruit
7.	*Dovyalis caffra* (Hook.f.&Harv.)	Flacaurtiaceae	Koshim	Tree	Fruit
8.	*Ficus sur* Forssk.	Moraceae	Shola	Tree	Fruit
9.	*Mangifera indica* L.	Anacardiaceae	Mango	Tree	Fruit
10.	*Musa x paradisiacal* L.	Musaceae	Muzi	Shrub	Fruit
11.	*Persea americana* Mill.	Lauraceae	Avocado	Tree	Fruit
12.	*Psidium guajava* L.	Myrtaceae	Zeyitun	Tree	Fruit
Cereal, pulses and oil crops					
1.	*Arachis hypogaea* L.	Fabaceae	Ocholoni		
2.	*Cajanus cajan* (L.) Mill.	Fabaceae	Yewef Ater	Shrub	Seed
3.	*Canavalia africana* L.	Fabaceae	Adenguare	Herb	Seed
4.	*Jatropha curcas* L.	Euphorbiaceae	Tsedaki	Shrub	Seed
5.	*Phaseolus vulgaris* L.	Fabaceae	Boloke	Climber	Seed
6.	*Ricinus communis* L.	Euphorbiaceae	Gulo	Shrub	Seed
7.	*Zea mays* L.	Poaceae	Bekolo	Herb	Seed
Spices plant species					
1.	*Capsicum annuum* L.	Solanaceae	Mitmita	Herb	Fruit
2.	*Capsicum frutescens* L.	Solanaceae	Kariya	Herb	Fruit
3.	*Coriandrum sativum* L.	Apiaceae	Dimbilal	Herb	Fruit
4.	*Menta spicata* L.	Lamiaceae	Nana	Herb	Leaves
5.	Ocimum basilicum L.	Lamiaceae	Besobila	Herb	Seeds, leaves

Appendix II: Continue...

No.	Scientific name	Family	Local name	Habit	Parts Used
6.	*Ruta chalpensis* L.	Rutaceae	Tenadam	Herb	Leaves
7.	*Rosmarinus officinalis* L.	Lamiaceae	Siga metbesha	Shrub	Leaves
8.	*Thymus schimperi*	Lamiaceae	Tosign	Herb	Leaves
Stimulant plant species					
1.	*Coffee arabica* L.	Rubiaceae	Buna	Shrub	Seed
Fragrant plant species					
1.	*Cympogen citrates* (DC.) Stapf.	Poaceae	Teji Sar	Herb	Leaves
2.	*Ocimum lamiifolium* Hochst.ex Benth.	Lamiaceae	Demakase	Shrub	Leaves
3.	*Olea europea*	Oleaceae	Weyira	Tree	Stem/Leaves
4.	*Ruta chalepensis* L.	Rutaceae	Tenadam	Herb	Leaves
5.	*Rosmarinus officinalis* L.	Lamiaceae	Siga metibesha	Shrub	Leaves
Fodder plant species					
1.	*Cynodon dactylon* (L.) Pers	Poaceae	Serdo	Herb	Leaves
2.	*Pennisetum puprureum* Schumach	Poaceae	Elphant grass	Herb	Leaves
3.	*Sesbania sesban* L. Merr	Fabaceae		Shrub	Seed
4.	*Vetiveria zizanioides* (Linn.) Nash	Gramineae		Herb	Leaves
5.	*Vernonia amygdalina* Del.	Asteraceae	Girawa	Tree	Leaves

Appendix III: List of medicinal plants documented in the parkland of paradise lodge

	Scientific name	Family	Local name	Habit	Parts used	Disease treated
1.	*Aloe vera* L.	Aloaceae	Rate	Herb	Stem	Malaria, wound
2.	*Aloe gilbertii* Reynolds	Aloaceae	Rate	Herb	Stem	Malaria, wound
3.	*Azadiachta indica* A. Juss.	Meliaceae	Neem	Tree	Leaves	Malaria
4.	*Carica papaya* L.	Caricaceae	Papaya	Tree	Leaves	Malaria
5.	*Coffee arabica* L.	Rubiaceae	Buna	Shrub	Seeda	Gastric illness and Wound
6.	*Dodonaea angustifolia*	Sapindaceae	Kitkita	Shrub	Stem	Tooth ace
7.	*Eucalyptus globulus*	Myrtaceae	Nechi barzaf	Tree	Leaves & Fruit	Common cold & Insect repellent
8.	*Euphorbia tirucalli*	Euphoriaceae	Kinchib	Shrub	Stem fluid	Hemorrhoid
9.	*Juniperus procera*	Cupressaceae	Yeabesha tid	Tree	Fruit	Insect repellent
10.	*Melia azedaracha*	Meliaceae	Neem	Tree	Shoot tip	Malaria, toothache
11.	*Moringa stenopetala* L.	Moringaceae	Halako/Shiferaw	Tree	Leaves	Malaria, hypertension
12.	*Olea europaea* ssp. cuspidata	Oleaceae	Weyira	Tree	Stem & Leaves	Tooth ache & Insect repellent
13.	*Ocimum lamiifolium*	Lamiaceae	Demakese	Shrub	Leaves	Sun stroke & Headach
14.	*Podocarpus falcatus* (Thunb.) Mirb	Podocarpaceae	Zigba	Tree	Stem bark	Jaundice
15	*Ruta chalepensis* L.	Rutaceae	Tenadam	Herb	Leaves	Stomach problem
16.	*Ricinus communis* L.	Euphorbiaceae	Gulo	Tree	Root	Pneumonia
17.	*Sesbania sesban* (L.) Merr.	Fabaceae		Shrub	Root	Body swelling
18.	*Solanum incanum* L.	Solanaceae	Emboy	Shrub	Root	Intestinal parasities
19.	*Vernonia amygdalina* Del.	Asteraceae	Girawa	Tree	Leaves	Malaria

Appendix IV: Timber (Furniture) tree species encountered in the study area

No.	Scientific name	Family	Local name	Habit
1.	*Acacia polyacantha* Willd.	Fabaceae	Girar	Tree
2.	*Azadirachta indica*	Meliaceae	Neem	Tree
3.	*Balanites aegyptiaca* (L.) Del.	Balanitaceae	Bedena	Tree
4.	*Casuarina cunninghamiana* Miq	Casuarinaceae	Shiwashiwe	Tree
5.	*Cordia africana* Lam.	Boraginaceae	Wanza	Tree
6.	*Cupressus lusitanica* Mill.	Cupresaceae	Yeabesha Tid	Tree
7.	*Eucalyptus globulus*	Myrtaceae	Nechi barzaf	Tree
8.	*Ficus sur* Forssk.	Moraceae	Shola	Tree
9.	*Ficus vasta*	Moraceae	Warka	Tree
10.	*Grevillea robusta* R.Br.	Proteaceae	Grevila	Tree
11.	*Juniperus procera*	Cupresaceae		Tree
12.	*Melia azedarch* L.	Meliaceae	Neem	Tree
13.	*Pinus patula* L.	Pinaceae		Tree
14.	*Podocarpus falcatus* (Thunb.) Mirb.	Podocarpaceae	Zigba	Tree

Appendix V: List of plants used as fire wood

No.	Scientific name	Family	Local name	Habit
1.	*Acacia mellifera* (Vahl) Benth.	Fabaceae	Giral	Tree
2.	*Acacia polyacantha* Willd.	Fabaceae	Giral	Tree
3.	*Acacia seyal* Del.	Fabaceae	Giral	Tree
4.	*Acacia tortilis* (Forssk.) Hayne	Fabaceae	Giral	Tree
5.	*Azadirachta indica*	Meliaceae	Neem	Tree
6.	*Casuarina cunninghamiana* Miq.	Casuarinaceae	Shewshewe	Tree
7.	*Combretum collinum* Fresen.	Combretaceae		Tree
8.	*Cordia africana* Lam.	Boraginaceae	Wanza	Tree
9.	*Cupressus lusitanica* Mill.	Cupresaceae	Tsid	Tree
10.	*Dodonaea angustifolia* L.	Sapindaceae	Kitkita	Tree
11.	*Eucalyptus globulus*	Myrtaceae	Barzaf	Tree
12.	*Ficus sur* Forssk.	Moraceae	Shola	Tree
13.	*Ficus vasta*	Moraceae	Warka	Tree
14.	*Grevillea robusta* R.Br.	Proteaceae	Gravila	Tree
15.	*Jacaranda mimosifolia* D.Don	Bignoniaceae	Jakeranda	Tree
16.	*Melia azedarch* L.	Meliaceae	Neem	Tree
17.	*Olea europaea L.ssp. Cuspidata* (Wall.ex G.Don) Cif.	Oleaceae	Weyira	Tree
18.	*Pinus patula* L.	Pinaceae	Shiwashiwe	Tree
19.	*Podocarpus falcatus* (Thunb.) Mirb.	Podocarpaceae	Zigba	Tree
20.	*Sesbania sesban* (L.) Merr.	Fabaceae		Tree
21.	*Spathodea campanulata* P.Beauv. ssp. nilotica.	Bignoniaceae	spatoda	Tree
22.	*Vernonia amygdalina* Del.	Asteraceae	Girawa	Tree
23.	*Balanites aegyptiaca* (L.) Del.	Balanitaceae	Bedena	Tree
24.	*Ziziphus spina-cristi* (L.) Desf.	Rhamaraceae	Kurkura	Tree

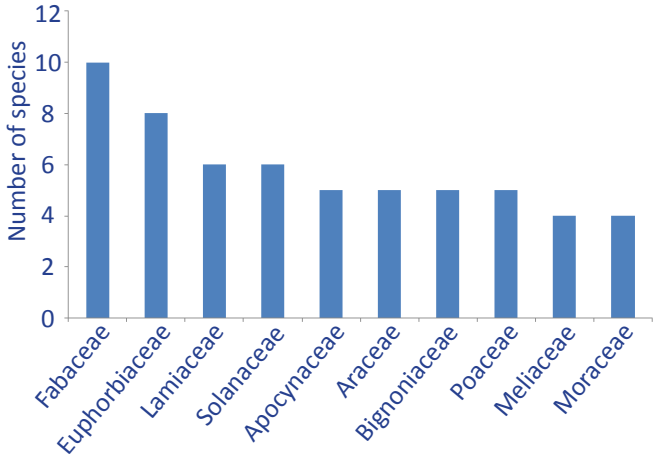

Figure 1: Plant species contribution of major plant families in the area

with 43 species (34.68%) followed by herbs 38(30.65%), shrubs 35(28.23%) and climbers 8(6.45%). Trees and herbs make up the highest proportion (65.33%) of the plant species (Figure 2). This could be related to the fact that the lodge are dominated by trees and herbs species due to environmental condition. This and field observation during data collection clearly confirmed the occurrence of high management in matured tree, shrub and herb of the lodge by watering, weeding and fencing. The result of getting more number of tree species agreed with that of Melese and Daniel (2015) and Chaminda and Rasika (2014).

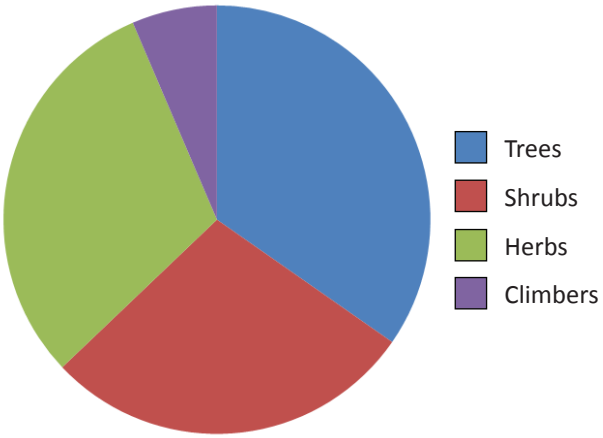

Figure 2: Growth forms of useful plants in percentages from parkland

3.3. Major use categories of plants species in the parkland paradise lodge

The result of the study showed that the plant species identified in the study area were placed into various use categories. Most of the plants species grown in the surveyed lodge have multiple uses and therefore they not only fulfill the nutritional requirement but also in one or other case the monitory needs of the lodge by the sold of the products in the lodge. For this study, five major plant use categories were identified (Figure 3). Moreover, the result on use of garden plants for diverse benefits agreed with the reports of Hoft et al. (1999) and Ashenafi (2009) in that indigenous people often have a wealth of knowledge and experience about local plant resource and rely on them for food, medicine, construction, firewood and so on. The lodge is not only important sources of food, fuel, medicines, spices, construction materials and fodder but are also important for in-situ and ex-situ conservation of a wide range of plant genetic sources.

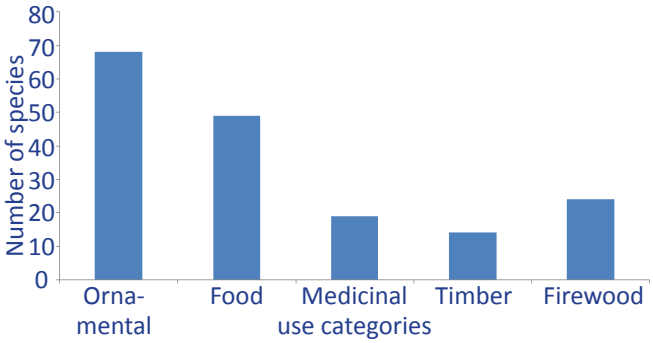

Figure 3: Plant species share of use categories identified during the study

3.3.1. Ornamental plants species

The most plant species cultivated in the parkland of Arba Minch paradise lodge were ornamental plants (Figure 4). Ornamental plant species are the most diversified, abundant and species rich use category. The ornamental plant use category consisted of 68(39.08%) species from which 22

Figure 4: Continue...

Figure 4: Some of ornamental plant in the study area

(32.35%) are native to Ethiopia, 46 (67.65%) is exotic. The ornamental plant species are distributed among 38 families with Apocynaceae, Bignoniaceae, Euphorbiaceae (5 species each) and Malvaceae (4 species each) presented the largest number of species corresponding to 27.94% of the total ornamental plants found in the parkland of paradise lodge. The major contributor to diversity of urban environments is horticultural floras which are mostly characterized by ornamental plants and vegetables (Marco et al., 2008). According to Nair (1993), the high number of ornamental plants is associated with the aesthetic role of gardens in cities. The number of ornamental plants has increased in areas near, as well as in urban areas in response to the process of modernization and the large supply of these plants in cities (Moura and Andrade, 2007). Most of the plants surveyed in the parkland of Arba Minch paradise lodge are exotic and widely disseminated throughout Arba Minch city. The most frequently distributed ornamental plants are *Melia azedarch*, *Jacaranda mimosifolia, Cupressus lusitanica, Callistemon citrinus*, *Hibiscus rosa-sinensis*, *Senna spectabilis, Duranta repens, Duranta erecta, Bougainnvillea glabra, Nerium olander*, *Terminalia mentalis, Araucaria heterophylla*, *Thevetia peruviana, cupercus lustantica* and *Ficus benjamina.*

3.3.2. Food plants species

The food plant constitutes 49(28.16%) species of the total useful plant flora of parkland paradise lodge. Among food plants fruits comprises 12(24.49%), spices 8(16.33%), cereals, pulses and oils 7(14.29%), root and tuber crops 6(12.24%), vegetables, stimulant and fodder 5 (10.20% each) and stimulant is the least 1 (2.04%) (Figure 5 and 6). A high number of food plants belonged to the Lamiaceae (6 species) followed by Fabaceae and Solanaceae (5 species each), Poaceae (4 species), Euphorbiaceae and Rutaceae (3 species each). The most widely distributed food crops are *Zea mays* with a frequency of occurrence, *Enste ventricosum*, *Musa paradisiaca*, *Mangifera indica, Carica papaya*, *Persea americana, Sccharum officinarum* and *Brassica rapa*. The majority food crops cultivated are used for household consumption. Fruit species commonly found in the study parkland of paradise lodge are Papaya (*Carica papaya*), Banana (*Musa paradisiaca*), Avocado (*Persea americana*) and

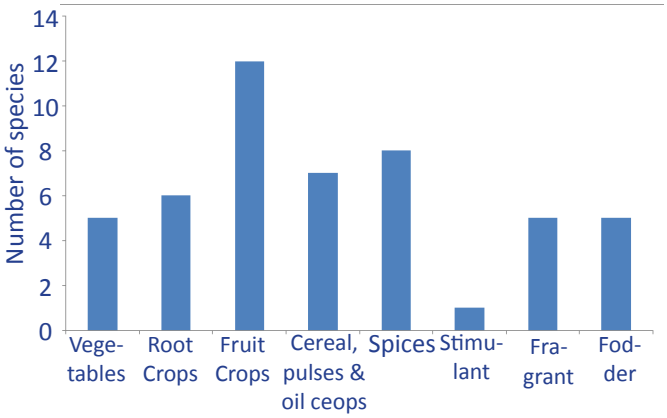

Figure 5: Number of food plant species in the study area

Figure 6: Some of food plant in the study area

Mango (*Mangifera indica*). The most commonly used spices were *Capsicum annuum, Capsicum frutescens, Coriandrum sativum, Menta spicata, Ruta chalpensis, Rosmarinus officinalis Ocimum basilicum.* The most commonly used fragrant plant species in the majority of home gardeners were *Olea europea, Cympogen citrates and Ocimum lamiifolium.*

3.3.3. Medicinal plants species

A total of 19 plant species with medicinal value were recorded

and this accounted for (10.92%) of the total plant species documented. Species of family Lamiaceae and Aloaceae were the most used for remedies representing nearly 26.32% of all medicinal plants. The majority of medicinal plants are trees 10 (52.63%) followed by shrubs 6(31.58%) and herbs 3(15.79%). The most frequently utilized plant parts were leaf 8(38.10%), stem 6(28.57%) followed by root 3 (14.29%) (Figure 7). Ninety seven percent of medicinal plants documented in the study area are indigenous. Top ten medicinal plants species commonly used were *Moringa stenopetala, Ocimum lamiifolium, Ruta chalepensis, Solanum incanum, Vernonia amygdalina, Eucalyptus globulus, Carica papaya, Azadiachta indica, Coffee arabica* and *Dodonaea angustifolia.*

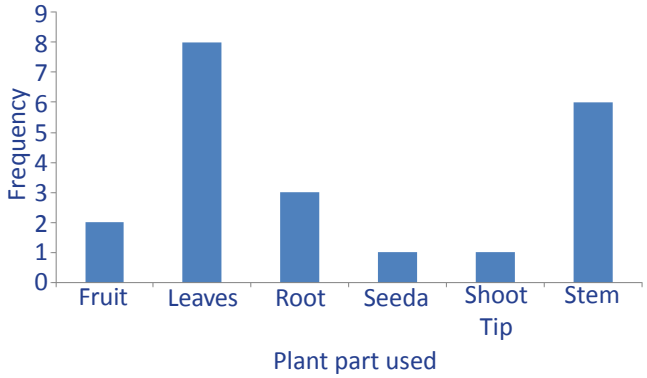

Figure 7: Number of plant part used for medicinal purpose

3.3.4. Timber (furniture) plants species

Timber plant species constitue 14 plant species which accounted 8.05% of all plant species documented. Timber plant species which frequently occurred in the parkland of paradise lodge namely *Melia azedarch, Grevillea robusta, Cupresuss lustanica, Cordia africana* and *Podocarpus falcatus.* Among 14 plant species recorded 3 were indigenous plants which were highly treated in the forest namely *Juniperus procera, Podocarpus falcatus* and *Olea europea*.

3.3.5. Firewood plant species

The results of the study revealed that a total of 24 plant species which accounted 13.79% belonging to different family with different habit (shrub and tree) were recognized in parkland of paradise lodge. Of the plant species, about 21 were trees and 3 were shrubs. The maximum plant species recorded in the lodge was for family of Fabaceae. Firewood plant species which frequently occurred in the park land of paradise lodge namely *Eucalyptus globulus*, *Melia azedarch, Grevillea robusta, Cupresuss lustanica, Cordia africana* and *Podocarpus falcatus.* Among 24 plant species recorded 16 were indigenous and the rest exotic plant species.

3.4. Endemic and threatened plant species

Conservation usually focuses on either endemic, threatened or economically, ecologically and culturally useful plant species. The parkland of paradise lodge contains a number of flowering plant species that are endemic to Ethiopia. Endemic plant species of Ethiopia and their level of threat have been given in Ensermu et al. (1992) and Vivero et al. (2005). Consequently, the parkland of paradise lodge host a number of endemic and threatened plants in Ethiopia (Figure 8). *Aloe gilbertii, Aloe otallensis, Enset ventricosum* were the endemic plant species identified from the parkland of paradise lodge (Hedberg and Edwards, 1989; Edwards et al., 1995; 1997; 2000; Hedberg et al., 2004). Some indigenous plants species which were highly treated in the forest namely *Cordia africana, Juniperus procera, Podocarpus falcatus* and *Olea europea.*

Figure 8: Some of Endemic and threatened plant species in the study area

3.5. Gardener role in the parkland Lodge plant species management

The management of lodge includes tree planting, watering, weeding and fencing. The gardeners maintain the lodge soil fertility by using animal manure and leaf litter. Both men and women are involved in the management of lodge parkland. Mostly the people are spent most of their time in the management of parkland in the paradise lodge. Some men and women managed plant species diversity by planting, watering and weeding while other managed by cultivation of food crops, ornamental, medicinal plants, fencing, digging, designing, searching seeds and other activities. Most youth participated in the cultivation of ornamental plants near road side, bed rooms and green space area of the lodge for recreation, enjoyment and gardens attractive for guests (Figure 9).

Figure 9: The role of men and women in the management of parkland in paradise lodge

3.6. Factors that affect plant species diversity of parkland in paradise lodge

According to the semi structured interview report the main constraints of parkland were knowledge gap in plant breeding, lack of planting materials and seeds, lack of agricultural support system, destruction by wild animals and disease

infestation. The main source of planting materials in the study area are market, cultivating in their gardens and from relatives. Agricultural office and institute are also another source of planting materials.

4. Conclusion

Among the 124 species identified, Fabaceae was dominant followed by Euphorbiaceae. The populations are composed of ornamental (68), food (49), medicinal (19), timber (14) and firewood (24). The present study indicates that high useful plant species diversity documented in the park land of Arba Minch paradise lodge was associated with the management of lodge includes tree planting, watering, weeding and fencing. The number of ornamental plant species diversity in the study area is higher. Conservation of useful plant species needs attention in Ethiopia in general and Arba Minch city in particular.

5. Acknowledgement

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