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# ASSESSMENT OF TREE DIVERSITY IN RAMNA AREAS OF DHAKA CITY, BANGLADESH

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*Keywords:* Tree diversity, Dominance, Exotics, Ramna, Dhaka city

## Abstract

The present article deals with the evaluation of the existing tree species diversity in the Ramna areas of Dhaka city. Both random and stratified random quadrat sampling were used for the data collection from July 2021 to June 2022. The study identified a total of 156 tree species in 46 families. Among the sampling areas, 115 tree species were found in Ramna Park, 61 tree species in Suhrawardy Udyan, and 98 tree species in the Dhaka University area. The sampling areas overlapped significantly with many tree species. Among the species, 33% of the species were of ornamental value, followed by timber (24%), medicinal (21%), fruit (19%), and wildlife-supporting (3%). 51% of the tree species belonged to exotics and 49% were native. The most abundant species were *Swietenia mahagoni* in Ramna Park and Dhaka University and *Eucalyptus camaldulensis* in Suhrawardy Udyan. Based on the important value index, the most dominant species were *S. mahagoni* in Ramna Park and Dhaka University and *Ficus elastica* in Suhrawardy Udyan. Among the top 15 most abundant and dominant trees, nine belonged to exotics, and the rest were native. The Shannon diversity index value ranged from 3.83 to 4.39. Ramna Park showed the highest index value (4.39), followed by Suhrawardy Udyan (3.91) and Dhaka University (3.83). Stakeholder's consultations revealed that on average 90% of the support was found for management strategies such as native enrichment, reducing exotic dominance, planting purposeful trees, heritage plantations, and expert consultation during plantation. Identified threats included construction works, exotic presence, lack of native seedlings, and low awareness. Recommendations include promoting the dominance of native species, gradual exotic replacement, enhancing wildlife-supporting species, increasing public awareness, and integrating expert opinions into urban plantation programs.

## Introduction

The low diversity of native trees in urban areas poses a significant threat to local biodiversity and ecosystem services, which leads to a loss of natural heritage. The high abundance and dominance of exotic trees in urban settings are also leading to a reduction in native biodiversity because of their aggressive nature in finding foods, water, nutrients, and space. Knowing the baseline information of the current tree diversity in urban areas helps to undertake the right policy and planning for the sustainable management of biodiversity and the environment. Urban settings are traditionally considered degraded ecosystems with lower ecological value species (Guneralp and Seto 2013). Protecting plant diversity and natural environments in urban places is considered a difficult preservation challenge (Salinitro *et al.* 2018). Planning for urban green areas is receiving attention as a major issue in urban design, economics, and research (Morris *et al*. 2016). For better management of the environment, abundance, dominance, and diversity data on plant diversity are crucial. These data provide basis for taking right policy and planning for urban green area management for biodiversity conservation and ecosystem services.

Currently, the city has no natural woodlands. Approximately 20% of the city of Dhaka's vegetation spaces, which were available in 1989, have rapidly dropped, according to a remotely sensed data analysis, to 15.5 percent and 7.3 percent in 2002 and 2010, respectively (Rahman *et*

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*al*. 2011). The majority of plants are trees such as *S. mahagoni*, *Lagerstroemia speciosa*, *Eucalyptus camaldulensis*, *Roystenia regia*, *Samanea saman*, *Polyalthia longifolia*, *Cocos nucifera*, *Delonix regia*, and *Mesua ferrea*. Beside trees, many ornamental trees are decorated here, as well as *Bauhinia acuminata*, *Bauhinia variegata*, *Cassia fistula*, *Cassia nodosa*, *Brunfelsia latifolia*, *Butea monosperma*, *Caesalpinia pulcherrima*, *Ixora coccinea*, *Michelia champaca* and *Gardenia augusta* (Uddin and Hassan 2016).

To assess the current state of knowledge in this field, we conducted a comprehensive review of existing literature. About 1000 plant species, including herbs, shrubs, trees, and climbers, were reported for the first time from Dhaka city and its surrounding areas (Datta and Mitra 1953). After this, a number of small reports on different groups of plants were made by Hussain 1965, Hossain 1966, Rahman 1966, Alam 1967, Zeauddin 1967, Khan and Huq 1981, Huq and Begum 1984, Hossain 2006, Hossain and Uddin 2011, Uddin and Hassan 2016, and Uddin *et al.* 2019. In the recent past, plant species diversity on the road dividers of Dhaka city was evaluated, and 90 tree species with 56% exotic plant species were found on the road dividers (Uddin *et al.* 2021). Likewise, an evaluation of the diversity, abundance, and dominance of trees in urban lakeside vegetation in Dhaka city reported 118 tree species, including 39% exotics (Akter and Uddin 2023). However, quantitative evaluations of tree diversity in Ramna Park, Suhrawardy Udyan, and the Dhaka University area were not found in the available scientific literature. For better management of these green areas, valid and reliable data on the current tree diversity and their present status are needed. In the present study, an attempt was made to identify the current composition of tree species; to determine the abundance, dominance, and species diversity of tree species; to identify exotic tree species; to collect stakeholder's perceptions in the management process; and to suggest measures for sustainable management of urban green areas of Ramna.

## Materials and Methods

The study was conducted in Ramna Park, Suhrawardy Udyan, and Dhaka University Campus of Dhaka city (Fig. 1). The area is situated between 90° 24' 8.75 N and 90° 24' 16.74" E, as well as 23° 43' 26.04" N and 23° 44' 30.7" E. The areas of Ramna Park, Suhrawardy Udyan and Dhaka University campus are 75, 68.5 and 275.083 acres, respectively (Uddin and Hassan 2016, Rahman and Nuzrat 2018, Pasha *et al.* 2021). The vegetation of Ramna Park and Suhrawardy Udyan is managed by the arboriculture section of the public works department, and the vegetation of the Dhaka University campus is managed by the arboriculture center of the university.

The soil of Dhaka is mainly composed of a fine sand layer with a red clay deposit at the uppermost layer. Chlorite, Kaolinite, Illite, and some non-clay minerals, especially feldspar and quartz, are considered the main components of the red tropical clay soils of Dhaka (Islam *et al.* 2013). Under the Köppen climate classification, Dhaka experiences a tropical wet and dry climate, with the summers showing a good deal of rainfall and the winter showing on a small scale.

Floristically, once Dhaka was the southern extended parts of Bhawal Sal Forest, the dominant tree species was *Shorea robusta*.

A total of 12 field trips to the study areas in Ramna Park, Suhrawardy Udyan, and Dhaka University were conducted from July 2021 to June 2022. The survey was done using random sampling, and in cases of patchy distribution of particular tree species, stratified random sampling was also used for data collection (Peet *et al.* 1998). For the tree data collection, a total of 97 quadrats of 10 m × 10 m were taken from three study sites (Oosting 1956). Among the quadrats, 34 from Ramna Park, 29 from Suhrawardy Udyan and 34 from the Dhaka University area were taken. The number of quadrats in the study area was determined using a species area curve (Goldsmith and Harrison 1976). In each quadrat, Tree species were recognized, individual counts

were made, and breast height circumference measurements were recorded. To determine the dominant tree species, the importance value index (IVI) was calculated using biostatistical formulas (Krebs 1989). Species diversity was determined using the Shannon-Weiner diversity index (Shannon 1948), the Simpson diversity index (Simpson 1949), the Margalef index (Margalef 1957), and the Pieolu index (Pielou 1981).

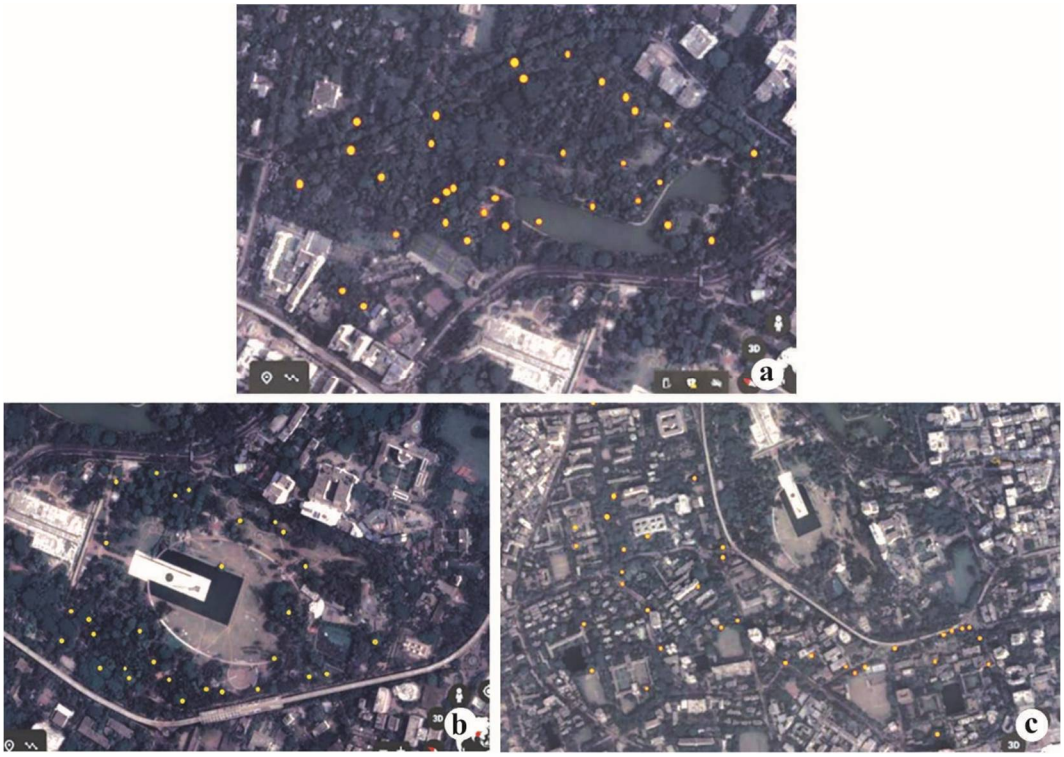


Fig. 1. Map of the study area showing the location of quadrats, a. The location of quadrats in Ramna Park, b. The location of quadrats in Suhrawardy Udyan c. The location of quadrats in Dhaka University campus (One dot = one quadrat).

Exotic tree species were recognized by comparing them with Hossain and Pasha (2004). Most of the identification of tree species was done by experts at the field site. The plant samples were identified up to the species by consulting different literature (Siddiqui *et al*. 2007, Ahmed *et al*. 2008–2009, Uddin *et al*. 2021) and also comparing with herbarium specimens preserved in Dhaka University Salar Khan Herbarium. In case of confusion in identity, plant samples were taken and brought to the Plant Taxonomy Laboratory of the Department of Botany, University of Dhaka, and processed using standard herbarium techniques (Hyland 1972). Color images of plant specimens were also collected using a digital camera to aid in identification. Stakeholders were interviewed following a structured, closed-ended questionnaire (Alexiades 1996) were used. A total of 16 informants were interviewed.

**Results and Discussion**

A total of 156 tree species from 46 families were recorded in the study area. Among the study sites, 115 tree species were found in Ramna Park, 61 in Suhrawardy Udyan, and 98 in the Dhaka University campus. A good number of tree species were very common among the three sites. The study on the road dividers of Dhaka was reported 90 tree species (Uddin *et al*. 2021). Using same methods, another study on lakesides vegetation of Dhaka was reported 118 tree species (Akter and Uddin 2023). The present study has reported 156 tree species from Ramna areas of Dhaka city which is very close to its lakeside's vegetation. That means species richness of the present study areas is higher than that of two areas of Dhaka city. The tree species representation in the family was not equal in number. In this instance, 49% of species are represented by 9 families, while 51% are represented by another 37 families. Moraceae is the most prevalent family, followed by Fabaceae, Arecaceae, Caesalpiniaceae, Meliaceae, Mimosaceae, Myrtaceae, Apocynaceae, and Rubiaceae (Fig. 2). Tree species recorded in the study were categorized into different utility groups. Ornamental trees were in the leading position, followed by timber, fruits, medicine, and wildlife-supporting species (Fig. 3). The presence of leading ornamental tree species in the park is the most desirable for aesthetic reasons. The low presence of wildlife-supporting tree species in the park indicates that it is not a biodiversity-friendly park. The present trade-off in park management is that plantations should be considered with native multipurpose tree species. For each species, common name, scientific name, family, number of individuals, origin status, and usefulness were recorded, and the top 50 tree species with the maximum IVI among the 156 species recorded are presented in Table 1.

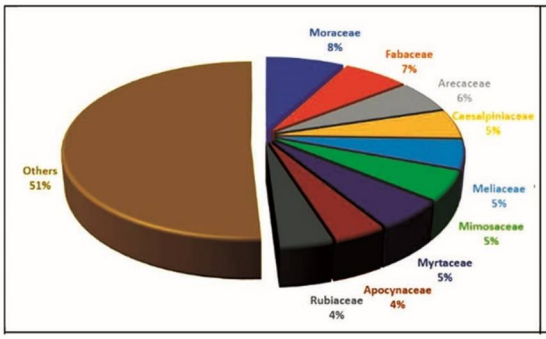


Fig. 2. Dominant plants families

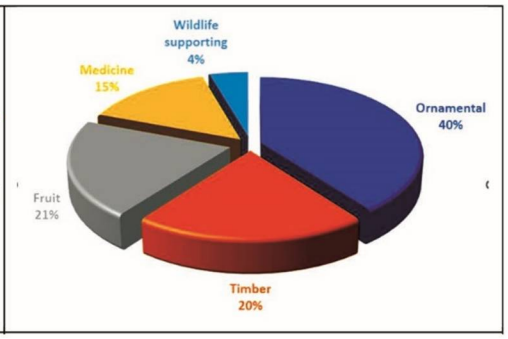


Fig. 3. Tree species of different utility categories.

Among the tree species in the study areas, 15 tree species were identified to be abundant based on the number of individuals and presented in the bar graph (Fig. 4). *Swietenia mahagoni* is the most abundant tree species. Among the top 15 abundant tree species, nine were exotics, and the rest were native species. Exotic tree species were *S. mahagoni*, *Polyalthia longifolia*, *Roystonea regia*, *Delonix regia*, *Eucalyptus camaldulensis*, *Tectona grandis*, *Mimusops elengi*, and *Livistona chinensis*. Native tree species were *Areca catechu*, *Cocos nucifera*, *Mangifera indica*, *Lagerstroemia speciosa*, *Azadirachta indica*, *Artocarpus heterophyllus*, and *Borassus flabellifer*. A very simple cause of the high abundance of exotics in the study was that no expert's opinion was taken during species selection for plantation, a lack of native seedlings was available in the nursery, or there was a lack of awareness about exotics and native issues. In the road divider of Dhaka city top abundant tree species was *Mimusops elengi* (Uddin *et al.* 2021). *S. mahagoni* was the top abundant tree species in the lakeside vegetation of Dhaka city (Akter and Uddin

2023). The present study reported that top abundant tree species in Ramna areas is *S. mahagoni* which is similar to the lakeside's vegetation of Dhaka city. Interesting to note that top abundant tree species *Mimusops elengi* and *S. mahagoni* are exotic. *Mimusops elengi* was introduced in Dhaka city for ornamental purpose whereas *S. mahagoni* was introduced and naturalized to meet timber demand.

**Table 1. Presented top 50 tree species with the maximum IVI among 156 recorded species (RD = Relative Density, RF = Relative Frequency, RA = Relative Abundance, IVI = Importance Value Index).**

| Species name | Common name | Family | Use | Origin | Abundance | RD | RF | RA | IVI |
|---|---|---|---|---|---|---|---|---|---|
| *Swietenia mahagoni* Jacq. | Mahagoni | Meliaceae | T | E | 79 | 11.48 | 5.14 | 6.24 | 22.86 |
| *Cocos nucifera* L. | Narikel, Coconut | Arecaceae | F | E | 26 | 3.77 | 3.43 | 3.55 | 10.75 |
| *Samanea saman* (Jacq.) Merr. | Rain tree | Mimosaceae | T | E | 8 | 1.16 | 1.50 | 7.90 | 10.56 |
| *Mangifera indica* L. | Aam, Mango | Anacardiaceae | F | N | 24 | 3.48 | 3.21 | 2.46 | 9.16 |
| *Polyalthia longifolia* (Sonn.) Benth. & Hook.f.ex.Thwaites | Debdaru, False ashoka | Annonaceae | O | E | 24 | 3.48 | 2.57 | 2.49 | 8.55 |
| *Eucalyptus camaldulensis* Dehnh. | River red gum | Myrtaceae | T | E | 14 | 2.03 | 1.93 | 4.36 | 8.32 |
| *Delonix regia* (Bojer ex Hook.) Raf. | Krisnochura, Royal poinciana | Fabaceae | O | E | 14 | 2.03 | 2.14 | 2.93 | 7.11 |
| *Lagerstroemia speciosa* (L.) Pers | Jarul | Lythraceae | O | N | 17 | 2.47 | 2.14 | 2.46 | 7.07 |
| *Ficus benghalensis* L. | Bot, Banyan tree | Moraceae | W | N | 7 | 1.02 | 1.28 | 4.37 | 6.68 |
| *Roystonea regia* O.F.Cook. | Royal palm | Arecaceae | O | E | 19 | 2.76 | 1.71 | 1.66 | 6.14 |
| *Schleichera oleosa* (Lour.) Oken. | Kushum, Ceylon oak | Sapindaceae | O | E | 2 | 0.29 | 0.21 | 5.31 | 5.81 |
| *Areca catechu* L. | Supari, Areca nut | Arecaceae | F | E | 27 | 3.92 | 1.50 | 0.25 | 5.67 |
| *Tectona grandis* L.f. | Segun, Teak | Verbenaceae | T | E | 14 | 2.03 | 2.14 | 1.48 | 5.66 |
| *Ficus elastica* Roxb. Ex Hornem | Indian rubber | Moraceae | W | E | 2 | 0.29 | 0.43 | 4.79 | 5.51 |
| *Mimusops elengi* L. | Bokul, Spanish cherry | Sapindaceae | O | E | 12 | 1.74 | 1.50 | 2.15 | 5.39 |
| *Ficus religiosa* L. | Ashwatha bot, Sacred fig | Moraceae | W | N | 1 | 0.15 | 0.21 | 4.81 | 5.17 |
| *Artocarpus heterophyllus* Lamk. | Kanthal, Jack fruit | Moraceae | F | N | 12 | 1.74 | 2.36 | 1.03 | 5.13 |
| *Mesua nagassarium* (Burm.f.) Kosterm. | Nageshwar | Clusiaceae | O | N | 7 | 1.02 | 0.86 | 2.04 | 3.91 |
| *Michelia champaca* (L.) | Sharna chapa | Magnoliaceae | O | N | 6 | 0.87 | 1.07 | 1.96 | 3.90 |

**Table 1. Contd.**

| Species name | Common name | Family | Use | Origin | Abundance | RD | RF | RA | IVI |
|---|---|---|---|---|---|---|---|---|---|
| *Peltophorum pterocarpum* (DC.) Backer ex Heyne | Konok chura, Copperpod | Caesalpiniaceae | O | E | 6 | 0.87 | 1.28 | 1.55 | 3.71 |
| *Tamarindus indica* L. | Tetul, Tamarind | Caesalpiniaceae | M | N | 7 | 1.02 | 1.50 | 1.10 | 3.62 |
| *Butea monosperma* (Lam.) Kuntze | Palash, Sacred tree | Fabaceae | O | N | 7 | 1.02 | 1.50 | 0.88 | 3.40 |
| *Terminalia catappa* L. | Kathbadam, Indian almond | Combretaceae | F | E | 9 | 1.31 | 1.50 | 0.58 | 3.39 |
| *Azadirachta indica* A. Juss. | Neem | Meliaceae | M | N | 14 | 2.03 | 0.86 | 0.47 | 3.36 |
| *Leucaena leucocephala* (Lamk.) de Wit. | Ipil ipil, River tamarind | Mimosaceae | T | E | 5 | 0.73 | 1.07 | 1.43 | 3.23 |
| *Barringtonia acutangula* (L.) Gaerth | Hijol, Indian oak | Lecythidaceae | T | N | 4 | 0.58 | 0.64 | 1.97 | 3.20 |
| *Borassus flabellifer* L. | Tal, Palm | Arecaceae | F | N | 9 | 1.31 | 1.28 | 0.60 | 3.19 |
| *Dypsis lutescens* (H. Wendl.) Beentje & J. Dransf. | Areca palm | Arecaceae | O | E | 2 | 0.29 | 0.43 | 2.30 | 3.02 |
| *Ceiba pentandra* (L.) Gaertn | Burma shimul, Silk Cotton tree | Bombaceae | O | E | 6 | 0.87 | 1.07 | 0.74 | 2.68 |
| *Dalbergia sissoo* Roxb. | Sissu, Shisham | Fabaceae | T | E | 6 | 0.87 | 1.28 | 0.47 | 2.63 |
| *Hopea odorata* Roxb. | Telsur, White thingan | Dipterocarpaceae | T | N | 4 | 0.58 | 0.64 | 1.29 | 2.52 |
| *Syzygium cumini* (L.) Skeels | Kalo-jam, Black plum | Myrtaceae | F | N | 6 | 0.87 | 1.28 | 0.35 | 2.50 |
| *Swietenia macrophylla* King | Mahagoni | Meliaceae | T | E | 5 | 0.73 | 1.07 | 0.67 | 2.47 |
| *Terminalia arjuna* (Roxb. ex DC) Wight & Arn | Arjun | Combretaceae | M | N | 6 | 0.87 | 1.28 | 0.30 | 2.46 |
| *Livistona chinensis* (Jacq.) R.Br.ex Mart. | China palm | Arecaceae | O | E | 9 | 1.31 | 0.86 | 0.29 | 2.45 |
| *Gmelina arborea* Roxb. | Gamari | Verbenaceae | T | N | 5 | 0.73 | 0.64 | 1.08 | 2.45 |
| *Acacia auriculiformis* A. Cunn. ex Benth. | Akashmoni, Northern black wattle | Mimosaceae | T | E | 7 | 1.02 | 1.07 | 0.28 | 2.37 |
| *Albizia richardiana* King & Prain | Raj koroi | Mimosaceae | T | E | 7 | 1.02 | 1.07 | 0.28 | 2.37 |
| *Couroupita guianensis* Aubl. | Naglingom, Cannonball tree | Lecythidaceae | O | E | 2 | 0.29 | 0.43 | 1.41 | 2.13 |
| *Litsea glutinosa* (Lour.) C. B. Rob. | Menda, Indian laurel | Lauraceae | M | N | 5 | 0.73 | 0.86 | 0.52 | 2.10 |
| *Melia sempervirens* (L.) Sw. | Gora neem | Meliaceae | M | E | 5 | 0.73 | 0.64 | 0.55 | 1.92 |

**Table 1. Contd.**

| Species name | Common name | Family | Use | Origin | Abundance | RD | RF | RA | IVI |
|---|---|---|---|---|---|---|---|---|---|
| *Moringa oleifera* Lamk. | Sajina, Drumstick tree | Moringaceae | M | E | 4 | 0.58 | 0.64 | 0.69 | 1.92 |
| *Millettia peguensis* Ali | Millettia, Moulmein rosewood | Fabaceae | O | E | 3 | 0.44 | 0.64 | 0.80 | 1.88 |
| *Phoenix sylvestris* (L.) Roxb | Khejur, Date | Arecaceae | F | N | 6 | 0.87 | 0.64 | 0.36 | 1.87 |
| *Lagerstroemia thorelli* Gagnep. | Borsha Jarul | Lythraceae | O | E | 5 | 0.73 | 0.86 | 0.27 | 1.85 |
| *Plumeria rubra* L. | Kathgolap | Apocynaceae | | | 5 | 0.73 | 0.86 | 0.16 | 1.74 |
| *Albizia lebbeck* (L.) Benth. & Hook | Shilkoroi, Lebbeck tree | Mimosaceae | T | N | 4 | 0.58 | 0.86 | 0.28 | 1.72 |
| *Alstonia scholaris* (L.) R. Br. | Chatim, Devil's tree | Apocynaceae | M | N | 4 | 0.58 | 0.86 | 0.28 | 1.72 |
| *Melaleuca citrina* (Curtis) Dum. Cours | Bottle brush | Myrtaceae | O | E | 4 | 0.58 | 0.64 | 0.47 | 1.70 |
| *Madhuca indica* Gmel. | Mohua, Honey tree | Sapotaceae | O | N | 2 | 0.29 | 0.43 | 0.97 | 1.69 |

(Habit: T = Tree, S = Shrub, H = Herb) (Native or Exotic: N = Native, E = Exotic) (Uses: T = Timber, M = Medicinal, F = Fruit, O = Ornamental, W = Wildlife Supporting).

A calculation of the importance value index was made for the tree species in the study area. According to the statistics, *S. mahagoni* was the species with the top IVI, followed by *Cocos nucifera*, *Samanea saman*, *Mangifera indica*, *Polyalthia longifolia*, *Eucalyptus camaldulensis*, *Delonix regia*, *Lagerstroemia speciosa*, *Ficus benghalensis*, *Roystonea regia*, *Schleichera oleosa*, *Areca catechu*, *Tectona grandis*, *Ficus elastica*, and *Mimusops elengi* (Fig. 5). Among the top 15 species with the maximum IVI, 3 were native, and the remaining 12 were exotics. The native tree species were *Mangifera indica*, *Lagerstroemia speciosa*, and *Ficus benghalensis*. Usually, tree species with the maximum IVI play critical roles in the structure, function, and ecosystem services of vegetation (Brindis-Badillo *et al*. 2022). Apart from theses tree species with the maximum IVI, the area supports a number of the oldest tree species, both native and exotic. *Samanea saman* (in Dhaka University), *Ficus elastica* (in Suhrawardy, Udyan), and *Courropita guinensis* (in Ramna Park) are examples of the oldest exotic tree species. These tree species are not related to our cultural heritage and may not support our biodiversity. *Tamarindus indica*, *Diospyros malabarica* (in Dhaka University), and *Ficus religiosa* (in Ramna Park) are native trees related to the heritage of Dhaka city. These tree species support local biodiversity, including birds. *Mimusops elengi* was reported as the top dominant tree species from the road dividers of Dhaka city (Uddin *et al*. 2021). Likewise, *S. mahagoni* was reported as the top dominant tree species from lakesides vegetation of Dhaka city (Akter and Uddin 2023). The top dominant tree species in Ramna areas is *S. mahagoni* which is similar to the top dominant tree species of Lakesides vegetation of Dhaka city.

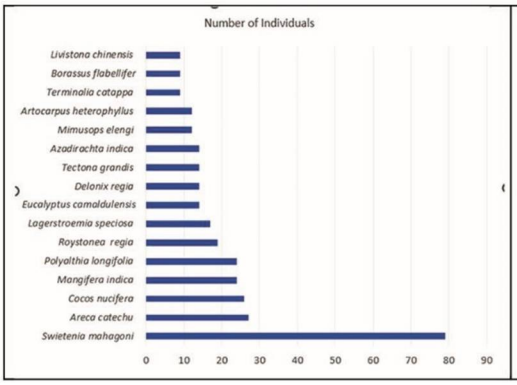


Fig. 4. Abundance of top 15 tree species.

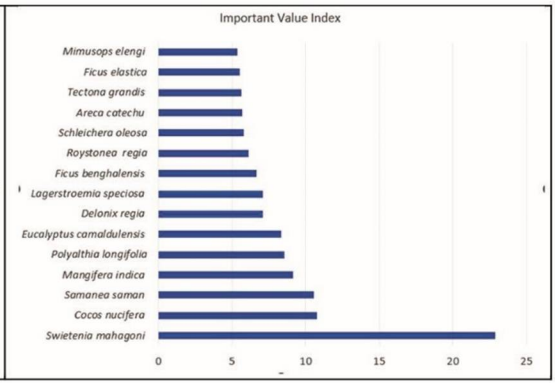


Fig. 5. IVI% of top 15 tree species.

All index of species diversity values were highest in Ramna Park and lowest in the Dhaka University area (Table 2). The Ramna Park site had the highest diversity index value because it had recently been planted with different species of trees that were roughly equally distributed among their various kinds. In Dhaka University, the diversity value was lowest because just a few species had an unevenly distributed number of individuals. This indicates that throughout the time of the plantation, a specific species was given top priority. In recent development activities in Suhrawardy Udyan, a huge number of tree species were cut, but the value of diversity was not like that of Ramna Park. Maximum tree species diversity value in the road dividers of Dhaka was 3.17 (Uddin *et al*. 2021). In case of lakesides vegetation of Dhaka city, maximum tree species diversity value of Shannon index was reported 3.78 (Akter and Uddin 2023). The present study reported that the tree species diversity value is 4.39 from the Ramna areas of Dhaka city which is very high to all previous reported values of tree species diversity.

**Table 2. Comparative Shannon-Weiner Diversity Index and Margalef index values among the study sites.**

| Site name | Number of species | Number of individuals | Shannon-Weiner Diversity Index | Pielou's evenness value | Margalef index |
|---|---|---|---|---|---|
| Ramna Park | 115 | 230 | 4.39 | 1 | 0.873 |
| Suhrawardy Udyan | 61 | 138 | 3.916 | 0.365 | 0.834 |
| Dhaka University Campus | 98 | 320 | 3.834 | 0.357 | 0.795 |

One of the important objectives of the study was to determine the exotic tree species studied for better management of plant diversity. The results showed that 51% of tree species were exotic, whereas 49% were native tree species. Out of the 15 most abundant plant species in each study site, Ramna Park has eight exotic species, Suhrawardy Udyan has nine, and the region around Dhaka University has 10 exotic species. Furthermore, the findings of the top 15 most dominant plant species also demonstrate that there are more exotic species than native ones. Within the top 15 plant species with the maximum IVI in each research location, both Ramna Park and Suhrawardy Udyan sites have nine exotic tree species individually, while the Dhaka University Campus (Fig. 7.5) has 10 exotic plant species. Maximum 56% exotic tree species was reported from the assessment of tree species in the road dividers of Dhaka city (Uddin *et al*. 2021). Using the same methods, 39% exotic tree species was reported from the study of lakesides vegetation of

Dhaka city (Akter and Uddin 2023). In the present study, 51% tree species is reported as exotics from Ramna areas of Dhaka city which is very close to the report of the road dividers of Dhaka city. The increased prevalence of exotic or exotic tree species may be attributed to reasons such as the accessibility of seedlings during plantation and/or a lack of taxonomic expertise during the species selection process. Typically, contractors oversaw plantation programs. Unfortunately, they are not capable of distinguishing native from exotic tree species. Exotic tree species such as *S. mahagoni*, *C. nucifera*, *S. saman*, *P. longifolia*, *E. camaldulensis*, *D. regia*, *R. regia*, *S. oleosa*, *A. catechu*, *T. grandis*, *F. elastica*, and *M. elengi* are among the most dominant plant species all over the study sites. Additionally, they displayed greater abundance in that area's dispersion. This is not the ideal character of a sustainable city model. Because the exotics do not benefit the environment or other organisms like the natives do. Rather, they affect negatively. *S. mahagoni* is a timber-yielding plant; it doesn't support wildlife. The origin of *S. mahagoni* was a native of the United States, Bahamas, Cuba, Haiti, Jamaica and Netherlands Antilles (Orwa *et al*. 2009). *S. mahagoni* seed oil was discovered by Mostafa *et al.* (2011) to have a bitter taste, a modest amount of drying oil, and a high level of unsaturated fatty acids. The range of *S. mahagoni* seed extract's toxicity was safe to mild (Sahgal *et al.* 2010). Additional chemical components found in *S. mahagoni's* bark, leaves, and fruit include phenolic flavonoids, tannins, triterpenoids, limonoids, saponins, and alkaloids (Kadota *et al*. 1990, Lin *et al.* 2009, Bhurat *et al*. 2011, Divya *et al*. 2012, Patel *et al*. 2012, Naveen *et al*. 2014, Sukardiman *et al*. 2017). Despite having many medicinal benefits, they are unable to directly support wildlife by providing any edible items in the wild; instead, the pharmacology portion uses modified chemical compounds. Zerga (2015) claims that *E. camaldulensis*, which originated in Australia, is a risky tree for erosion control because it upsets the nutritional balance of the soil by quickly absorbing additional minerals (Dessie and Erkossa 2011). A high evapo-transpiration rate is reported to have a detrimental impact on local rainfall levels and could cause the area to become desertified because eucalyptus absorbs excessive amounts of water from the soil (FAO 1985, Khan and Mahmood-Ul-Hasan 2006). Eucalyptus leaf doesn't decompose easily (FAO 2011), and leaf extracts also impeded seedling growth and production, which aided biodiversity loss and the creation of allelochemicals with an immediate impact on native vegetation (Dejam *et al.* 2014).

Long-term widespread plantings of *A. auriculiformis* have developed invasive traits (Richardson *et al*. 2015), which are probably caused by a consistent seed supply in addition to other local environmental conditions. *Acacia* leaves do fall, breakdown into humic acid, and increase the acidity of the soil, which may reduce the plantations' productivity and affect the ability of native plants to later repopulate the area (Yamashita *et al.* 2008). Native habitats are indeed threatened by *Acacia* plantings (Wuenschel 2019).

In the structured, closed-ended interview, six selected questions were asked to 16 stakeholders. The initial query concerned whether or not the conclusions from the study of ecological data suggested that the plant variety at three separate sites should be increased. In response to the first question, 94% of the informants positively responded to increasing native plant diversity in the study area, and 6% negatively responded. In response to the second question, the majority of participants agreed to increase native trees in the study area and avoid exotics. In response to the third question, 87.5% of participants agreed to the expected ratio of ornamental, medicinal, fruit, wildlife-supporting, and timber trees in the study area, and a minimum of 12.5% agreed to put some exotics for aesthetic reasons in the study area. All of the interviewees agreed, in response to the fourth question, that professional advice should be sought in any situation involving urban park management. All informants made it clear that the current vegetation scenario does not represent expert opinion. Therefore, it is important to consult specialists while managing urban vegetation. The last question was about restoring the floral heritage of Dhaka city

by planting the once-existing plants like *S. robusta*, *B. monosperma***,** *A. scholaris*, *Toona ciliata*, *Bombax ceiba*, *Sterculia villosa*, *Holarrhena pubescens*, *Grewia microcos*, *Tabernaemontana divaricata*, *Woodfordia* fruticosa, and *Flacourtia jangomas* (Uddin *et al.* 2021). 87.5% of the stakeholders gave favorable responses, 6.25% gave negative responses, and 6.25% gave confusing responses, pondering if something would be achievable or not. According to observation from the study area and calculated data, it was clear that the area is dominated by a few numbers of exotic tree species, including *S. mahagoni, E. camaldulensis*, *F. elastica*, *C. nucifera*, and *P. longifolia.*

Based on observation and a number of threats were detected in the study areas. Among them new construction activities in the study area, the presence of abundant and dominant exotic species, ignorance of botanical knowledge in the plantation programs, and the absence of visionary policy in the management system, which are the main threats to native tree diversity. One interesting constraint on native tree species is the dominance of non-botanists in greenery management planning and the maximum development allocations each year they like to spend on development works and less on green development. Experts' opinions were not considered in the planning process, gardener's dependent plantation programs, or the absence of a taxonomist position in the concerned department, which is another dimension of threats to native tree diversity. In plantations, species selection, site selection, and after-plantation management are applied biological sciences; unfortunately, all such important sciences are ignored during plantation programs that are most important to promote native tree diversity.

Based on the present research results, stakeholders' perceptions, and field observations, a number of measures have been suggested for the better management of the study area. Initially, a long-term master plan should be developed with the involvement of local stakeholders, including city corporations, RAJUK, the public works department, the forest department, the environment department, and experts from universities. Secondly, immediate management measures for the invasive species that have already been planted are required. *S. mahagoni*, *S. saman*, *C. nucifera*, *P. longifolia*, *A. catechu*, *E. camaldulensis*, *T. grandis*, *D. regia*, *M. elengi*, and *T. catappa* are a few examples of current exotic plant species that need to be included in a management framework. Pruning, cutting, and threshing can be done as required for these tree species. If any of these species are soft, fragile, and very prone to falling during a normal disaster, they should be eliminated from the study area, and instead, one should be planted with three native species. Third, wildlife-supporting native tree species *B. monosperma*, *Ficus racemosa*, *B. ceiba*, *Terminalia bellirica*, *S. robusta*, *T. arjuna*, *Miliusa velutina*, *L. glutinosa*, *A. scholaris*, *S. villosa*, *Neolamarckia cadamba*, *A. indica*, *Terminalia chebula*, *S. cumini*, *T. ciliata*, *Phyllanthus emblica*, *D. malabarica*, *T. indica, and Crateva nurvala* could be the best choice for the urban plantation (Datta and Mitra 1953). Fourth, small, native, showy tree species of different flowering seasons should be put on the plantation list. The most noteworthy species are *Melastoma malabathricum***,** *W. fruticosa*, *G. microcos*, *T. divaricata*, *I. coccinea*, and *Clerodendrum viscosum*, to satisfy the ornamental demand (Datta and Mitra 1953). Fifth, for aesthetic purposes, several indigenous plants with various blooming times may be used to beautify various footpaths and roads. For instance, the road divider at Dhaka University might be decorated with *C. fistula,* and in some free spaces at Suhrawardy Udyan, *B. monosperma* and *B. ceiba* might be planted in a patch or a linear plantation. Seventh, the interview findings revealed that the selection of tree saplings, planted sites, and after-plantation management are crucial and should involve plant taxonomists and silviculturists.

This study provides a comprehensive assessment of tree species diversity in Ramna areas of Dhaka city. While 156 species were identified, 51% of them were found to be exotic, and the rest are native. 15 tree species were identified based on the number of individuals, and among them, 9 were exotics. Among the top 15 species with the maximum IVI, 12 were exotics. Such a scenario

is a significant threat to local biodiversity, ecosystem services, and natural heritage. Ramna Park showed the highest Shannon diversity (4.39), followed by Suhrawardy Udyan (3.91) and Dhaka University (3.83). Among the trees of different utility categories, wildlife-supporting species were the lowest, which is not suitable for promoting wildlife diversity in the area. Sharing our current findings with local stakeholders, 90% of them were in favor of changing the current management policy of Ramna areas, which includes native enrichment, reducing exotic dominance, planting purposeful trees, heritage plantations, and expert consultation during plantation. By implementing these recommendations, the native biodiversity of Ramna areas will be increased, the ecosystem services that it provides will be enhanced, natural heritage will be saved, and the abundance and dominance of exotics will be reduced. Based on current findings, the authority can take appropriate policies, planning, and programs for urban green management, biodiversity conservation, and ecosystem services.

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