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TREE DIVERSITY AND REGENERATION POTENTIALS OF NATIONAL BOTANICAL GARDEN, MIRPUR, DHAKA

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Abstract

Plant diversity in botanical gardens plays a vital role in conservation, education, and research, especially in urban areas. This study assesses tree species diversity, regeneration potential and stakeholders' perception in National Botanical Garden, Mirpur, Dhaka. A total of 220 tree species from 61 families were recorded using a stratified random quadrat method (10 × 10 m). Among these, 59% were native and 41% exotic. The most abundant and dominant species were *Swietenia mahagoni* (L.) Jacq., *Acacia auriculiformis* A. Cunn. *ex* Benth., *Terminalia arjuna* (Roxb. *ex* DC.) Wight & Arn., and *Polyalthia longifolia* (Sonn.) Thwaites. Shannon-Wiener, Simpson's, and Margalef's Diversity Indices were 1.97, 0.82 and 28.2, respectively, indicating moderate diversity and low evenness. Zone 1 of the garden showed the highest diversity, while Zones 1, 9, and 12 had the greatest number of exotics in their top ten dominant species. High Jaccard Similarity between zones suggested repetition in species composition. Regeneration was low, with only seven species showing seedling development. *Dipterocarpus alatus* Roxb. had the highest seedling density and *Hopea odorata* Roxb. showed the best recruitment success. Stakeholder surveys revealed strong support for increasing native species, planting more wildlife-supporting trees, and involving experts in garden management. Identified threats include poor planning, exotic dominance, and lack of awareness. Key recommendations include enhancing native diversity, lowering spatial repetition of similar species, introducing rare species, and improving expert-led management to ensure ecological sustainability.

Introduction

According to Botanic Gardens Conservation International, botanic gardens are 'institutions holding documented collections of living plants for the purpose of scientific research, conservation, display, and education.' (BGCI, 2022). Given the increasing 'urbanization' of contemporary human habitats, Carrus *et al.* (2017) concluded that botanical gardens have assumed a strong social relevance nowadays besides being a focus of study of forestry, agriculture, botany and horticultural science. According to Global deforestation rates and statistics - "From 2001 to 2020, Dhaka lost 5.04 k/ha of tree cover, equivalent to a 5.5% decrease in tree cover" (Turubanova *et al.*, 2018). Moreover, Uddin *et al.* (2021) showed that a part of the present vegetation of Dhaka city is not at a desirable condition for a sustainable future because of the high percentile presence of exotic tree species. Besides, though a research work has been done on National Botanical Garden (NBG), Mirpur, Dhaka by Morshed *et al.* (2021), they didn't record the dominance and abundance of each species in the garden area and in different stratified plant zones. Moreover, no attempt was done to conduct stakeholder interviews to suggest conservation and management means for this garden.

Therefore, a detailed study was needed to assess the current status of plant diversity, species dominance, and regeneration potential within the National Botanical Garden. Moreover, this study aimed to identify key management challenges and incorporate stakeholders' perceptions to develop informed strategies for the garden's sustainable future.

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Materials and Methods

Study area: The National Botanical Garden, situated in Mirpur, Dhaka, holds the distinction of being the oldest artificial plant reservoir in the country. It was established during 1962 and covers a large area of approximately 215.22 acres (87.01 hectare) (Morshed *et al.,* 2021). The garden is bordered by Eastern Housing to the north, Turag river to the west, Duyari para and Pallabi to the east, and the Dhaka zoo to the south. On a daily basis, an average of six hundred visitors, including students, researchers, and tourists, explore the garden's splendor (Morshed *et al.,* 2021).

The National Botanical Garden has been categorized into 13 'Proposed Plant Zones' with a total area of 3.92 lac sq. meter for more focused and specialized plant collections (Fig. 1). While conducting the floristic survey, Zone 3 was excluded as this zone consisted of aquatic bodies.

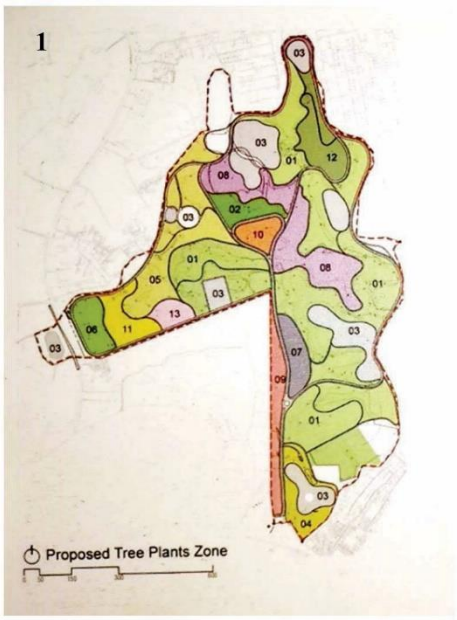

Fig. 1. Thirteen 'Proposed Plant Zones' in NBG (Morshed *et al.* 2021)

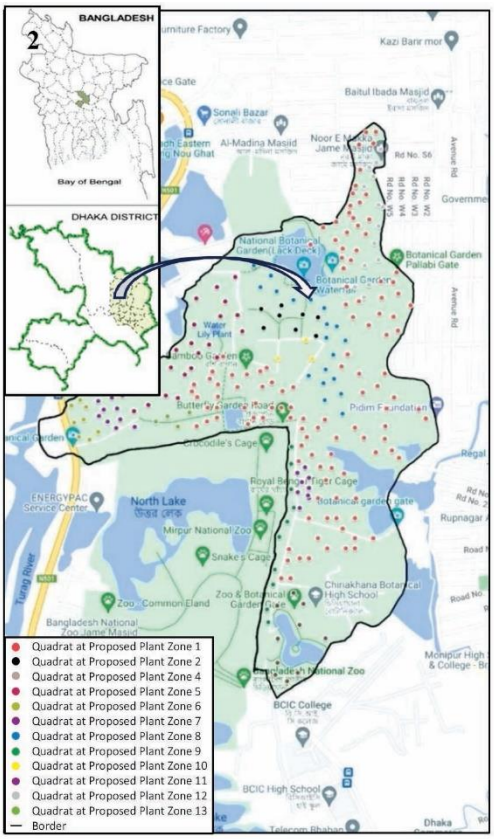

Fig. 2. Map showing quadrats that were surveyed inside NBG (Source of inset image: Saiful, 2013).

Tree Species Survey: The tree species survey covered all the 12 plant zones (excluding Zone 3) of NBG. Stratified random quadrat method (Subrahmanyam and Sambamurty, 2006) was applied for survey. The stratification was based on twelve 'Proposed Plantation Zones'. The quadrat size was taken as 10 m × 10 m according to Oosting (1956) and a total of 260 quadrats were surveyed in the study area (Fig. 2). In each sampling spots, names of the tree species present, their number of individuals and Circumference at Breast Height (CBH) (D'Eon *et al.,* 1994) were recorded. Individuals having ≥ 30 cm CBH were considered trees (Swaine and Alexander, 1987). Using a smartphone, GPS coordinates of the quadrat data were also noted in the same data sheet.

Density, dominance, and frequency for each species were calculated using the collected data. Moreover, relative values for these three parameters as described by Cox (1992) were also measured and later Important Value Index (IVI) was determined.

Identification of Species: Identification of plant species was mostly done consulting experts and standard floristic literatures such as Ahmed *et al.* (2009a, b, c, d, e); Ahmed *et al.*, (2008a, b); Prain (1903) and Hooker (1872-1897). Some exotic plant species were identified comparing with the reports of Akter and Zuberi (2009) and Hossain and Pasha (2004). The family of each species was identified following the classification system of Cronquist (1981).

Spatial Heterogeneity, Evenness and Jaccard Similarity: Heterogeneity and evenness were determined using Shannon-Wiener diversity index (Shannon, 1948), Simpson's diversity index (Simpson, 1949) and Margalef's index (Margalef, 1957). The similarity between the tree species composition of different 'Proposed Plant Zones' was estimated by Jaccard coefficient index (Jaccard, 1912).

Regeneration Potential: A complete stratified random quadrat method (Subrahmanyam and Sambamurty, 2006) was adopted for this study. The stratification was based on the area that showed the seedling generation of a particular species. Random quadrats having 2 m × 2 m area were laid within the area for the assessment of regeneration.

Interviews with Stakeholders: To gather the viewpoints of stakeholders on future management of NBG, interviews were conducted employing a structured close-ended questionnaire, following the methodology outlined by Alexiades (1996).

Results and Discussion

Tree Species Composition: A total of 2400 individuals belonging to 220 species and 61 families have been recorded from the study area. Among these families, the largest 10 families contain 54% of the species and the remaining 51 families contain the rest 46% of the total species recorded. Fabaceae is the largest family containing 13% of all the species followed by Myrtaceae, Moraceae, Meliaceae, Arecaceae, Bignoniaceae, Euphorbiaceae and others.

Based on their usefulness, the tree species found in overall study sites were separated into a number of classifications (Table 1). The majority of tree species falls into the category of timber plants (95 spp.), followed by wildlife supporting (60), ornamental (61), medicinal (42) and fruit producing (34). Many of the species were found to have multiple use values.

Not all 12 plantation zones have showed equal distribution of plants. Depending on area and types of plantations done, each zone contains different number of species and individuals. Such as: Zone 1 has 123 tree species which is highest and other zones were found to contain less than 60 species of trees. Zone 10 has lowest number of tree species.

On average, about 9.5 individuals are present in each quadrat having a size of 100 sq. m, indicating a high tree density. According to Morshed *et al.* (2021), 90% of tree species in the National Botanical Garden are planted, while only 10% grow naturally. The dense planting by NBG authorities likely contributes to this high density.

This study aligns with Dutta *et al.* (2014) and Bahnasy and Khamis (2019), who conducted similar surveys in other botanical gardens. Dutta *et al.* (2014) recorded 104 tree species from Sitakunda Botanical Garden and Eco-park, fewer than the present study, despite Sitakunda's larger area (808.38 ha). In contrast, Orman Botanical Garden (Bahnasy and Khamis, 2019) has more species (247) but far fewer individuals (576 vs. 2400), reflecting a design that prioritizes species diversity over density, a picture opposite to NBG.

Table 1. Tree species Diversity in the Study Area (Origin: E = Exotic, I = Indigenous; Uses: M = Medicinal, T = Timber producing, O = Ornamental, F = Fruit bearing, W = Wildlife supporting)

Name of species	Origin	Family	Local Name	Use
Acacia aulacocarpa A.Cunn. *ex* Benth.	E	Mimosaceae	Golden Salwood	M
Acacia auriculiformis A.Cunn. *ex* Benth.	E	Mimosaceae	Akashmoni	T
Acacia crassicarpa A.Cunn. *ex* Benth.	E	Mimosaceae	Chhoto Manjium	T
Acacia mangium Willd.	E	Mimosaceae	Mangium	T
Adansonia digitata L.	E	Bombacaceae	Baobab	O
Adenanthera pavonina L.	E	Mimosaceae	Roktokombol	M
Aegle marmelos (L.) Corrêa	I	Rutaceae	Bel	F, M
Aglaia chittagonga Miq.	I	Meliaceae	Boro Pitraj	T
Aglaia cucullata Pellegr.	I	Meliaceae	Amoor	T
Albizia chinensis (Osbeck) Merr.	E	Mimosaceae	Chakua Koroi	T
Albizia lebbeck (L.) Benth.	I	Mimosaceae	Kalo Koroi	T, W
Albizia lucidior (Steud.) I.C.Nielson *ex* H.Hara	I	Mimosaceae	Motor Koroi, Shil Koroi	T
Albizia niopoides var. *niopoides* (Benth.) Burkart	E	Mimosaceae	Gogon Shirish	T
Albizia odoratissima (L.f.) Benth.	E	Mimosaceae	Tehua Koroi	T
Albizia procera (Roxb.) Benth.	I	Mimosaceae	Sada Koroi	T
Albizia saman (Jacq.) F. Muell.	E	Mimosaceae	Rain Tree	T, W
Aleurites moluccanus Willd.	I	Euphorbiaceae	Pathor Badam	M
Alstonia scholaris (L.) R.Br.	I	Apocynaceae	Chatim	M, W
Anisoptera scaphula (Roxb.) Kurz	I	Dipterocarpaceae	Boilam	T, W
Aphanamixis polystachya (Wall.) R.Parker	I	Meliaceae	Royna, Pitraj	T, W
Aporosa wallichii Hook.f.	I	Euphorbiaceae	Chapalish	T
Aquilaria malaccensis (Lam.) Roxb.	I	Thymeliaceae	Agar	M
Araucaria columnaris Hook.	E	Araucariaceae		O
Artocarpus heterophyllus Lam.	I	Moraceae	Kathal	F, T, W
Artocarpus lacucha Roxb. *ex* Buch.-Ham.	I	Moraceae	Deoa	F, T, W
Averrhoa carambola L.	I	Oxalidaceae	Kamranga	F, M, W
Azadirachta indica A. Juss.	E	Meliaceae	Neem	M, T, W
Barringtonia acutangula (L.) Gaertn.	I	Lecythidaceae	Hizol	T, W
Bauhinia variegata L.	E	Caesalpiniaceae	Rokto Kanchon	O
Bixa orellana L.	E	Bixaceae	Doigota	M
Bombax ceiba L.	I	Bombacaceae	Shimul	M, W
Borassus flabellifer L.	I	Arecaceae	Tal	F, T, W
Butea monosperma (Lam.) Taub.	I	Fabaceae	Polash	O
Callistemon citrinus (Curtis) Skeels.	E	Myrtaceae	Bottle Brush	O

Name of species	Origin	Family	Local Name	Use
Calophyllum inophyllum L.	I	Cluaiaceae	Punyal, Punnal	O
Calophyllum polyanthum Wall. *ex* Planch. & Triana	I	Clusiaceae	Kamdeb	M
Canarium resiniferum Bruce *ex* King	I	Burseraceae	Dhup	M
Carallia brachiata Merr.	I	Rhizophoraceae	Roskao	T
Careya arborea Roxb.	I	Lecythidaceae	Kumvi	M, W
Cassia fistula L.	I	Caesalpiniaceae	Sonalu	M, O, W
Cassia javanica (L.) Spreng.	I	Caesalpiniaceae	Sonail	O
Castanopsis indica (L.) A. DC.	I	Fagaceae	Batna	T
Castanopsis tribuloides A. DC.	I	Fagaceae	Batna	F
Casuarina equisetifolia L.	E	Casuarinaceae	Jhau	O
Casuarina glauca Spreng.	E	Casurinaceae	Pobon Jhau	O
Ceiba pentandra (L.) Gaertn.	I	Bombacaceae	Burma Shimul	T
Chukrasia tabularis A. Juss.	I	Meliaceae	Chikrashi	T
Cinnamomum camphora (L.) J. Presl	E	Lauraceae	Korpur	M
Cinnamomum verum J. Presl	E	Lauraceae	Daruchini	F
Citrus maxima (Burm.) Merr.	E	Rutaceae	Batabi Lebu	F, M
Cocos nucifera L.	I	Arecaceae	Narikel	F, W
Cordia dichotoma G. Forst.	I	Boraginaceae	Bowla Gota	M
Cordia grandis Roxb.	I	Boraginaceae		
Corymbia calophylla (Lindl.) K.D. Hill & L.A.S. Johnson	E	Myrtaceae	Eucalyptus	T
Corymbia citriodora (Hook.) K.D. Hill & L.A.S. Johnson	E	Myrtaceae	Eucalyptus	T
Corymbia maculata (Hook.) K.D. Hill & L.A.S.Johnson	E	Myrtaceae	Eucalyptus	T
Corymbia tessellaris (F.Muell.) K.D. Hill & L.A.S. Johnson	E	Myrtaceae	Eucalyptus	T
Corymbia torelliana (F.Muell.) K.D. Hill & L.A.S. Johnson	E	Myrtaceae	Eucalyptus	T
Couroupita guianensis Aubl.	E	Lecythidaceae	Naglingom	O
Crateva religiosa G. Forst.	I	Capparaceae	Barun	O
Crescentia cujete L.	E	Bignoniaceae	Pagla Bel	M
Cycas pectinata Buch.-Ham.	I	Cycadaceae	Cycas	O
Dalbergia sissoo Roxb. *ex* DC.	I	Fabaceae	Sissoo	T
Delonix regia (Hook.) Raf.	E	Caesalpiniaceae	Krishnachura	O, W
Dillenia indica L.	I	Dilleniaceae	Chalta	F, W
Dimocarpus longan Lour.	I	Spaindaceae	Kath Lichu	F, W

Name of species	Origin	Family	Local Name	Use
Diospyros discolor Willd.	E	Ebenaceae	Bilati Gaab	F, W
Diospyros malabarica (Desr.) Kostel.	I	Ebenaceae	Deshi Gaab	F, W
Diospyros montana Roxb.	I	Ebenaceae	Tomal	M
Dipterocarpus alatus Roxb.	I	Dipterocarpaceae	Dholi Garjan	T
Dipterocarpus costatus C.F. Gaertn.	I	Dipterocarpaceae	Boitta Garjan	T
Dipterocarpus turbinatus Gaertn. f.	I	Dipterocarpaceae	Teli Garjan	T
Duabanga grandiflora (Roxb. *ex* DC.) Walp.	I	Sonneratiaceae	Bandor Hola	T
Dypsis lutescens (H. Wendl.) Beentje & J.Dransf.	E	Arecaceae	Areca Palm	O
Elaeis guineensis Jacq.	E	Arecaceae	Oil palm	O
Erythrina stricta Roxb.	I	Fabaceae	Mandar	O
Eucalyptus camaldulensis Dehnh.	E	Myrtaceae	Eucalyptus	T
Eucalyptus cosmophylla F. Muell.	E	Myrtaceae	Eucalyptus	O
Eucalyptus drepanophylla F. Muell. *ex* Benth.	E	Myrtaceae	Eucalyptus	T
Eucalyptus glaucescens Maiden & Blakely	E	Myrtaceae	Eucalyptus	O
Eucalyptus macrocarpa Hook.	E	Myrtaceae	Eucalyptus	O
Eucalyptus myrtifolia Link	E	Myrtaceae	Eucalyptus	T
Fagus grandifolia Ehrh.	E	Fagaceae		T
Ficus altissima (Blume) Miq.	I	Moraceae	Holudbot	W
Ficus benghalensis L.	I	Moraceae	Lalbot	T, W
Ficus benjamina L.	I	Moraceae	Jhuribot	W
Ficus elastica Roxb. *ex* Hornem.	I	Moraceae	Rubber Bot	W
Ficus hispida L. f.	I	Moraceae	Kak Dumur	W
Ficus nervosa Roth	I	Moraceae	Pani Dumur	W
Ficus racemosa L.	I	Moraceae	Jog Dumur	F, M, W
Ficus religiosa L.	I	Moraceae	Ashwatha Bot	T, W
Ficus rumphii Blume	I	Moraceae	Pakur Bot	W
Gardenia coronaria Buch.-Ham.	I	Rubiaceae	Koinar	O
Garuga pinnata Roxb.	I	Burseraceae	Shilvadi	T, W
Gliricidia sepium (Jacq.) Kunth	E	Fabaceae	Bosonto Manjuri	O
Gmelina arborea Roxb.	I	Lamiaceae	Gamar, Gamari	T
Grevillea robusta A. Cunn. *ex* R. Br.	E	Proteaceae	Silver Oak	O
Grewia asiatica L.	I	Tiliaceae	Phalsa	W
Guettarda speciosa L.	E	Rubiaceae	Choto Holdu	T
Gustavia augusta L.	I	Lecythidaceae	Boro Gustava	O
Haldina cordifolia (Roxb.) Ridsdale	I	Rubiaceae	Haldi	T

Name of species	Origin	Family	Local Name	Use
Hevea brasiliensis (Willd. *ex* A. Juss.) Müll. Arg.	E	Euphorbiaceae	Rubber	T
Hopea odorata Roxb.	I	Dipterocarpaceae	Telsur	T, W
Hydnocarpus kurzii (King) Warb.	I	Flacourtiaceae	Chalmugur	M
Hymenodictyon orixense (Roxb.) Mabb.	I	Rubiaceae	Bhui Kadam	T
Jacaranda mimosifolia D. Don	E	Bignoniaceae	Jackaranda	O
Khaya anthotheca C. DC.	E	Meliaceae	Lombu	T
Lagerstroemia duperreana Pierre *ex* Gagnep.	I	Lythraceae	Chhoto Jarul	O
Lagerstroemia speciosa (L.) Pers.	I	Lythraceae	Jarul	O, T
Lannea coromandelica (Houtt.) Merr.	I	Anacardiaceae	Jiga, Jeol	M, T
Lepisanthes rubiginosa (Roxb.) Leenh.	I	Sapindaceae	Chagolnadi	F, W
Leucaena leucocephala (Lam.) de Wit	E	Mimosaceae	Ipil Ipil	T
Licuala peltata Roxb. *ex* Buch.-Ham.	I	Arecaceae	Korud	O
Limonia acidissima Houtt.	I	Rutaceae	Kodbel	F, M, W
Litchi chinensis Sonn.	I	Sapindaceae	Litchu	F, T, W
Litsea glutinosa (Lour.) C.B. Rob.	I	Lauraceae	Pichla Menda	M
Litsea monopetala Pers.	I	Lauraceae	Kukur Chita	M
Lophopetalum wightianum Arn.	I	Celastraceae	Rokton	T
Macaranga peltata Müll. Arg.	I	Euphorbiaceae	Macaranga	T
Madhuca longifolia (L.) J.F. Macbr.	I	Sapotaceae	Mohua	M, W
Magnolia champaca (L.) Baill. *ex* Pierre	I	Magnoliaceae	Champa	O
Magnolia grandiflora L.	E	Magnoliaceae	Uday Padma	O
Magnolia liliifera Baill.	E	Magnoliaceae	Choto Maglonia	O
Mallotus nudiflorus (L.) Kulju & Welzen	I	Euphorbiaceae	Pidali	T
Mallotus philippensis (Lam.) Müll. Arg.	I	Euphorbiaceae	Sindur	T
Mangifera indica L.	I	Anacardiaceae	Aam	F, T, W
Manilkara zapota (L.) P. Royen	E	Sapotaceae	Sofeda	F, W
Melaleuca cajuputi Powell	I	Myrtaceae	cajuput	O
Melaleuca lophantha (Vent.)	E	Myrtaceae	Boro Bottle Brush	O
Melia azedarach L.	I	Meliaceae	Gora Neem	T, W
Mesua ferrea L.	I	Calophyllaceae	Nageshwar	O
Microcos paniculata L.	I	Tiliaceae	Datoi	W
Millettia peguensis Ali	E	Fabaceae	Milishia	O
Mimusops elengi L.	E	Sapotaceae	Bakul	O
Mitragyna parvifolia Korth.	I	Rubiaceae	Dakrum	T
Moringa oleifera Lam.	E	Moringaceae	Sajina	V
Morus alba L.	E	Moraceae	Tut	F, W

Name of species	Origin	Family	Local Name	Use
Murraya paniculata (L.) Jack	E	Rutaceae	Kamini	O
Neolamarckiana cadamba (Roxb.) Bosser.	I	Rubiaceae	Kadam	M, O
Nyctanthes arbor-tristis L.	E	Verbenaceae	Shiuli	M, O
Oroxylum indicum (L.) Kurz	I	Bignoniaceae	Kanai Dinga	M
Parmentiera aculeata (Kunth) Seem.	E	Bignoniaceae	Candle Tree	F, W
Peltophorum dubium (Spreng.) Taub.	E	Caesalpiniaceae	Copperpod	O
Peltophorum pterocarpum (DC.) K. Heyne	E	Caesalpiniaceae	Haldechura	O
Persea americana Mill.	E	Lauraceae	Avocado	F
Phoenix dactylifera L.	E	Arecaceae	Khejur	F, W
Phoenix sylvestris (L.) Roxb.	I	Arecaceae	Khejur	F, W
Phyllanthus emblica L.	I	Euphorbiaceae	Amlaki	F, W
Pinus roxburghii Sarg.	E	Pinaceae	Pine	O, T
Pithecellobium dulce (Roxb.) Benth.	I	Mimosaceae	Jilapi	T, W
Platycladus orientalis (L.) Franco	E	Cupressaceae	Thuja	O
Plumeria obtusa L.	E	Apocynaceae	Golachi	O
Plumeria rubra L.	E	Apocynaceae	Kathgolap	O
Podocarpus neriifolius D. Don	I	Podocarpaceae	Banshpata	T
Polyalthia longifolia (Sonn.) Thwaites	E	Annonaceae	Debdaru	O
Polyalthia suberosa (Roxb.) Thwaites	E	Annonaceae	Hamjam	O
Pongamia pinnata (L.) Pierre	I	Fabaceae	Karanja	T
Populus ciliata Wall. *ex* Royle	E	Salicaceae	Chhoto Poplar	T
Protium serratum Engl.	I	Burseraceae	Gut-guitta	T
Psidium guajava L.	I	Myrtaceae	Peyara	F, W
Pterocarpus indicus Willd.	E	Fabaceae	Padauk	T, W
Pterocarpus marsupium Roxb.	E	Fabaceae	Beji Chandan	T
Pterocarpus santalinus L.f.	I	Fabaceae	Roktopadok	T
Pterospermum acerifolium (L.) Willd.	I	Sterculiaceae	Muskanda	T
Pterospermum semisagittatum Buch.-Ham. *ex* Roxb.	I	Sterculiaceae	Ashar	O
Pterygota alata (Roxb.) R. Br.	I	Sterculiaceae	Buddho Narikel	T, W
Putranjiva roxburghii Wall.	E	Euphorbiaceae	Tosbi	M, T
Ravenala madagascariensis Sonn.	E	Strelitziaceae	Panthopadop	O
Roystonea regia (Kunth) O.F. Cook	E	Arecaceae	Royal Palm	O
Santalum album L.	E	Santalaceae	Sweet Chandan	T, W
Sapindus mukorossi Gaertn.	I	Sapindaceae	Ritha	M
Saraca asoca (Roxb.) Willd.	E	Caesalpiniaceae	Ashok	O
Saraca thaipingensis Cantley *ex* Prain	E	Caesalpiniaceae	Sharno Ashok	O
Schima wallichii (DC.) Choisy	I	Theaceae	Bonak	T

Name of species	Origin	Family	Local Name	Use
Schizolobium parahyba (Vell.) S.F. Blake	E	Caesalpiniaceae	Brazilian Fern Tree	T
Schleichera oleosa (Lour.) Oken	E	Sapindaceae	Kusum	T
Senegalia chundra (Roxb. *ex* Rottler) Maslin	I	Mimosaceae	Khoyer	M
Senna siamea (Lam.) H.S. Irwin & Barneby	E	Caesalpiniaceae	Minjiri	O
Sesbania grandiflora (L.) Poir.	E	Caesalpiniaceae	Bak Phul	M
Shorea robusta C.F. Gaertn.	I	Dipterocarpaceae	Shaal	T
Sindora siamensis var. *siamensis* Miq.	I	Caesalpiniaceae		T
Spathodea campanulata P. Beauv.	E	Bignoniaceae	Rudra Palash	O
Spondias pinnata (L.f.) Kurz	I	Anacardiaceae	Aamra	F, W
Sterculia foetida L.	I	Sterculiaceae	Basket Badam	F, W
Sterculia villosa Roxb.	I	Sterculiaceae	Udal	M
Stereospermum chelonoides (L.f.) DC.	I	Bignoniaceae	Parul	M
Stereospermum colais (Buch.-Ham. *ex* Dillwyn) Mabb.	I	Bignoniaceae	Yellow Snake Tree	O
Streblus asper Lour.	I	Moraceae	Sheora	M
Strychnos nux-vomica L.	E	Loganiaceae	Kuchila	M
Suregada multiflora (A. Juss.) Baill.	I	Euphorbiaceae	Ban Naranga	M
Swietenia macrophylla King in Hook.	E	Meliaceae	Boro Mahagoni	T
Swietenia mahagoni (L.) Jacq.	E	Meliaceae	Mahogani	T
Swintonia floribunda Griff.	I	Anacardiaceae	Ceiveit	T
Syzygium cumini (L.) Skeels.	I	Myrtaceae	Jaam, Kalo Jaam	F, T, W
Syzygium firmum (Dyer) Merr. & L.M. Perry	I	Myrtaceae	Dhaki Jaam	T
Syzygium grande (Wight) Walp.	I	Myrtaceae	Baro Jaam	F, T, W
Syzygium jambos (L.) Alston	E	Myrtaceae	Golap Jaam	F, W
Syzygium samarangense (Blume) Merr. & L.M.Perry	E	Myrtaceae	Jaamrul	F, W
Tabebuia rosea (Bertol.) Bertero *ex* A.DC.	E	Bignoniaceae	Tabebuia	O
Tabernaemontana divaricata (L.) R.Br. *ex* Roem. & Schult.	I	Apocynaceae	Togor	O
Tamarindus indica L.	E	Caesalpiniaceae	Tentul	F, T, W
Tectona grandis L.f.	E	Verbenaceae	Segun	T
Terminalia arjuna (Roxb. *ex* DC.) Wight & Arn.	I	Combretaceae	Arjun	M, T
Terminalia bellirica (Gaertn.) Roxb.	I	Combretaceae	Bahera	M, T
Terminalia catappa L.	E	Combretaceae	Kathbadam	F, W
Terminalia chebula Retz. *ex.* DC.	I	Combretaceae	Haritaki	M, W
Tetrameles nudiflora R. Br.	I	Datiscaceae	Chundul	O
Thespesia populnea Sol. *ex* Corrêa	I	Malvaceae	Parash Pipul	T

Name of species	Origin	Family	Local Name	Use
Toona ciliata M. Roem.	I	Meliaceae	Toon	T
Trema orientalis (L.) Blume	I	Ulmaceae	Jibon	T
Vachellia nilotica (L.) P.J.H. Hurter & Mabb.	I	Mimosaceae	Babla	T
Vitex negundo L.	I	Verbenaceae	Nishinda	M
Vitex peduncularis Wall.	I	Verbenaceae	Arshol	T
Vitex pinnata L.	I	Verbenaceae	Awal	T
Washingtonia filifera (Rafarin) H. Wendl. *ex* de Bary	E	Arecaceae	Desert Fan Palm	O
Wrightia arborea (Dennst.) Mabb.	I	Apocynaceae	Dudhkurush	O
Wrightia coccinea Sims	I	Apocynaceae	Palong	O
Xylia xylocarpa (Roxb.) W. Theob.	E	Mimosaceae	Lohakath	T
Xylocarpus moluccensis M. Roem.	I	Meliaceae	Passur	W
Zanthoxylum rhetsa (Roxb.) DC.	I	Rutaceae	Bajna	T

While NBG includes many wildlife-supporting species, most are exotic. Native birds rely on native flora for habitat and food, but dominant native tree species are underrepresented in NBG. Although 21% of trees are native and wildlife-supporting, their low dominance poses risks to avifaunal diversity. Interviewees, including fitness trainees and wildlife enthusiasts, noted the scarcity of native and medicinal species, such as *Azadirachta indica*, and expressed concern over the declining bird population.

Origin of Species: The findings revealed that 43% of recorded tree species are exotic whereas 57% are indigenous. According to the recorded data, *Acacia auriculiformis* is the most dominant tree species followed by *Swietenia mahagoni*, *Artocarpus heterophyllus*, *Terminalia arjuna*, *Polyalthia longifolia*, *Mangifera indica*, *Delonix regia*, *Gmelina arborea*, *Xylia xylocarpa*, *Barringtonia acutangula*, *Albizia saman*, *Tectona grandis*, *Lagerstroemia speciosa*, *Eucalyptus camaldulensis* and *Tabebuia rosea*. Among these 15 top dominant species, 9 are exotic to our country (Fig. 3).

Even in case of total number of individuals, out of top 15, 8 have been found to be exotics. *S. mahagoni*,is the most abundant species in the garden followed by *A. auriculiformis*, *T. arjuna*, *P. longifolia*, *A. heterophyllus*, *L. speciosa*, *M. indica*, *B. acutangula*, *D. regia*, *T. rosea*, *G. arborea*, *T. grandis*, *Hopea odorata*, *X. xylocarpa* and *A. saman*.

Several exotic species such as *A. auriculiformis*, *S. mahagoni*, *P. longifolia*, *D. regia*, and *A. saman* are not only common in the NBG but also widely planted along Dhaka's road dividers (Uddin *et al.*, 2021) and on the Dhaka University campus (Uddin and Hassan, 2016). Similar trends are seen in Sitakunda Botanical Garden and Eco-park, where *A. auriculiformis*, *A. mangium*, and *P. longifolia* are among the most common species (Dutta *et al*., 2014). In NBG, some of these exotics were planted in monoculture-like patches.

Most Dominant Species in the Proposed Plant Zones: Among the twelve studied zones, Zone 1, 9 and 12 have the highest number of exotics, each containing five foreign species in their top ten species with the most IVI. Interestingly, for each of these three zones, the species with the highest IVI are exotic (*Acacia auriculiformis* for Zone 1, *Tectona grandis* for Zone 9 and *Albizia saman* for Zone 12). On the other hand, five out of these twelve plantation zones have an indigenous species as their most dominant tree species. These include *Artocarpus heterophyllus*

(Zone 1, 11), *Lagerstroemia speciosa* (Zone 4), *Ficus benghalensis* (Zone 5) and *Albizia lebbeck* (Zone 13). The most native species friendly zone has been recorded as Zone 6 which has eight native plants out of ten dominant tree species.

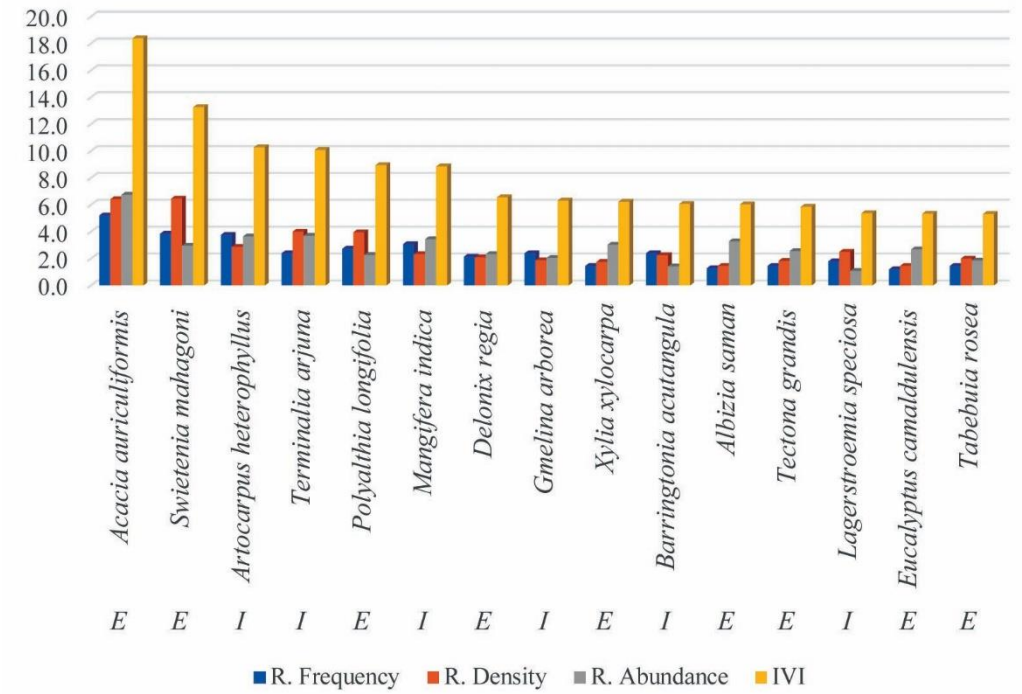

Fig. 3. Relative frequency, relative density and relative abundance of top 15 species with the most IVI. E= Exotic, I = Indigenous

The top 15 tree species with the highest IVI in the National Botanical Garden (NBG), including *Swietenia mahagoni*, are commonly found in urban areas like Dhaka city (Uddin *et al*., 2021; Uddin and Hassan, 2016), largely believed to be due to their aesthetic appeal, quality wood, and wide availability in nurseries. Limited natural regeneration of native species—caused by urbanization, land-use change, and habitat fragmentation—further contributes to the dominance of exotics. Media promotion and public preference for attractive, fast-growing species might also play a role. Importantly, the lack of involvement of plant experts in urban greening and garden planning often leads to the widespread planting of exotics, a pattern evident not only in NBG but also in places like Sitakunda Botanical Garden (Dutta *et al*., 2014).

Heterogeneity, Evenness and Similarity: A Shannon Diversity Index of 1.97 found for the NBG, compared to its maximum value of 5.39, indicates that the National Botanical Garden has less than moderate species diversity with uneven species distribution. This contrasts with Orman Botanical Garden, where Bahnasy and Khamis (2019) reported higher Shannon values (5.70, 4.22, and 7.06) due to its smaller area, high species count, and fewer individuals—factors contributing to greater homogeneity. NBG's Simpson's Diversity Index of 0.82 suggests some dominant species but a relatively even distribution among others, confirming uneven diversity. Meanwhile, the Margalef Index value of 28.2 reflects high species richness, emphasizing that NBG hosts a large variety of species relative to the total number of individuals, despite the unevenness in their distribution.

Comparing each zone with the other, Jaccard similarity was found for the twelve proposed zones (Fig. 4). The zones showed relatively high percentage of similarity; going as high as 28.3% for Zone 11 and 12; and as low as 0% for each of Zone 2, 7 and 9 with Zone 10.

Zone	2	4	5	6	7	8	9	10	11	12	13
1	11.0	13.5	23.5	14.3	9.9	23.4	21.7	1.6	11.1	16.5	10.6
2		8.1	10.5	10.1	7.6	21.4	15.4	0.0	15.8	14.5	6.1
4			16.7	14.0	11.1	13.9	11.3	3.3	12.2	13.2	10.8
5				20.8	12.8	14.6	16.3	1.7	13.7	20.6	11.3
6					11.3	16.9	14.3	5.3	23.1	19.0	13.6
7						13.0	13.7	0.0	13.5	10.3	4.7
8							16.9	2.1	17.7	18.2	13.5
9								0.0	12.3	18.2	11.3
10									3.5	1.3	1.7
11										28.3	21.2
12											20.0

Fig. 4. Jaccard Similarity among 12 different proposed plant zones.

Jaccard Similarity is a useful metric for evaluating the conservation value and planning quality of botanical gardens, where high similarity often indicates poor spatial diversity and repetition of species. In the National Botanical Garden, the highest Jaccard Similarity was observed between Zone 11 and Zone 12, both containing fruit-bearing species. Zone 1 also showed over 10% similarity with nine of eleven other zones due to its large size and high species count. Given that most zones have fewer than 60 species, even 10–20% similarity is significant, suggesting limited species variation across zones. Zones 2, 5, 6, 8, and 9 also contributed to high similarity values. Such repetition limits opportunities for introducing new species and reduces the garden's diversity and visual appeal. In contrast, Bahnasy and Khamis (2019) reported Jaccard similarities between 5–14% in Orman Botanical Garden, a more desirable range. The elevated similarity in NBG may result from poor planning or natural processes like seed dispersal. With limited space and increasing urbanization in Dhaka (Turubanova *et al*., 2018), maximizing plant diversity within existing garden boundaries like NBG is essential for effective conservation, aesthetic and wildlife friendly landscaping.

Regeneration Potential of Different Species: In National Botanical Garden, seven tree species were found to have natural seedling and sapling development. These species are *Hopea odorata, Barringtonia acutangula, Dipterocarpus alatus, Dipterocarpus turbinatus, Macaranga peltata, Swietenia mahagoni* and *Pterygota alata*. Among these species, *D. alatus* showed maximum seedling density (2.9 seedlings/sq. m.) followed by *B. acutangula* (2.4) and *P. alata* (2.1). On the other hand, minimum density was recorded for *S. mahagoni* (1.1).

Distribution of seedlings into different CBH classes showed that maximum number of seedlings (79.8%) belong to the CBH class of 0 - 30 cm (Fig. 5a). Though *D. alatus* has the highest seedling density, the highest recruitment success was found for *Hopea odorata* (Fig. 5b). Not all of these species showed equal regeneration potential and for some species including *M. peltata, S. mahagoni* and *P. alata*, there were one or two mid-CBH classes that had no individual.

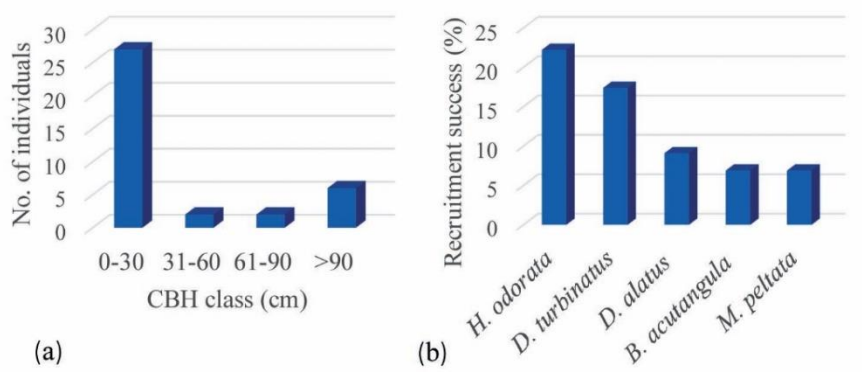

Fig. 5. (a) Regeneration capacity of different species in NBG, (b) Recruitment success of top five species from first CBH class to last CBH class in NBG.

Understanding plant regeneration is crucial for effective forest management (Yang *et al*., 2014). In the NBG, only seven species showed seedling development, much lower than in natural forests like Dudhpukuria-Dhopachari (120 spp.), Chunati Wildlife Sanctuary (105 spp.), Madhupur National Park, and Durgapur hill forest (Hossain *et al*., 2004, 2013; Rahman *et al*., 2020a, 2020b). This limited regeneration is likely due to frequent human intervention, such as clearing seedlings, which was observed during the field visits. Most individuals fall within the lowest CBH class (0–30 cm), aligning with findings by Rahman *et al.* (2020b). Species like *H. odorata*, *D. alatus*, *D. turbinatus*, and *S. mahagoni* showed strong regeneration, while others like *P. alata*, *M. peltata*, and *B. acutangula* were disturbed. Selective cleaning by workers, especially around *S. mahagoni* and *Dipterocarpus* patches, may explain uneven seedling patterns. Notably, *M. peltata*, found in undisturbed areas, had high regeneration in its first CBH class, similar to observations by Nur *et al*., (2016). The successful recruitment of *Dipterocarpus* spp. and *H. odorata*, species native to Chittagong and Sylhet regions, mirrors result from Hossain *et al*. (2013) and suggests that deeper ecological understanding is needed to explain their success in NBG.

People's Perception: 108 participants were randomly chosen for interviews from a variety of backgrounds, including retired and incumbent govt. officers, businessmen, private job holders, housewives, teachers and students.

On whether plant composition needs greater diversification, 83% agreed, noting underutilized spaces and the aesthetic potential of seasonal blooms like *Saraca asoca*. However, 17% were satisfied, likely due to limited knowledge about native flora or botanical garden standards. Regarding the dominance of exotic species, 77% opposed it, though many admitted confusion about which species are exotic and lacked awareness of their ecological impacts. After a brief discussion on the subject, most leaned toward favoring native species. On increasing indigenous species, 85% supported both greater variety and individual count. An even higher 92% agreed on enhancing the presence of purposeful species—such as medicinal and wildlife-supporting trees—citing a lack of avifauna-friendly flora and species like *Azadirachta indica*. Finally, 95% of respondents favored involving specialists—such as gardeners, ecologists, and environmental experts—in vegetation management to improve the garden's ecological and aesthetic value.

Threats to NBG Vegetation Management: Natural disasters, human settlements, and a lack of public awareness pose significant threats to the diversity and management of the National Botanical Garden (NBG) in Dhaka. The dominance of exotic species and poor management practices further hinder its development.

These challenges are not only a concern for the environmental enthusiasts, but also for the visitors who visit this garden once in a while or regularly. So, to make people more nature-headed and to attract more people, especially children and students towards the garden, these challenges need to be overcome as fast as possible.

Recommendations

Based on the findings of the study, it is recommended that the National Botanical Garden (NBG), Mirpur, adopt a comprehensive and ecologically informed management approach to enhance its conservation value. Although the garden hosts 220 tree species, only 132 are native, and exotic species dominate both in abundance and spatial distribution. This imbalance necessitates the gradual replacement of exotic dominants with ecologically significant native species to promote 'right greening' of the garden. Spatial repetition across zones, as evidenced by high Jaccard similarity, reflects poor planning and limits biodiversity potential; future plantings should aim to reduce redundancy and maximize zone-specific diversity. Stakeholder surveys reveal overwhelming support for increasing native and wildlife-supporting trees, and for involving ecological experts in garden management. The incorporation of educational programs and guided tours can enhance public awareness and environmental stewardship especially regarding native species. Additionally, improving plant labeling, creating forest-type representative zones, and distributing and planting seedlings of rare species can collectively elevate the garden's role as a center for conservation, education, and urban ecological restoration.

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