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Woody Plant Species Diversity, Relative Abundances and Distribution in Dire Dawa University

Legesse Tadesse*

[1]*Department of Biology, Dire Dawa University, E-mail: legesetadese2004@gmail.com ,*
☎ +251 (0) 911956570; 🖂 1362, Dire Dawa, Ethiopia
**Corresponding Author*

Abstract

The purpose of this study was to ascertain the composition, diversity, distributional pattern, and present management of woody species in the Dire Dawa University (DDU) complex. Woody plant cultivation is a well-known land use practice at the university that serves instructional, windbreak, ornamental, recreational, and biodiversity protection purposes. This study's goal was to determine the relative richness, diversity, and density of woody plant species and how they are managed in the study area. From the 34 plots in the University Compound that were specifically chosen, several species were identified using a straightforward inventory procedure. In each plot, woody species were counted to evaluate the plantation's species richness and diversity evenness, diversity indices, relative frequency, and density were used. The management practice determine the plant species diversity with the plantation system during the past 12 or more years at the university was investigated using a focal person interview. For statistical analysis, Fast Software and Microsoft Excel 16 were employed. The study identified 41 distinct species of woody plants from 24 distinct families. There were more species in the families: Fabaceae, Bignoniaceae Malvaceae, and Moraceae had more than two species. In terms of habit, trees represented the majority (68.3%) of the species, while shrubs comprised the remainder (31.7%). The results of the finding for Shannon, Simpson, and evenness were, 2.882, 0.895, and 0.772, respectively. In the DDU compound, *Azadirchta indica* was the species that was most prevalent (27.71%), followed by *Nerium oleander* (7.9), *Sophora japonica* (6.6%), and *Delonix regia* (7%). The current findings showed that the studied area had a significant amount of genetic diversity. The plantation did not, however, achieve its objective as anticipated owing to a shortage of skilled employees and other related circumstances; as a result, management had to give proper attention to feature plantation. The research suggested that in the future, skilled staff should monitor, scale up, and further expand the plantation and management of valuable aesthetically pleasing and edible plant species in the university's assets for the coming generation.

Key words/Phrases: Dire Dawa University; management practice; plantation; species diversity; woody plants

**Corresponding author: Legesse Tadesse; email: legesetadese2004@gmail.com ; Cell phone: +251911956570*

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1. Introduction

Ethiopia has a wide variety of plant species. Due to Ethiopia's complex ecological systems, both native and foreign woody plants have been able to flourish in a range of circumstances (Aklilu *et al.*, 2022). A century ago, the country's complete area was covered by woods to the amount of 40%. From 40% in 1900 to 16% in 1954, 8% in 1961, 4% in 1975, 3.2% in 1980, and currently it is projected to be less than 3%, the spatial pattern of the forest has rapidly decreased (Getahun and Ginjo, 2020). Between 1973 and 2013, a substantial loss of woods (54 percent) was recorded in Ethiopia’s central rift valley, whereas agricultural rose by 38.78 percent, grassland increased by 11.12 percent, and bare land increased by 40 percent (Mesfin *et al.*, 2020). In fact, with a population growth rate of 3%, followed by deforestation and land degradation, vegetation resources in all regions of the nation did not be used wisely (Tesfaye *et al.*, 2015; Newton and Cantarello, 2015). Land usage in cities has significantly changed recently as a result of expanding agricultural land and rising urbanization. The average covering area of woody plants in city yards has been declining (Cardel's *et al.*, 2019; Scull *et al.*, 2017; Solomon *et al.*, 2018) due to the expanding population and the increasing demand for resources that are already accessible, such as infrastructure and forest products. The reduction in rainfall and inadequate forest management techniques exacerbate this loss of plant covering. Currently, mass mobilization is used to plant woody plants and forest resources that provide shade, food, and ways to conserve soil and water in DDA generally and DDU specifically. The compound in DDU has been planted by perennial plants since its establishment, at least to change the unsuitable micro and macroclimate in the DDU compound linked to its establishment in 2006. Numerous and similar research on the variety of plants in various parts of the world has been conducted (Banda *et al.*, 2006; DeFries *et al.*, 2010). Hence, designing a management strategy that is economically sustainable, socially acceptable, and environmentally viable in order to alter the microclimate and provide the university communities with sufficient shade against intense sunshine is a crucial first step (Mebrat, 2015).

In this regard, the Ethiopian government, particularly the Dire Dawa Administration, has designed and implemented a number of conservation strategies, including soil and water conservation, sustainable land management, green legacy, integrated watershed management, forest restoration, and rehabilitation programs. These strategies significantly encourage the university communities to actively participate in plantation of the compound for the last 12 years. It is important for preserving biodiversity, restoring vegetative cover, and enhancing local and university residents' quality of life by creating a good working environment (Tefera *et al.*, 2005). In order to understand the management of various species to contribute to food security, climate regulation, income generation, soil conservation, plant diversity, and wind break, it is crucial to identify the factors influencing plantation and related issues. The microclimate and macroclimate have been intentionally changed and manufactured to be comfortable for the university community (Aklilu *et al.*, 2022). However, DDU plantations currently have many gaps in managing which plants can grow where and how well as expected in urban areas. It was crucial to evaluate the diversity of woody species, management strategies, and other related issues. Formerly there were no reports or enough information on the diversity, use value, distribution pattern, management of woody plants in DDU compound vegetation systems. The objective of this study was to assess the diversity and management practice of cultivated woody plants in the DDU compound.

2. Materials and Methods

2.1. Description of the study area

Dire Dawa University (DDU) is a public institution founded in 2006. It is situated in Dire Dawa city 02 kebele and partly bounded by Shinile District, Somali National Regional State. Dire Dawa town is situated between 90 25'N and 90 45'N latitude and 410 40′E and 420 10′E longitude in the huge East African rift valley. Oromia National Regional State borders it on the south and south-west, while Somali Regional State borders it on the north, east, and west. The city is situated at the base of nearby mountains. A total of 1288 km2 is occupied by Dire Dawa's urban and rural areas. Dire Dawa is between 1000 and 1600 meters above sea level. Mountains in the watershed can be found up to 2400 meters above sea level. According to Ethiopia's projected statistics report for 2013, the population of Dire Dawa is predicted to be around 535 684, with an annual growth rate of 3.2% (CSA, 2013). The research region has an unpredictable rainfall environment with an annual mean rainfall of 1760 mm and two distinct seasons, one dry from December to January and the other extended from March to November. Dire Dawa has generally semi-arid (kola) climatic conditions. Temperature is hot throughout the year with minor seasonal variations. Sandy soil and a nearly plain landform make it suitable for planting.

2.2. Data Collection

An intensive inventory field work was conducted during the months of November to June 2023. The predominant vegetation sites including the initial reconnaissance study was surveyed to identify the most appropriate transect and to frame the plots systematically. Three transect lines were laid following the coble road lines and quadrats of size 10 m × 10 m by 34 (3400 m^2) were established systematically with variable intervals. The choice of the plots was based on the presence of plants that had been intentionally produced, which excludes Toni farm, the building area and the football plain. The vegetation area of the DDU, a thorough inventory and identification of woody plants were used. Focal person discussions with three respondents directly or indirectly engage in plantation and management of vegetation’s for the last 12 or more years were used with semi-structured interviews to collect information mainly on management practice and care of woody plants. During data processing, the Amharic-language interview and field observation were also used. The native names of the many types of woody plants and their numbers were meticulously documented. Plant species that were challenging to identify in the field were collected, photographed, and identified using digital technology and with the help of departmental botanists. The names of the recognized pictures were then verified. Additional verification of identification was also carried out using Bekele's (2007) work and the flora of Ethiopia and Eritrea (Edwards *et al.*, 1997, 2000; Hedberg *et al.*, 2003).

2.3. Data analysis

The relative frequency and abundance of species were calculated using descriptive statistics. Utilizing PAST, the indices of species richness, diversity, and evenness were derived after accurately encoding the parameters into the correct formula (Rosenzweig, 1995). The species diversity was measured and analysed using the Shannon-Wiener diversity index (H′), Simpson's diversity index (Kent and Koker 1992; Perry and McIntosh, 1991; Krebs, 1999), Menhinick’s index as computed by the following formulas as described by Daniel *et al.* (2023).

Shannon-Weaver diversity index (H′)

The Shannon-Weaver diversity index (H’) as described by Perry and McIntosh (1991)

$$H' = -\sum_{i=1}^{S} p_i \ln p_i$$

is given as

Where, H′ = Shannon-Wiener index of species diversity

s = number of species in community

pi = proportion of total abundance represented by i^{th} species

The calculation of species richness by using Menhinick’s index (which index is based on the ratio of the number of species(S) and the square root of the total number of individuals(N) IMn=S/√N)

Evenness:

Species evenness is a diversity index, a measure of biodiversity which is used to measure the homogeneous distribution of woody plant species in sample plot (Krebs, 1999). The evenness
of a population was calculated by;

$$E = \frac{H'}{H_{\max}} = \frac{H'}{\ln S} \text{ with } H_{\max} = \ln S$$

Where, E = Evenness

H′ = Calculated Shannon-Wiener diversity

Hmax = ln(s) [species diversity under maximum equitability conditions]

S = the number of species,

Pi = proportion of individuals of the i^{th} species or the proportion of the total Species

The more evenly distributed a species is within a community, the higher the E value. Equitability presupposes a value in the range between 0 and 1, with 1 denoting total evenness. In a similar vein, the more varied the community or region, the greater the value of H'.

Simpson’s diversity Index:

For this investigation, Simpson's diversity index was also applied simpson's diversity index is the most sensitive to changes in these species (Magurran,1988). In this instance, a rise in Simpson (1-D) value corresponds to a rise in diversity. The Shannon diversity index's typical range of values in ecological data is 1.5–3.5.

$$\text{Simpson's index of diversity} = 1-(D)^2; \quad D = \frac{\sum n_i(n_i - 1)}{N(N-1)}$$

Where D = Simpson's index
n = The total number of organisms of a particular species
N = The total number of organisms of all species

Structural data analysis is the most crucial structural criteria to take into account while analysing vegetation data is the density of woody species as well as presence or absence of a given species within each sample plot (frequency) need to be evaluated in the study area (Moreno-Casasola *et al.*, 2011). Hence, characterization of woody plants structure density, relative density, frequency was analysed based on the following formula as described by Mengistu and Asfaw (2016).

$$\text{Density} = \frac{\text{Total number of individuals}}{\text{Sample area (ha)}}$$

$$\text{Realtive Density} = \frac{\text{Total number of individuals of a species}}{\text{Total number of individual of all species}} \times 100$$

$$\text{Frequency (\%)} = \frac{\text{Frequency of a species}}{\text{Total number of sample plot}} \times 100$$

$$\text{Realtive Frequency} = \frac{\text{Frequency of a species}}{\text{Frequency of all species}} \times 100$$

3. Results and Discussions

3.1. Species diversity

A total of 41 woody plant species from 26 families were identified. The Fabaceae family, which comprised the majority of the families, contributed the most abundant species to the total (19.5%) followed by Bignoniaceae (9.7%), Malvaceae (7.3%) and Moraceae (7.3%). The others thee families contributed (Apocynaceae, Meliaceae, Proteaceae) each with two (4.8 %) species. One species each was used to represent the remaining 14 families. Similar surveys were conducted at Hawassa Teacher Education College, which had a high species variety, with Fabaceae being the second most common family (Reta Regassa 2013). Families Fabaceae and Euphorbiaceae each including seven and three species respectively, were the most diversified among the woody species. In terms of their habit distribution, 26 (63.4%) of the overall species of woody plants were trees, and 13 (31.6%) were shrubs (Table 1). The investigation indicated that the various woody plants adapted to semi-arid environments are cultivated in the University primarily based on their space requirements and capacity to thrive in dry and semi-arid climates (Table1). Similar study was also conducted at Haramaya University by Eba and Lenjisa (2017) identifying 34 species on site one and 40 species in sites two of the university. Similar study was also conducted by Amanual and Gemedo (2018) Yemrehane Kirstos Church Forest of Lasta Woreda, North Wollo Zone, Amhara Region, identified most abundant woody species in their order of density were *Juniperus procera*, *Olea europaea*, *Maytenus arbutifolia*, *Osyris quadripartite*, *Calpurnia aurea*, and *Debregeasia saeneb*.

Table 1. Observed plant species with their family, habit, number of individuals, frequency, relative frequency, density and relative density at Main campus, Dire Dawa University

S.No.	Vernacular name	Scientific name	Family	Habit	N	Frequency	RF%	D/ha	RD%	E/I *
1	Neem tree	*Azadirachta indica*	Meliaceae	T	486	14.294	0.277	1429.41	0.277	E
2	Lemon	*Citrus limon*	Rutaceae	T	17	0.500	0.010	50.00	0.010	E
4	Oleander	*Nerium oleander*	Apocynaceae	S/T	139	4.088	0.079	408.82	0.079	E
6	Chinese hubiscus	*Chinese hibiscus*	Malvaceae	S/T	11	0.324	0.006	32.35	0.006	E
7	Yellow oleander	*Thevetia peruviana*	Apocynaceae	S	31	0.912	0.018	91.18	0.018	E
8	Moringa	*Moringa oleifera*	Moringaceae	T	75	2.206	0.043	220.59	0.043	E
9	Pongame oil tree	*Pongamio pinnata*	Fabaceae	T/S	51	1.500	0.029	150.00	0.029	E
10	Jerusalem thorn	*Parkinsonia acuelata*	Fabaceae	T/S	39	1.147	0.022	114.71	0.022	E
11	White lead tree	*Leucaena leucocephala*	Fabaceae	T	111	3.265	0.063	326.47	0.063	E
12	Japanese pagoda	*Sophora japonica*	Fabaceae	T	116	3.412	0.066	341.18	0.066	E
13	Acerola cherry	*Acerola cherry*	Malphigiaceae	T	27	0.794	0.015	79.41	0.015	E
14	Fire	*Terminalia browni*	Malvaceae	T	28	0.824	0.016	82.35	0.016	E
15	African tulip tree	*Spathodea campanulata*	Bignoniaceae	T	58	1.706	0.033	170.59	0.033	E
16	Indiyan banyan	*Ficus benghalensis*	Moraceae	T	10	0.294	0.006	29.41	0.006	E
17	Princess tree	*Paulownia tomentosa*	Paulowniceae	T	5	0.147	0.003	14.71	0.003	E
18	Kapok tree	*Geiba pentandra*	Malvaceae	T	58	1.706	0.033	170.59	0.033	E
19	Royal poincana	*Delonix regia*	Fabaceae	T	123	3.618	0.070	361.76	0.070	E
20	Rubber plant	*Ficus elastica*	Moraceae	T	5	0.147	0.003	14.71	0.003	E
21	Ombu	*Phytolacca dioica*	Phytolaccaceae	T	43	1.265	0.024	126.47	0.024	E
22	Coffee	*Coffee arabica*	Rubiaceae	T	2	0.059	0.001	5.88	0.001	I
23	Peruvian pepper tree	*Schinnus molle*	Anacardiaceae	T	6	0.176	0.003	17.65	0.003	E
24	Desert false indigo	*Amorpha fruticosa*	Fabaceae	S	59	1.735	0.034	173.53	0.034	E
25	Yellow trumpetbush	*Tecoma stans*	Bignoniaceae	S/T	20	0.588	0.011	58.82	0.011	E
26	China berry tree	*Melia azedarach*	Meliaceae	T	18	0.529	0.010	52.94	0.010	E
27	Japan spoku	*Cryptomeria japonica*	Cupressaceae	T	18	0.529	0.010	52.94	0.010	E

28	Grafilia	*Grevillea caleyi*	Proteaceae	S	5	0.147	0.003	14.71	0.003	E
29	Silk oaky	*Gravillea rhobusta*	Proteaceae	S	11	0.324	0.006	32.35	0.006	E
30	Tree of heaven	*Ailanthus altissima*	Simaroubaceae	T	26	0.765	0.015	76.47	0.015	E
31	Specider flower	*Cleoma spinosa*	Cleomaceae	S	10	0.294	0.006	29.41	0.006	E
32	Olipan yellow	*Tababuia ochracea*	Bignoniaceae	T	19	0.559	0.011	55.88	0.011	E
33	Wild crapemyrtyle	*Malphigia glabra*	Lythraceae	S/T	23	0.676	0.013	67.65	0.013	E
34	Jujube	*Zizibus jujube*	Rhamnaceae	T/S	17	0.500	0.010	50.00	0.010	E
35	Common fig	*Ficus carica*	Moraceae	T/S	40	1.176	0.023	117.65	0.023	E
36	Watter mattle	*Acacia retinodes*	Fabaceae	S	21	0.618	0.012	61.76	0.012	E
37	Avocado	*Persea americana*	Lauraceae	T	9	0.265	0.005	26.47	0.005	E
38	Guava	*Psidium guava*	Myrtaceae	S/T	3	0.088	0.002	8.82	0.002	E
39	Silver mattle	*Acacia dealbata*	Fabaceae	T/S	7	0.206	0.004	20.59	0.004	E
40	Barbadis nut	*Jatropha curcas*	Euphorbiaceae	S/T	5	0.147	0.003	14.71	0.003	E
41	Golden dewdrops	*Duranta erechta*	Verbeneceae	S	4	0.118	0.002	11.76	0.002	E
42		Total			1756					

1	Shannon weaver diversity index	2.882
2	species richness	0.978
3	species evenness	0.776
4	Simpson div index	**0.895**
5	Total area sampled	**3400m2**

*= E=exotic, I= indigenous, N =number

3.2. Plant species richness, abundance and frequency

Diverse tree and shrub components are retained in the grown woody plants study area depending on the space available, the compatibility of the plants with their surroundings, and the goals of the plantation. *Azadiracta indica* (27.7%) and *Coffee arabica* (0.1%) had the most and least species abundance (woody and bushes), respectively although, it is more practical to describe species richness as species richness per unit area. In 3400m2 (0.34 hectare) of the DDU, a measure of the diversity of species based just on a count of the number of species richness of 41 species was noted. In this particular case, the extent of species richness was 0.978, indicating a considerable variation in abundance that is likely caused by eliminating the buildings present in the compound and plantation practices that mostly depend on the purpose and location of the growers/gardeners. The quantity of a species depends on the grower's desire or the species that is most suited to the task, such as ornamental, windbreak and shadow creation, presumably, cause greater species richness. Additionally, it was shown that *Azadirachta indica* woods had densities of at least 14.294 woody plant species per hectare in the identified woody plantation. It is proposed that *Azadirachta indica* is favored in the selection of woody plants for a sustainable and most adaptive semi-arid environment with suitable species-to-site establishment.

The identified plants, Fabaceae (8 species) > Bignoniaceae (4 species) > Malvaceae (3 species) and Moraceae (3 species)> Apocynaceae (2 species), Meliaceae (2 species), Proteaceae (2 species) contributed accordingly on distribution pattern. Similar study was conducted in Haramaya University by Eba and Lenjisa (2017) identified 34 species in the first site of which *Lantana camara* (14.7%) of the relative abundance followed by *Thuja accidantalis* (11%), *Podocarpes falcatus* (9.2) and *Cupressus lussitanica* (6.6%) of the relative abundance. Numerous exotic (with one exception) species that were seen in the study area presumably the mother plants during plantation were not available (Table 1). According to the total frequency of all the identified plants, the four most often observed species in the study area were *Azadirachta indica*, *Nerium oleander*, *Leucaena leucocephala*, and *Sophora japonica*. Similar study was conducted in northern high land of Ethiopia (Daniel *et al.*, 2023)

3.3. Species diversity and evenness

In the DDU woody plantation, the diversity and evenness of the woody species were 2.882 and 0.776, respectively. Kent and Coker (1992), state that the Shannon-Wiener index value typically ranges between 1.5 and 3.5 and seldom surpasses 4. The evenness index E was derived for the research area, indicating equity in terms of species distribution in each, although the outcome was likely attained because the construction area was excluded and the study relied on artificial plantations for the producers' particular purposes. Amanuel and Gemedo (2018) conducted similar study on Yemrehane Kirstos Church Forest of Lasta Woreda, North Wollo Zone, Amhara Region found Shannon-Wiener diversity index (H’) and evenness values for the entire forest of 2.88 and 0.79, respectively. DDU showed significant level of variety, with an 89% diversity score for the Simpson (1-D) value of 0.895. A similar study was also conducted at Haramaya University by Eba and Lenjisa (2017) showing greater species diversity (H’=3.16, 2.96) in the two sites of the university. This demonstrates that the research area's woody species diversity and evenness are quite high. The findings therefore demonstrated that woody species were greatly diverse and equally dispersed. The availability of mother plants in the government nursery, the selected landscape, and the climate all had a significant impact on the variety and richness of species. The diversity measures used by Teshager *et al.* (2018) on woody plants in North Ethiopia indicated a diversity index value of 2.3 and an evenness value of 0.66. These values provide insights into the species richness and relative abundance of woody plants in the studied area. A higher evenness value indicates a more equitable distribution of individuals among species, meaning that no single species dominates the community. In this case, the evenness value of 0.66 indicates a moderate level of evenness, suggesting a relatively balanced representation of woody plant species in the North Ethiopian area.

3.4. Plantation management practice

The fundamental requirement for the creation of a green space that ensures the appeal and appropriateness of the environment to the communities is the availability of high-quality planting materials suitable to the working environment (Wubalem *et al.*, 2019). Adopting high standards is crucial for the university's renown, as is altering the micro- and macroclimate of the environment. From the focal person discussion with three respondents, it was understood that higher university officials were not well aware of the social, economic and ecological advantages of tree planting as such and hence reflected by disregard of the management of plantations to the intended objectives. The major problems forwarded by interviewees in plantations of DDU were lack of planting materials and seeds, lack of awareness, lack of water availability destruction by animals and knowledge gap in plant growers. All these indicated that choice of plants based on their management, site suitability, purpose, and beauty mostly depends on the untrained grower, not the expert.

As indicated by the interviewees the installation and administration of the plantation have not been led by trained personnel, and not in accordance with the landscape. The growers have not been planned and not focused on the major objectives, instead concentrated on covering the land with greenery. The plantations were not done better in site preparation, protection, species diversity, and soil and water harvesting structure. Even the growers depended on the accessibility of mother plants that have an impact on the freedom selection of plants. That is why most plants were exotic. Pruning needs to be directed by a professional, but it is not something that is taught at university. Pruning is crucial for the creation of shade, for promoting and maintaining healthy plant development, and for making plants more compact for display by removing dead or crisscrossed branches and sick or insect-infested plant components (Aklilu *et al.*, 2022). Hence, to guarantee the protection and use of woody plants in accordance with goals to be reached within a specific physical and socioeconomic environment, the University's plantation needs highly qualified and technically competent employees to oversee effective planning and monitoring to satisfy the demands of present and future generations. This is achieved by building internal capacity, inter-agency coordination linkages with concerned stake holders. The landscape's overall beauty is influenced by how the plants are maintained.

A landscape's aesthetic appeal may suffer if horticultural practices are not in accordance with plant requirements. In order to choose the right plants, we must be honest about the amount of upkeep we are prepared to do (Wubalem *et al.*, 2019). When working with plant experts and landscape designers to accomplish the goals of the University plantation for future generations, it is suggested that following the process, carefully considering the criteria, and narrowing down the potential selections will pay off with an aesthetically pleasing, functional, and appropriate landscape composition (Schutzki 2005). Setting clear objectives and preparing management plans, using certified and quality tree seeds of indigenous plants, wider and appropriate spacing suitable to the objectives of the plantation is the mandatory focus area in the feature (Aklilu *et al.*, 2022).

4. Conclusion and Recommendations

4.1. Conclusion

The abundance and diversity of woody plants is significant in DDU, noticeably, changing the makeup of the communities and the way in which the ecosystem functions. In order to work on changes in land-use practices that accommodate the needs of land users for ornamental, windbreak, shade, and conservation purposes, it is necessary to develop an appropriate road map and integrate it into the 10-year strategic plan. This calls for the implementation of effective and sustainable management. Knowledge of the landscape, a thorough examination of the impact of other environmental factors would give a more comprehensive understanding of species distribution patterns for the university and the neighborhood's maximum environmental suitability and attraction for the working environment.

In conclusion, in the present study, the woody plant species diversity in the studied area was relatively high, with a total of 41 species from 24 families identified. The Fabaceae family contributed the most abundant species, followed by Bignoniaceae, Malvaceae, and Moraceae. The distribution patterns of woody plant species varied, with Fabaceae and Bignoniaceae being the most diversified families. Trees constituted the majority of the species, while shrubs also made a significant contribution. The abundance and frequency of species varied, with *Azadirachta indica* being the most abundant species, while *Coffee arabica* had the least abundance. The diversity and evenness of woody species in the plantation were relatively high, indicating a well-balanced distribution of species. The availability of mother plants, selected landscape, and climate influenced the variety and richness of species. The plantation management practices in the studied area were found to be lacking in several aspects. There was a lack of awareness among university officials regarding the social, economic, and ecological benefits of tree planting. Issues such as the lack of planting materials and seeds, water availability, destruction by animals, and knowledge gaps among plant growers were identified as major challenges. The plantation establishment and management were not carried out by trained personnel, and the objectives were not properly focused on. The choice of plants depended on untrained growers rather than experts, leading to a predominance of exotic species. Pruning and maintenance practices were not conducted effectively, impacting the overall beauty and health of the landscape.

4.2 Recommendations

Based on the finding of the study the following recommendations were forwarded

1. Increase awareness among university officials and stakeholders about the importance of tree planting and the benefits it provides in social, economic, and ecological aspects.
2. Improve the selection of woody plants based on their management, site suitability, and purpose, with a focus on using indigenous species.
3. Enhance the capacity of plantation staff through training and workshops to ensure proper planning, site preparation, protection, and species diversity.
4. Develop management plans for the plantation, setting clear objectives and guidelines for maintenance practices, including pruning, watering, and overall plant care overseen by expert.
5. Strengthening nurseries within the university to ensure the availability of quality planting materials and seeds of indigenous species.
6. Foster inter-agency coordination and collaboration with relevant stakeholders to support the university in achieving its plantation objectives.
7. Conduct regular monitoring and evaluation of the plantation to assess the progress, identify challenges, and make necessary adjustments for the sustainable management of woody plants.
8. Involve landscape designers and plant experts in the decision-making process to ensure a visually appealing, functional, and appropriate landscape composition, growth, promoting shade, and enhancing the overall aesthetics of the landscape.

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