



Diversity, distribution and abundance of plant species in Bangladesh Agricultural University campus

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Abstract

The study was conducted on distribution, abundance and diversity of plant species of Bangladesh Agricultural University (BAU), Mymensingh. To conduct the experiment, 20 sampling sites were selected randomly within the study area having an area of 3 square meter and all the plants of various genera and species within the sampling sites were identified. A total number of 9140 plants of 36 species belonging to 28 families were recorded from all the sampling sites among which *Axonopus compressus* species was identified at the highest number (2755) whereas the species of *Borassus flabellifer*, *Prunus avium*, *Saracaasoca*, *Lagerstroemia speciosa*, *Cassia fistula* and *Acacia catechu* were found at the lowest (01). In case of relative abundance, the percentage was found approximately 30.14% for *Axonopus compressus* whereas for each of *Borassus flabellifer*, *Prunus avium*, *Saracaasoca*, *Lagerstroemia speciosa*, *Cassia fistula* and *Acacia catechu* it comprises only 0.01% within the total plant species. Considering the habits of the plants, in case of tree species *Swietenia macrophylla* showed a relatively high abundance (0.175%) and *Borassus flabellifer* showed the low (0.01%) whereas among the herb *Axonopus compressus* (30.14%) was found at the highest and *Centellaasiatica* (0.005%) was at the lowest in terms of abundance. The diversity indexes also revealed that the highest diversity of the plants was observed in the BINA quarter having a value of 0.763 and the lowest was observed in front of the Agronomy faculty (0.018) among the twenty sampling sites. These results emphasized the importance of furthermore and a wide variety study on the plant species within this study area.

Key words: Distribution, abundance, diversity, plant species, BAU

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Introduction

Biodiversity generally refers to the variety and variability of life on Earth. According to the United Nations Environment Program (UNEP), biodiversity typically measures variation at the genetic, the species, and the ecosystem level (UNEP, 1992). Biodiversity is not distributed evenly on Earth such as terrestrial biodiversity tends to be greater near the equator, which seems to be the result of the warm climate and high primary productivity (Field *et al.*, 2009). Biodiversity generally tends to cluster in

hotspots, and has been increasing through time, but will be likely to slow in the future (Rabosky and Daniel, 2009).

Nowadays, due to rapid environmental changes there causes mass extinctions of biodiversity (Charles *et al.*, 2006). More than 99.9% of all species that have ever lived on Earth, amounting to over five billion species, are estimated to be extinct. During the last century, decreases in biodiversity have been

increasingly observed. In 2007, German Federal Environment Minister reported that an estimated up to 30% of all species will be extinct by 2050. Of these, about one eighth of known plant species are threatened with extinction. More recently, in May 2016, scientists reported that 1 trillion species are estimated to be on Earth currently with only one-thousandth of one percent described in comparison to the total mass of the biosphere has been estimated to be as much as 4 TtC (trillion tons of carbon) (Wade and Nicholas, 2016). This figure indicates unsustainable ecological practices, because few species emerge each year. Almost all scientists acknowledge that the rate of species loss is greater now than at any time in human history with extinctions, occurring at a rate of hundreds times higher than the background extinction rates.

Bangladesh is well known to have a wide variety of plant species with enormous genetic diversity. But unfortunately, these valuable plant resources have not been well studied, and so far, only a few species have ever been evaluated for their medicinal, horticultural, and agricultural potentials. As Bangladesh is an over populated country having a less number of forest so plant resources are very important for serving food, wood, and others. Bangladesh is rich flora and fauna diversity which are maintaining balance ecosystem. Presently, biodiversity is affecting due to deforestation, forest exploitations, agriculture and industrial pollution, air and water pollution, irrigation and flood control developments, shifting land use and over exploitation of biological resources (Mondol et al., 2020; Mitu et al., 2019;). But it is unfortunate that there is a loss of plant resources worldwide including Bangladesh (IUCN, 2016).

It has been reported the 24 vascular plant species are threatened in Bangladesh of which 1 species is extinct/endangered, 21 species are vulnerable, 1 rare, and 1 indeterminate (Hasan, 1997). Some 45 wild plant species have been threatened with extinction (Khan, 1991; Huq and Banik, 1992), and many other wild

species are now at risk of being lost in all or part of their distribution ranges because of reduction in their population due to degradation and fragmentation of habitats. These plant species of reduced population are facing increased rate of extinction due to a combination of many factors like demographic, natural, and genetic changes and social dysfunction (WRI, 1989). Universities and research institutes all over the world including Bangladesh Agricultural University (BAU), Mymensingh, plays an important role to conserve various kinds of plant species including the rarest one to the most common one. In previous, a research was done on Plant diversity of horticultural farm of BAU campus (Hossain *et al.*, 2009) but research on plant diversity at whole BAU campus has not been done yet. Therefore, keeping these views in mind the study was undertaken to prepare a complete list of different plant species under different taxa as well as to evaluate the diversity of rare and endangered plant species grown at Bangladesh Agricultural University (BAU) campus, Mymensingh.

Materials and Methods

Geographical location of the study area: Bangladesh Agricultural University, which is one of the largest Agricultural Universities of South Asia was selected as study area to conduct the present study. The university is located at Mymensingh division of Bangladesh in between the latitude of 23.7099°N and longitude of 90.4071°E. Having an area of about 486ha and covered by scenic rural surroundings, the university campus is located on the western bank of the old Brahmaputra River which is about 5km south from the Mymensingh Railway Station and about 120km north from Dhaka, the capital of Bangladesh.

Physical condition of the study area

Soil condition and climate: The soil belongs to Sonatola series of the Brahmaputra alluvium tract and is medium textured (loam and salty loam), but there are also some fine textured soils. Soil pH varies from 6.0 to 7.6 while most of the soil exhibited a pH value

around neutrality. On the other hand, the climatic condition of the study area is sub-tropical in nature where rainfall is heavy during Kharif (16 March to 15 November) season and scanty in the Rabi (16 November to 15 March) associated with moderately low temperature and plenty of sunshine.

Data collection: At first a guide map was collected from the Bangladesh Agricultural University website. Then 20 sampling sites were selected randomly from the map, covering the whole University area and from the each of 20 sampling sites 3m² areas were selected randomly. Then total numbers of all individual plant species were counted from each site and finally the botanical information of different plants, such as common name, scientific name, family, genus, species, and habits were collected from different websites and scientific journals.

Calculation of abundance: Relative species abundance is a component of biodiversity and refers to how common or rare a species is relative to other species in a defined location or community. Relative abundance also refers to the percent composition of an organism of a particular kind relative to the total number of organisms in the area. Different populations in a community exist in relative proportions and this idea is called as relative abundance. The relative abundance of plant species was calculated by using the following equation (Equ. 1).

$$\text{Relative Abundance} = \frac{\text{Total number of individual of a species in all quadrates}}{\text{Total number of individual of all species in all quadrates}} \times 100 \dots (1)$$

Calculation of diversity index: Species diversity index is a measure which renders considerable ecological entity insight. Simpson's diversity index (SDI) measures the community diversity. Index of species diversity was calculated to examine the species richness and abundance distribution at Bangladesh Agricultural University campus by using the following equation (Equ. 2)

$$D = 1 - \frac{\sum n(n-1)}{N(N-1)} \dots \dots \dots (2)$$

Where n is the number of individuals of each species, N is the total number of individuals of all species and D is the Diversity Index.

Results and Discussion

Distribution of the total plant species: Different plant species are distributed all over the Bangladesh Agricultural University campus and a total number of 9140 plants of 36 species were recorded from all those twenty selected sites belonging to 28 families. Out of those recorded 36 species, 20 species were trees and rest of them were herbs. The study revealed that among all those species recorded within the selected sites, *Axonopus compressus* was found at the highest number (2755) followed by the *Dactyloctenium aegyptiacum* (2109) (Table 1) whereas the lowest number was recorded for the species of *Borassus flabellifer*, *Prunus avium*, *Saraca asoca*, *Lagerstroemia speciosa*, *Cassia fistula* and *Acacia catechu* (01) which represents only 0.01% of the total number. It also exhibited that the number of total species recorded within the selected sites was smaller than a previous study, conducted on plant distribution in Lewoh-Lebang in the Lebialem Highlands of Southwestern Cameroon, in which a total of number 100 species belonging to 39 families and 82 genera were recorded and among all those recorded 39 families, the Rubiaceae had the highest number of genera and *Cola* (Rubiaceae) was the most abundant species (Fonge et al., 2013). This variation in result may occur due to the variation between climatic and geographical factor of South Cameroon and Bangladesh Agricultural University campus.

Similar study was conducted on plant distribution in a tropical evergreen forest in Bangladesh and recorded a total of 40 species belong to 25 families and 37 genera with 3148 woody individuals within that 1600m² plot among which Euphorbiaceae and Moraceae were recorded as the most species rich families, with four species each whereas *Castanopsis*, *Ficus* and

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Terminalia were recorded as the most species rich genera, with two species each. The study also revealed that only 12.5% of all the recorded species had one individual each (Feroz et al., 2016). A previous study conducted on homestead forest in Mymensingh reported that banana (*Musa sapientum*), betel nut

(*Areca catechu*), jackfruit (*Artocarpus heterophyllus*), mango (*Mangifera indica*), mahogany (*Swietenia mahogani*), teak (*Tectona grandis*) and acacia (*Acacia auriculiformis*) were the major plant species cultivated mostly across the study areas (Muhammad et al., 2011).

Table 1. Distribution of major plant species of the study sites.

Species Sites	<i>Axonopus compressus</i> (Chapra)	<i>Dactyloctenium aegyptiacum</i> (Kakpaya)	<i>Cynodon dactylon</i> (Durba)	<i>Swietenia macrophylla</i> (Mahogoni)	<i>Glycine max</i> (Soyabean)	<i>Rosa acicularis</i> (Golap)	<i>Magnifera indica</i> (Aam)
S ₁	203						03
S ₂		1278		02			
S ₃	75	113		02			
S ₄		253					
S ₅							
S ₆	35						01
S ₇	221						
S ₈	1141						
S ₉		422		05			
S ₁₀			124				
S ₁₁	147	43		01			01
S ₁₂	23						
S ₁₃	231		562	02			01
S ₁₄	431		262	02			
S ₁₅			12				
S ₁₆	123						
S ₁₇					195		
S ₁₈				02			
S ₁₉	53		161			07	
S ₂₀	72						
Total	2755	2109	1121	16	195	07	06

Whereas in another study conducted at Horticultural farm of Bangladesh Agricultural University campus, it was found that the population of fruit plants was the highest followed by ornamentals and palms on the contrary the lowest population was found under the category of rattan plants (Hossain et al., 2009). The variation in result may due to variation in plantation purpose as well as variation in site.

Distribution of the tree plant species: A large number of ornamental, medicinal, woody and fruit trees are found at Bangladesh Agricultural University campus. The major tree plant species distribution within the study areas (Figure 1) revealed that among those recorded plant species for trees, *Swietenia macrophylla* was the highest in number (16) followed by *Rosa acicularis* (7) which was found at site-19 (Horticultural Farm) whereas *Swietenia macrophylla* was present at

several site marked as site-2 (Boishakhi Chattar), site-3 (Health Complex), site-9 (K.B. High School), site-11 (BINA quarter), site-13 (Dairy Farm), site-14 (Sheep and goat Farm) and site-18 (BFRI).

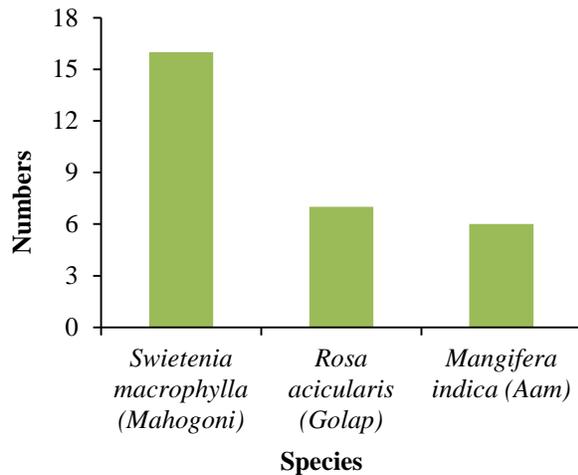


Figure 1. Distribution of major tree plant species.

On the other hand, the lowest number (1) was recorded for *Borassus flabellifer*, *Prunus avium*, *Saraca asoca*, *Lagerstroemia speciosa*, and *Acacia catechu* species. The result obtained from this study was different from that of some previous studies, conducted on distribution of plant species at different areas of Bangladesh such as in tropical evergreen forest in Bangladesh, it was found that *Castanopsis*, *Ficus* and *Terminalia* were most species rich genera whereas for horticultural farm of Bangladesh Agricultural University it was found that, the population of fruit plants was the highest in number among which Rutaceae was the largest family having 13 species and for Sundarbans, it was found that Sharankhola area was randomly covered by healthy trees of *Heritiera fomes* followed by *Hibiscus tiliaceus*, *Cynometra ramiflora* and *Excoecaria agallocha* (Feroz et al., 2016; Hossain et al., 2009; Muhibbullah et al., 2007).

Distribution of the herb plant species: The distribution of major herb plant species at Bangladesh Agricultural University campus are represented in (Figure 2). From the present study it was observed that among the

recorded herb plant species *Axonopus compressus* represented the highest number which was in total 2755 and was distributed at 12 sites in total. Among those 12 sites it was most distributed at site-8 (back sight of Veterinary Faculty). On the other hand the lowest number (5) was found for *Centella asiatica* which was distributed at site-18 (BFRI).

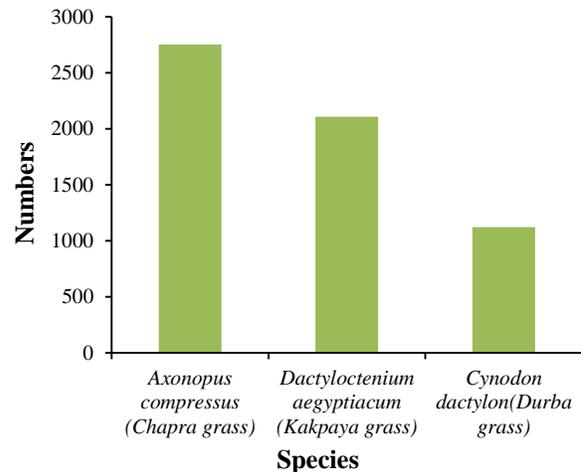


Figure 2. Distribution of major herb plant species.

Fonge et al. (2013) conducted his study on plant distribution in Lewoh-Lebang of Southwestern Cameroon and reported *Gaertner apaniculata* as the highly distributed herb of Southwestern Cameroon which is different from the findings obtained for Bangladesh Agricultural University campus, where *Axonopus compressus* was recorded as the highly distributed species. This variation may due to the result of geographical variation.

Relative abundance of plants: The relative abundance of plant species both trees and herbs within the Bangladesh Agricultural University campus are represented in (Figure 3) and (Figure 4). The study revealed that among all those plant species both trees and herbs recorded from twenty different sampling sites, *Axonopus compressus* exhibited the highest percentage (30.14%) in terms of relative abundance and the second highest percentage was found for *Dactyloctenium aegyptiacum* with the value of 23.07%

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whereas the lowest percentage (0.01%) in terms of relative abundance was recorded for *Borassus flabellifer* and *Prunus avium*. The study also highlighted that among all those recorded tree species *Swietenia macrophylla* represented the highest

abundance (0.175%) and *Borassus flabellifer* was the lowest (0.01%) whereas for herb *Axonopus compressus* exhibited the highest percentage (30.14%) and *Centella asiatica* was the lowest (0.005%) in terms of relative abundance.

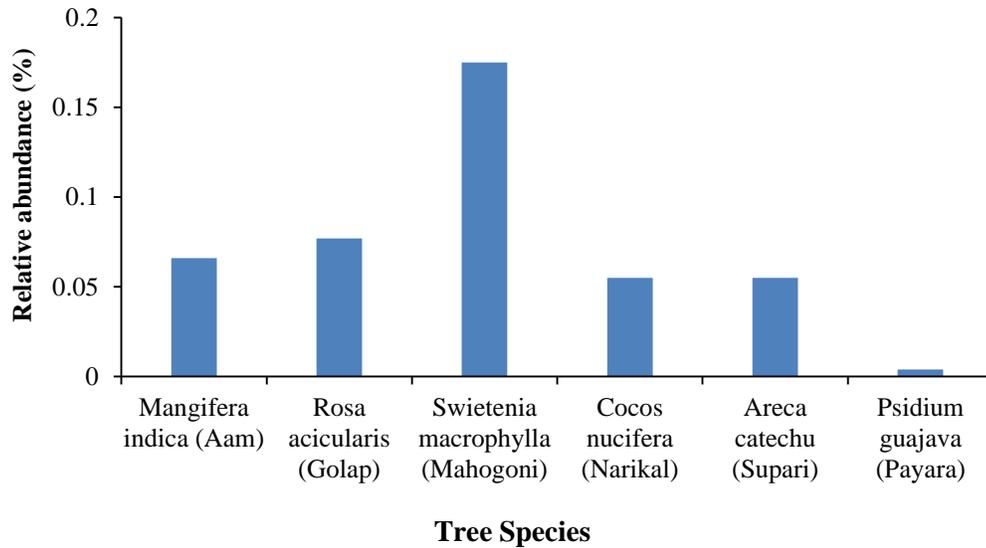


Figure 3. Relative abundance of trees species.

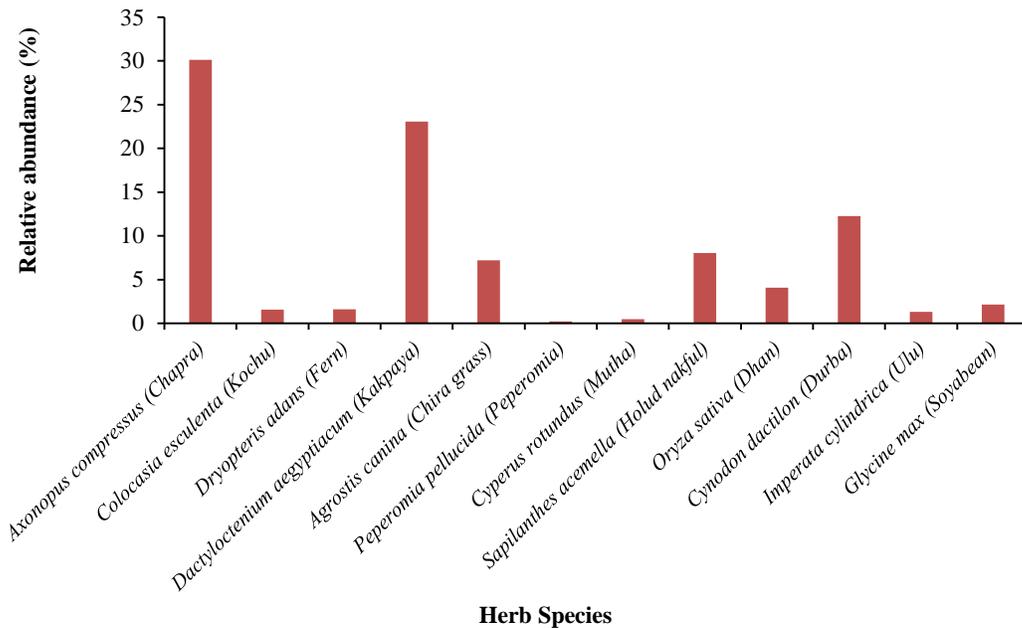


Figure 4. Relative abundance of herb species.

These species were different from the reported species *Bursera serrata*, which was found as the most dominant and abundant (14%) species in tropical evergreen forest of Bangladesh (Feroz et al., 2016) and from *Macaranga monandra* (179) which was recorded as the most abundant species in another previous study with a relative abundance of 8.47% and was followed by *Pen-tadesmabutyracea* (6.20%), *Gaertnera paniculata* and *Maesa lanceolata* (5.16%) (Fonge et al., 2013).

Diversity index: The diversity indices of twenty sampling sites are represented in (Figure 5). The study revealed that among all the sampling sites those are selected for this study site no. 11 (BINA quarter) exhibited the highest diversity having a value of 0.763. A large varieties of fruit plants such as *Psidium guajava*, *Mangifera indica*, *Citrus limon*, *Artocarpus heterophyllus*; woody plants such as *Cassia fistula*, *Swietenia macrophylla* and various types of grass vegetation were present there.

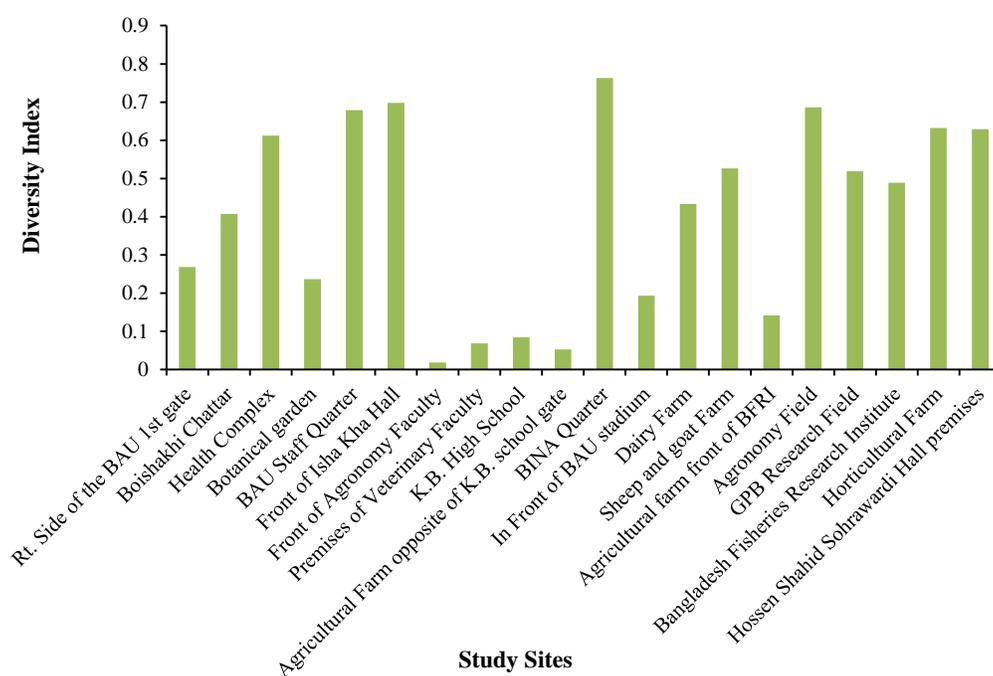


Figure 5. Diversity Index of twenty sampling sites of the study area.

For diversity indices the second highest value (0.698) was observed in front of Isha Kha Hall (site no. 6) whereas the lowest value (0.018) was obtained in front of Agronomy Faculty (site no. 7) which normally indicates a poor number of plants at site no. 7 and there was only 2 *Polyalthia longifolia* and 221 *Axonopus compressus*.

A similar experiment was conducted by Fonge et al., (2013) in Lewoh-Lebang in the Lebialem Highlands of Southwestern Cameroon *Nyitebongsub mountaine* exhibited the highest diversity index value. Another

study conducted on deciduous forest reported that Shannon and Simpson indices are very high in case of Querco-Carpinetum and Carpineto-Fagetum communities (Rad et al., 2009). This variation in diversity among these areas may occur due to geographical variation.

Conclusion

The study was undertaken to investigate the present scenario of plant diversity, abundance and wide ranges of distribution of various plant species at Bangladesh

Agricultural University, Mymensingh, one of the most beautiful and famous agricultural universities of Bangladesh. To conduct this study, the whole study area was divided into twenty sampling sites having an area of 3m² each and the results of this study provide an overview about the abundance, distribution and diversity of plants species. A total number of 9140 plants of 36 species were recorded from all the sampling sites belonging to 28 families. Out of these recorded 36 species, 20 species were trees and rest of them were herbs, among which *Axonopus compressus* was the richest species in terms of number (2755) followed by the *Dactyloctenium aegyptiacum* (2109) whereas the lowest number (01) was recorded for the species of *Borassus flabellifer*, *Prunus avium*, *Saraca asoca*, *Lagerstroemia speciosa*, *Cassia fistula* and *Acacia catechu* which covers only 0.01% of the total number. The study also revealed that among all the recorded tree plant species *Swietenia macrophylla* exhibited the highest number (16) and was present at several sites and the second highest number (7) was found for *Rosa acicularis* which was present at site-19 (Horticultural Farm) whereas the lowest number (01) was obtained for *Borassus flabellifer*, *Prunus avium*, *Saraca asoca*, *Lagerstroemia speciosa*, *Acacia catechu* species. On the contrary, among the recorded herb species *Axonopus compressus* represented the highest number (2755) and was distributed at 12 different sites whereas the lowest number (5) was obtained for *Centella asiatica* which was distributed at site-18 (BFRI). The result of the study also highlighted that in terms of relative abundance of both trees and herbs *Axonopus compressus* represented the highest value (30.14%) followed by *Dactyloctenium aegyptiacum* having a value of 23.07% and *Borassus flabellifer* and *Prunus avium* represented the lowest value (0.01%) whereas in between only the tree species *Swietenia macrophylla* had a relatively high abundance (0.175%) and *Borassus flabellifer* had the lowest (0.01%). Similarly, among the herb species *Axonopus compressus* represented the highest abundance (30.14%) and *Centella asiatica* was the lowest

(0.005%) which concluded that abundance of herb plant species was relatively higher than the trees. The study also revealed that among all those twenty selected site, site-11 (BINA quarter) represented a relatively high diversity index (0.763) in comparison to others. As Bangladesh is an over populated country having a less number of forest and plant resources, this study highlighted the role of Bangladesh Agricultural University campus in conservation of plants. It also suggested that a wide range of further study considering more sampling sites should be conducted to identify all the plants of Bangladesh Agricultural University as well as to create a database system for these plant species so that the authority and the students can get idea easily about the rare and endangered species, understand the necessity of its conservation as well as take proper steps to protect the biodiversity of this beautiful campus from being destroyed.

References

- Charles C, Christian K, Iain G (2006). Biological processes associated with impact events (1st eds.). Science and Business Media, 9(2): 197-219.
- Feroz S, Abdullah A, Enamul K (2016). Composition, diversity and distribution of woody species in relation to vertical stratification of a tropical wet evergreen forest in Bangladesh. *Global Ecology and Conservation*, 8(2): 144-153.
- Field R, Hawkins BA, Cornell HV, Currie DJ, Diniz-Filho AF, Guegan J, Kaufman DM, Kerr JT, Mittelbach GG, Oberdorff T, O'Brien EM, Turner JRG (2009). Spatial species-richness gradients across scales: a meta-analysis. *Journal of Biogeography*, 36(1): 132-147.
- Fonge BA, Tchetcha DJ, Nkembi L (2013). Diversity, distribution, and abundance of plants in Lewoh-Lebang in the Lebalem Highlands of Southwestern Cameroon. *International Journal of Biodiversity*, 44(3): 114-117.

- Hasan MM (1997). Bio-diversity conservation and management in Bangladesh. *Bangladesh Journal of Environmental Science*, 3(1): 1-7.
- Hossain A, Chowdhury MAS, Islam MSTT, Malakar PK, Iqbal SM (2009). Plant diversity of the horticultural farm of Bangladesh Agricultural University. *Bangladesh Journal of Agricultural Resources*, 34(2): 189-204.
- Huq MF, Banik RL (1992). Country Report-Bangladesh. Proc. Reg. Workshop Tree Breeding and Propagation, Bangkok, Thailand. pp. 19-48.
- IUCN (International Union for Conservation of Nature and Natural Resources). 2016. Extinction of species.
- Khan MS (1991). Towards Sustainable Development: Conservation of Genetic Resources of Bangladesh. A Background paper for National Conservation Strategy of Bangladesh. The World Conservation Union and Bangladesh Agricultural Resource Council (BARC), Dhaka. pp.12-19.
- Mitu KJ, Islam MA, Biswas P, Marzia S, Ali MA (2019). Effects of Different Environmental Pollutants on the Anatomical Features of Roadside Plants. *Progressive Agriculture*, 30(4): 344-351.
- Mondol M, Hossain M, Sultana S, Islam M, Biswas P. (2020). Impact of air pollution in Mymensingh city of Bangladesh: focusing peoples' perception. *Progressive Agriculture*, 31(3): 154-163.
- Muhammad N, Masum FH, Hossain M, Chakma S, Oesten G, Detten RV (2011). Floral composition and biodiversity conservation in homestead forests in Mymensingh, Bangladesh. *International Journal of Biodiversity Science, Ecosystem Services and Management*, 7(4): 247-257.
- Muhibbullah M, Chowdhury MA, Sarwar I (2007). Floristic condition and species distribution in sundarban mangrove forest community, Bangladesh. *Journal of Biological Sciences*, 7(2): 384-388.
- Rabosky R, Daniel L (2009). Ecological limits and diversification rate: alternative paradigms to explain the variation in species richness among clades and regions. *Ecology Letters*, 12(8): 735-743.
- Rad EJ, Manthy M, Mataji A (2009). Comparison of plant species diversity with different plant communities in deciduous forests. *International Journal of Environmental Science and Technology*, 6(3): 389-394.
- UNEP (United Nations Environment Programme). 1992. Convention on Biological Diversity.
- Wade L, Nicholas J (2016). Meet Luca, the Ancestor of All Living Things. *New York Times*. Warning of 'ecological Armageddon' after dramatic plunge in insect numbers.
- WRI (World Resources Institute) (1989). Keeping options Alive. *The Scientific Basis for Conserving Biodiversity*. pp.45-48.