Title	Shading Trees Resources growing in Mandalay University Estate
All Authors	May Phyoe Thynn and Soe Myint Aye
Publication Type	Local Publication
Publisher (Journal name, issue no., page no etc.)	Mandalay University Research Journal, Vol. 6
Abstract	The greening trees resources and its quantitative analysis were carried out in Mandalay University Estate, Mandalay Region. A total number of 489 tree individuals representing 57 species of 47 genera belonging to 21 families were recorded by establishing on 34 sample plots. The most dominant families were Fabaceae with 20 species in 236 individuals, Sapotaceae with 4 species in 33 individuals, and Combretaceae with 3 species in 32 individuals. The diversity index of greening trees was 4.8 and 0.94 by using the methods of Shannon-Wiener's index (H) and Simpson index (D). According to the Jackknife estimate for species richness, the species richness of trees in Mandalay University was 58.07. The importance value index (IVI) for tree species showed that *Azadirachta indica*A. Juss., *Samanea saman* (Jacq.) Merr. *Delonix regia* (Bojer ex Hook.) Raf. and *Acacia leucophloea* (Roxb.) Willd. are important species for the University Estate. According to quantitative analysis, the majority of the high IVI value indicating its dominance due to environmental suitability and ability of the species. According to the results of higher distribution values were found in lower frequency class (Frequency classes A, B and C), the study area of Mandalay University Estate had a high degree of floristic heterogeneity. The distribution of the basal area across GBH interval classes revealed that the dominance of small stemmed individuals in the study area. Total picture of height class showed that, 55.2 % belong to 5-10 m, 16.4 % in 10-15 m, and 3.1% in 15-20 m. The density of trees is 359.56 stem ha^{-1} and basal area is 33.8 m^2ha^{-1}. Because of the study area is in dry zone, the overall population structure indicated that the study area represents mature stand.
Keywords	Shading trees resources diversity, Mandalay University Estate
Citation	
Issue Date	2015

Shading Trees Resources growing in Mandalay University Estate

May Phyoe Thynn[1] & Soe Myint Aye[2]

Abstract

The greening trees resources and its quantitative analysis were carried out in Mandalay University Estate, Mandalay Region. A total number of 489 tree individuals representing 57 species of 47 genera belonging to 21 families were recorded by establishing on 34 sample plots. The most dominant families were Fabaceae with 20 species in 236 individuals, Sapotaceae with 4 species in 33 individuals, and Combretaceae with 3 species in 32 individuals. The diversity index of greening trees was 4.8 and 0.94 by using the methods of Shannon-Wiener's index (H) and Simpson index (D). According to the Jackknife estimate for species richness, the species richness of trees in Mandalay University was 58.07. The importance value index (IVI) for tree species showed that *Azadirachta indica* A. Juss., *Samanea saman* (Jacq.) Merr. *Delonix regia* (Bojer ex Hook.) Raf. and *Acacia leucophloea* (Roxb.) Willd. are important species for the University Estate. According to quantitative analysis, the majority of the high IVI value indicating its dominance due to environmental suitability and ability of the species. According to the results of higher distribution values were found in lower frequency class (Frequency classes A, B and C), the study area of Mandalay University Estate had a high degree of floristic heterogeneity. The distribution of the basal area across GBH interval classes revealed that the dominance of small stemmed individuals in the study area. Total picture of height class showed that, 55.2 % belong to 5-10 m, 16.4 % in 10-15 m, and 3.1% in 15-20 m. The density of trees is 359.56 stem ha^{-1} and basal area is 33.8 m^2ha^{-1}. Because of the study area is in dry zone, the overall population structure indicated that the study area represents mature stand.

Key words: Shading trees resources diversity, Mandalay University Estate

Introduction

Plant diversity is defined as the condition of having many different plants. The diversity of plant life is essential for the terrestrial ecosystems. Such diversity could be measured on the basis of number of species in a region. In urban area the trees are very important for local citizens. Urban vegetation reduces storm water runoff and flooding. Urban vegetation was to be implemented in conjunction with water filtration, storm water runoff and pollution would be significantly reduced. Urban vegetation also has countless additional benefits (Burden 2006). Trees have always helped man in his struggle for survival by providing him the food, shelter and other basic needs. Trees check soil erosion, act as wind-breakers and also help to prevent floods by building the soil of riverbanks. They give us shade and protection from heat and rain and they clean and purify the polluted air by absorbing obnoxious gases such as carbon dioxide and releasing oxygen needed for the respiration (Sabhaswal 2005).

A first step to improve the management of the urban forest is to evaluate its current structure and distribution, obtaining a base line from which to set goals and to monitor any changes. By measuring the structure of the urban forest, the functions of the urban forest can also be calculated and valued. The physical effects of trees—the shade (solar regulation), humidity control, wind control, erosion control, evaporative cooling, sound and visual

[1] Daw May Phyoe Thynn, Demonstrator, Department of Botany, University of Mandalay
[2] Dr Soe Myint Aye, Professor, Department of Botany, University of Mandalay

screening, traffic control, pollution absorption and precipitation—all have economic benefits (Rogers 2011).

Nowadays, the green environment of a university plays an important role in regarding the rank of the university. Therefore, the aims of the present study were to achieve the inventory of greening trees (a primary strategic planning tool), to record the natural vegetation to describe how much possesses the green environment, and to assess the floristic composition and distribution of tree canopy in Mandalay University. The objective was to provide the baseline data for an urban green spaces strategy for the Mandalay University Estate to develop the more greening spaces with urban trees in the future.

Materials and Methods

The vegetation survey of study area was carried out. The studied area includes thirty four sample plots s ≥ 10 cm girth at breast height (GBH) and the height of trees were visually estimated. Species diversity and Species Richness were calculated by methods of Colwell (2009) and Heltshe and Forrester (1983). Importance Value Index (IVI) is developed by Curtis and McIntosh (1950), it can be used to compare the ecological significance of species in a given forest types. IVI is the sum of relative density (R.D), relative frequency (R.F) and relative dominance (R.Dm) (Curtis 1959).

The absolute frequency of a species was followed to Raunkiaer (1934). These five frequency classes were used to determine whether the vegetation of the study area is homogeneous or heterogeneous. Population structure of tree species were analyzed across fixed girth classes (Horizontal structure). Species and their corresponding individuals were proportionately analyzed by height classes intervals (Vertical structure).

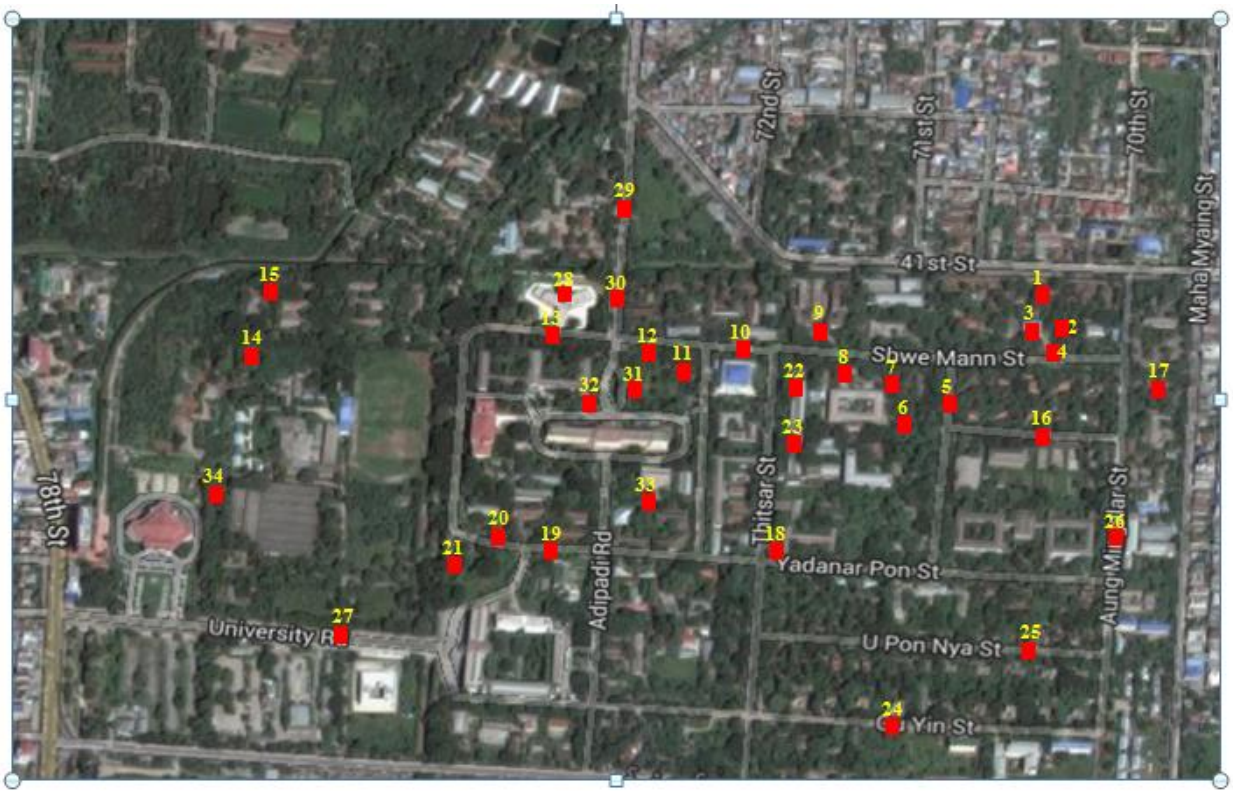

Figure 1 Location of sample plots in Mandalay University Estate

Results

Species Diversity

Plant species diversity

A total number of 489 tree individuals representing 57 species, 47 genera and 21 families in Mandalay University Estate were recorded in all 20m x 20m sample plots.

Species composition

In Mandalay University Campus, the most dominant families was the Fabaceae with 236 individuals representing 20 species, followed by Sapotaceae 4 species, Combretaceae, Bignoniaceae, Moraceae, Apocynaceae, and Malvaceae with 3 species each, Annonaceae, Myrtaceae, Anacardiaceae, and Rubiaceae with 2 species each and the other families such as Meliaceae, Rhamnaceae, Ulmaceae, Casuarinaceae, Euphorbiaceae, Rutaceae, Capparaceae, Lecythidaceae, Boraginaceae and Lamiaceae with one species each were recorded. In present study, the higher distribution of Fabaceae was found in all sites. These species occurred everywhere and frequently found in all sample plots.

Table 1. Ranking of Family by Number of Tree Species Composition

No.	Family	No. of species	Total no. of individuals
1	Fabaceae	20	236
2	Sapotaceae	4	33
3	Combretaceae	3	32
4	Bignoniaceae	3	18
5	Moraceae	3	7
6	Apocynaceae	3	4
7	Malvaceae	3	3
8	Annonaceae	2	28
9	Myrtaceae	2	7
10	Anacardiaceae	2	4
11	Rubiaceae	2	3
12	Meliaceae	1	80
13	Others	9	34
	Total	**57**	**489**

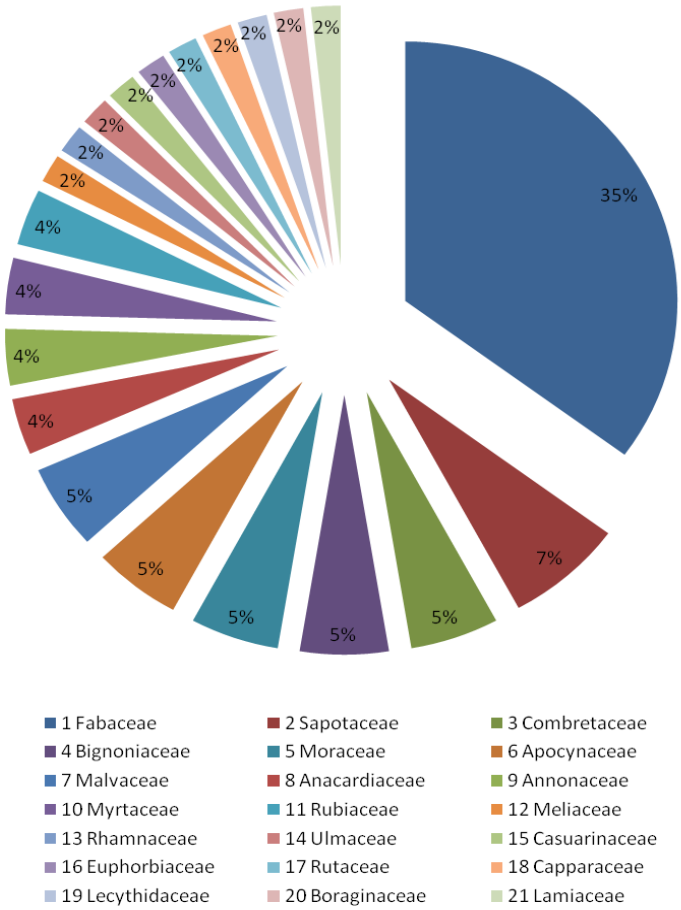

Figure 2. Ranking of family by number of tree species composition

Jackknife estimate of species richness

The tree layer was analyzed by sampling 34 plots of 20m x 20m size in Mandalay University. According to the results of Jackknife estimate of species richness; the tree layer of Mandalay University was 58.07.

Species diversity and evenness

In Mandalay University Estate, *Azadirachta indica* A. Juss. (16.36 % of total individual species) occupied by only one species, *Delonix regia* (Bojer ex Hook.) Raf. (9.2 % of total individual species), *Madhuca longifolia* (L.) Macbride (5.52% of total individual species), *Acacia leucophloea* (Roxb.) Willd. (5.11% of total individual species), and *Polyalthia longifolia* (Sonnerat.) Thwait. (5.11% of total individual species) were found to be the most abundant species.

Species diversity indices

Shannon – Wiener Index (H) and Simpson Index (D)

Species diversity of a community can be analyzed by two indices; Shannon – Wiener Index (H) and Simpson (D) Index.

According to the result of Shannon – Wiener Index (H), it was observed that the index of trees was 4.8. Similarly, Simpson Index (D) of trees was 0.94 as shown in Table 2.

Therefore, both indices give appropriate measure of diversity and provide different insights into the diversity of trees in Mandalay University Estate.

Evenness (E)

According to the result of Shannon – Wiener evenness (E), the value for evenness of trees was 0.82 as shown in Table 2.

Quantitative Analysis and Forest Stand Structure

Important Value Index (IVI)

The importance value index (IVI) for the tree species were determined as a sum of the relative density, relative frequency and relative dominance. Ranking of ecological significance by IVI of 57 tree species in site Mandalay University Estate were recorded. The tree layer was dominated by *Azadirachta indica* A. Juss. with the highest IVI value of 44.16% , the second most dominant species was *Samanea saman* (Jacq.) Merr. with the IVI of 40.72% and the third dominant species was *Delonix regia* (Bojer ex Hook.) Raf. with the IVI value of 22.76 %. The fourth dominant species was *Acacia leucophloea* (Roxb.) Willd. with 20.58% of IVI value. The follower species were *Albizzia lebbeck* Benth., *Tamarindus indica* L., *Dolichandrone spathacea* (L.f.) K.Schum, *Limonia acidissima* L., *Madhuca longifolia* (L.) Macbride, *Polyalthia longifolia* (Sonnerat.) Thwait. and *Terminalia catappa* L. with IVI value of 16.06, 11.32, 10.24, 9.94, 9.88, 9.36 and 7.39 respectively. The ranking of Important value index were shown in Table 3 and Figure 2. According to the result of quantitative analysis, the majority of the high IVI value indicating its dominance due to environmental suitability and ability of the species.

Table 2. Jackknife Estimate of Tree Species Richness and Diversity Indices

	Quantitative estimate of species richness
Total no. of species (s)	57
Total individual in all sample plots	489
Total no. of unique species (k)	17
Jackknife estimate of species richness($\hat{S}$)	58.07
Shannon Wiener Index (H)	4.80
Simpson's Index (D)	0.94
Eveness (E)	0.82

Table 3. Importance Value Index (IVI) Value of Top Ten Species in the Study Area

No.	**Scientific name**	**IVI**
1	*Azadirachta indica* A.Juss.	44.16
2	*Samanea saman* (Jacq.) Merr.	40.72
3	*Delonix regia* (Bojer ex Hook.) Raf.	22.76
4	*Acacia leucophloea* (Roxb.) Willd.	20.58
5	*Albizia lebbeck* Benth.	16.06
6	*Tamarindus indica* L.	11.32
7	*Dolichandrone spathacea* (L.f.) K.Schum.	10.24
8	*Limonia acidissima* L.	9.94
9	*Madhuca longifolia* (L.) Macbride.	9.88
10	*Polyalthia longifolia* (Sonnerat.) Thwait.	9.36

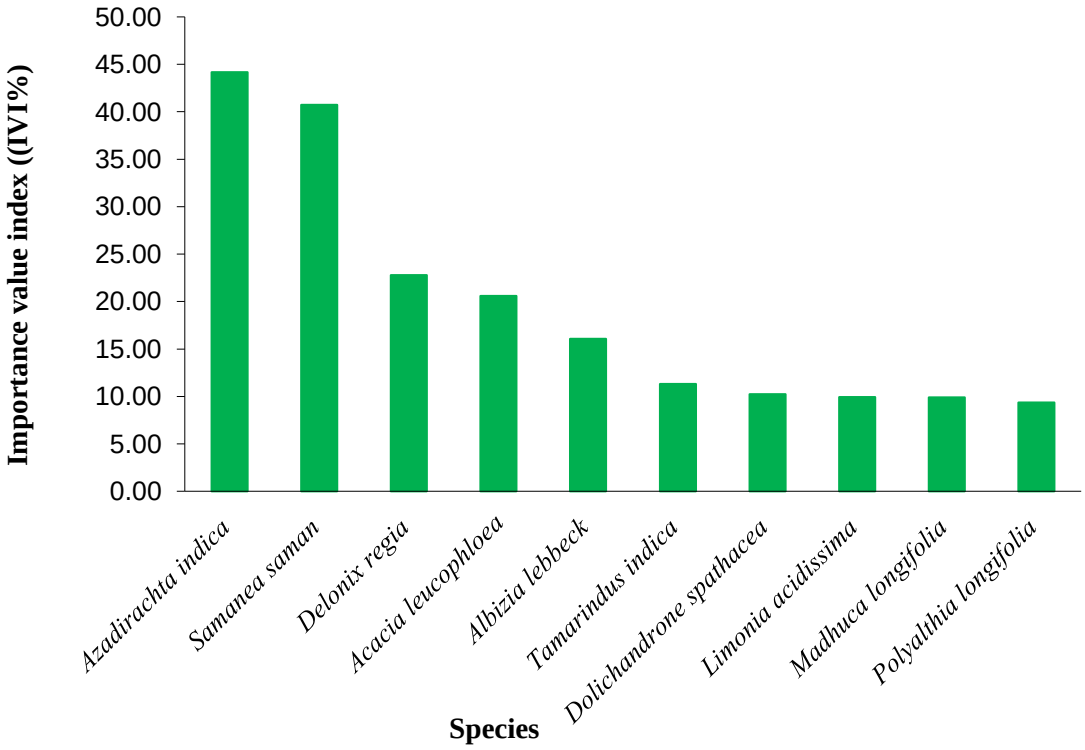

Fig. 2 Importance Value Index (IVI) Value of Top Ten Species in the Study Area

Tree species distribution by frequency classes

According to the Raunkiaer (1934), five frequency classes of species frequency distribution found in the study area are shown in Table 4 and Figure 3. The frequency gives an approximate indication of the homogeneity of a stand.

The only species of *Azadirachta indica* A. Juss. in frequency class D (61 – 80%) was found in Mandalay University Estate. There were two species belong to frequency class C (40 – 60%) in study area. These are *Delonix regia* (Bojer ex Hook.) Raf. and *Acacia leucophloea* (Roxb.) Willd. In frequency class B (20 – 40%) nine species belonging to Mandalay University Estate. These species are *Samanea saman* (Jacq.) Merr., *Limonia acidissima* L., *Albizzia lebbeck* Benth., *Dolichandrone spathacea* (L.f.) K.Schum., *Tamarindus indica* L., *Polyalthia longifolia* (Sonnerat.) Thwait., *Cassia fistula* L., *Prosopis juliflora* (Swartz.) DC. and *Terminalia catappa* L.

In frequency class A (1 – 20%) the rest forty five species belong to study area. In the present study, higher distribution values were found in lower frequency class (Frequency classes A, B and C) whereas lower values were found in higher frequency classes (frequency classes D). It indicates that study area of Mandalay University Estate had a high degree of floristic heterogeneity.

Table 4. Tree species distribution by frequency classes in Mandalay University Estate

Frequency range	Frequency class	No. of species	No. of individual	% of total species frequency distribution
1-20%	A	45	185	78.95
21-40%	B	9	154	15.79
41-60%	C	2	70	3.51
61-80%	D	1	80	1.75
Total		**57**	**489**	**100**

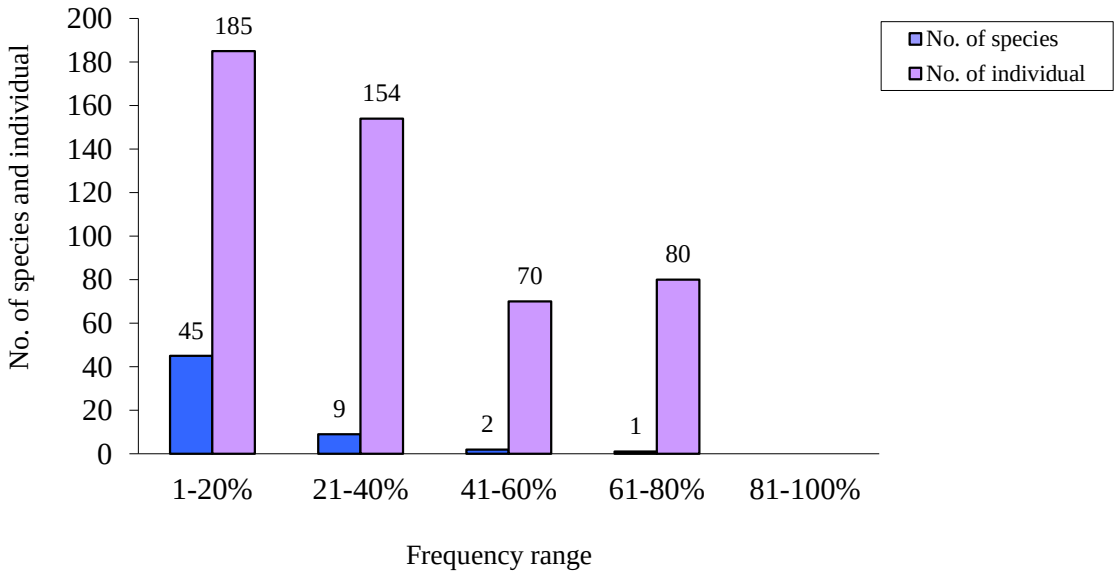

Fig. 3 Tree Species Distribution by Frequency Classes

Stratification: Horizontal and Vertical Stand Structure

Horizontal Stand Structures

The distribution of the basal area across GBH interval classes reveals that the dominance of small stemmed individuals in the study area. The population structure by GBH class decreased from class to class with a steeper gradient in lower GBH classes and with a gentle slope in higher classes Table 5 and Figure 4. Out of total number of stems inventoried in study area, 9.61 % of stems were accumulated in the <30cm GBH class, 29.65 % of stems in the 30-60 cm, 26.38% in the 60-90 cm, 12.47 % in the 90-120 cm, 9.82 % in 120-150 cm, 4.29 % of stems in the 150-180 cm, 2.86% in the 180-210 cm, 1.23 % in the 210-240 cm, 0.82 % in 240-270 cm, 0.61 % of stems in the 270-300cm, 1.02% in the 300-330 cm, 0.61 % in the 330-360 cm, 0.41 % occurs in 360-390 cm, 0.20 % occurs in 390-430 cm. The highest GBH was measured in the case of *Samanea saman* (Jacq.) Merr. (401 cm). It was followed

by second species measured by *Albizia lebbeck* Benth. (389 cm), and third species *Ficus rumphii* Blume (315 cm).

Basal area provides a better measure of the relative importance of the species than simple stem count. Therefore, these species with the largest contribution in basal area can be considered as the most important woody species in Mandalay University Estate.

Table 5. Population density of tree species across GBH class interval

GBH (cm)	No. of species	Total no. of individuals	% of total no. of individuals
< 30 ≥ 10	18	47	9.61
< 60 ≥ 30	37	145	29.65
< 90 ≥ 60	37	129	26.38
< 120 ≥ 90	25	61	12.47
< 150 ≥ 120	17	48	9.82
< 180 ≥ 150	11	21	4.29
< 210 ≥ 180	7	14	2.86
< 240 ≥ 210	3	6	1.23
< 270 ≥ 240	3	4	0.82
< 300 ≥ 270	2	3	0.61
< 330 ≥ 300	3	5	1.02
< 360 ≥ 330	1	3	0.61
< 390 ≥ 360	2	2	0.41
< 430 ≥ 390	1	1	0.20
Total	**57**	**489**	**100**

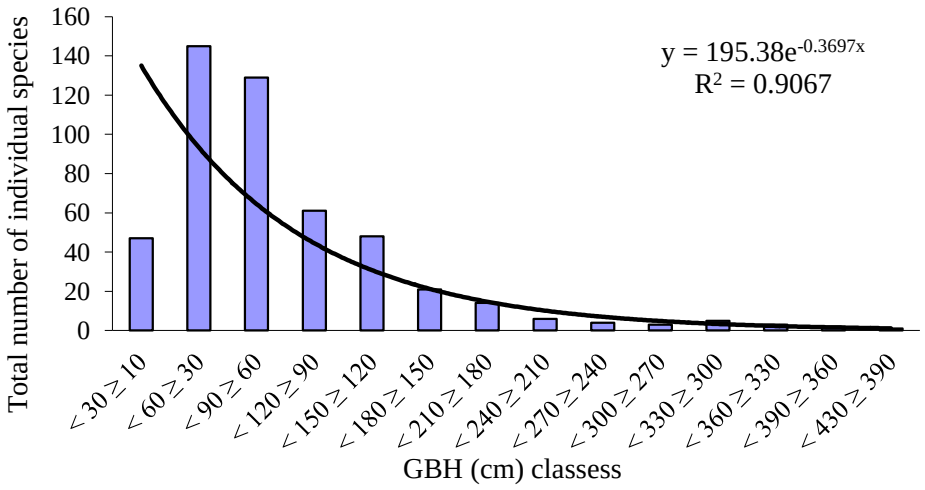

Fig. 4 Species Distribution by GBH

Vertical Stand Structure

The stratification or vertical layering of the community was occurred in different growth forms. Plant community have a vertical structure, different species were occurred the different height upon the nature of habitat.

Tree distribution by height intervals showed that among the 489 total number of individual in study area, 124 individuals 25.4%) are belong to <5 m category, followed by 270 individuals (55.2%) in 5-10 m, 80 individuals (16.4 %) in 10-15 m, 15 individuals (3.1%) in 15-20 m. The height class of <20≥15m includes only (3.1 %) of total individuals Table 6 and Figure 5.

Whereas < 5m height trees of 124 individuals (25.4 %) infer natural regeneration is poor or frequent disturbance on ground cover plant. The population structure by height classes in Mandalay University is highest in <10≥5m class and gradually decreases to higher classes. The tallest individual trees were *Eucalyptus citriodora* Hook. (15 m), *Albizia lebbeck* Benth. with 15 m and *Samanea saman* (Jacq.) Merr. (15m).

Total picture of height class showed that, 55.2 % belongs to 5-10 m category, 16.4 % in 10-15 m, and 3.1% in 15-20 m. Because of the study area is in dry zone, the overall population structure indicates that study area represents mature stand.

Table 6. Population density of tree species across height class interval

Height classes (m)	No. of species	Total no. of individuals	% of total no. of individuals
< 5	35	124	25.4
< 10 ≥ 5	45	270	55.2
< 15 ≥ 10	19	80	16.4
< 20 ≥ 15	3	15	3.1
Total	**57**	**489**	**100.0**

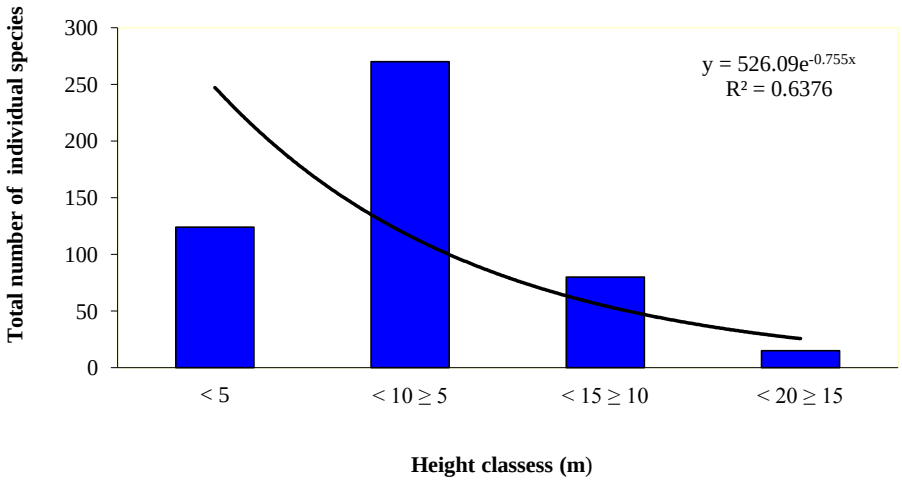

Fig. 5 Species Distribution by Height Classes

The Mandalay University Estate is covered by greening trees of various diversified species in various sizes. Altogether 57 species belonging to 42 genera of 21 families occur as shady trees. The density of stem per ha was 359.56 and basal area of trees was 33.8 m^2/ha. The total number of unique species is 17 as shown in Table 6.

Table 7. Summary of species inventory in study area

Description	Mandalay University Estate
No. of sample plots	34
No. of species	57
Density (stem/ha)	359.56
Basal area (m^2/ha)	33.80
Total no. of unique species	17

Discussion and Conclusion

Plant species diversity, dominance, abundance and species composition of trees species were studied in Mandalay University Estate, Mahaaungmyay Township, Mandalay District, Mandalay Region. Most of the areas are occupied with large and shady trees, especially along the roadsides. The areas where there are no large buildings are also covered with shady plants. Nowak *et al.* (2007) stated that trees in cities can contribute significantly to human health and environmental quality. It is needed to be better understanding the urban forest resource and its numerous values. Mandalay University Estate is an interesting area for sustainable greening area of the Mandalay city.

Rogers (2011) stated that the first step to improve the management of the urban forest is to evaluate its current structure and distribution, obtaining a base line from which to set goals and to monitor any changes. Colwell (2009) mentioned that monitoring was often loosely regarded as a programme of repeated surveys in which qualitative or quantitative observations were made, usually by means of a standardized procedure data collected for monitoring purposes. That can sometimes also be used to examine possible causes of change and to investigate the relationship between features of interest and environmental variables and pressures. Such information can then be used to formulate appropriate responses.

Floristic inventory is a necessary prerequisite for much fundamental research in tropical community ecology, such as modeling patterns of species diversity or understanding species distributions. In this area, a total of 489 tree individuals representing 57 species of 47 genera belonging to 21 families were recorded. In this study, totally 34 sample plots were analyzed for species diversity and urban forest structure.

Species are the fundamental units of biological organization, and any small changes in the species diversity may alter to some extent ecosystem functions and services. Species diversity is a fundamentally multidimensional concept that includes species richness and abundance (You *et al.* 2009). Phillips *et al*. (2003) stated that quantitative floristic sampling also provides necessary context for planning and interpreting long-term ecological research.

In the present study, Fabaceae were the richest family with 20 species, Sapotaceae were the second richest family with 4 species followed by Combretaceae, Bignoniaceae, Moraceae, Apocynaceae, and Malvaceae with 3 species each, whereas the other 14 families were slightly distributed in this studied area. According to the result, Fabaceae and Meliaceae families were important value of the leading dominant families in this area.

According to Jackknife estimate of species richness for tree species, the species richness is 58.07. Similarly, the species diversity index was found in Mandalay University Estate with the value of 4.80, 0.94. According to the result, evenness for tree species was 0.82. The degree of evenness showed the distribution of plant species in study area. In the

present study, the dominant species are found as *Azadirachta indica* A. Juss., *Samanea saman* (Jacq.) Merr. and *Delonix regia* (Bojer ex Hook.) Raf. The unique (rare) species are 17 individuals in the studied area. These are *Bombax ceiba* L., *Carissa spinarum* L., *Casuarina equisetifolia* L., *Ceiba pentandra* (L.) Gaertn., *Cordia gharaf* (Forssk.) Ehren., *Ficus racemosa* L., *Jacaranda ovalifolia* R. Br., *Lannea coromandelica* (Houtt.) Merr., *Manilkara zapota* (L.) P.Royen., *Millingtonia hortensis* Linn. f., *Morindacitrifolia*L., *Muntingia calaburn*L., *Pithecellobium dulce* (DC.) Backer., *Planchonella obovata* (R.Br) Pierre., *Streblus asper* Lour., *Terminalia chebula* Retz. and *Thevetia peruviana* (Pers.) K. Schum.. Therefore, the rare species observed in the present study should be taken into the planning for long term existence.

Importance Value Index (IVI) can also permit a comparison of the ecological significance of species in a given forest type. *Azadirachta indica* A. Juss. possesses the greatest importance value index (IVI) 44.16%. According to the data, *Azadirachta indica* A. Juss. occurred everywhere in Mandalay University Estate. *Samanea saman* (Jacq.) Merr. is the second largest IVI value with 40.72%.

According to the frequency classes, most of the tree species distribution were found in low frequency classes (A, B and C) while few of the species were in higher frequency classes (D) in study area. *Azadirachta indica* A.Juss. (Tamar) possessed the highest frequency class (D). Tree density is a fundamental metric of forest structure. It is a quantitative measure of the number of trees on a unit area of land. The size of forest trees is a useful indicator of tree productivity and age (Enquist *et al.* 1999 as cited in San Nyunt Nwe 2014).The value of the total density of all the tree species was 359.56 stem ha^{-1}. The basal area of trees was 33.80 m^2ha^{-1}.

According to the data, stand structure was related to the height of tree, basal area and distribution of various diameter size classes. *Eucalyptus citriodora* Hook. (Eucalip) (15 m), *Albizia lebbeck* Benth. (Bamarkoko) with 15 m and *Samanea saman* (Jacq.) Merr. (Thinbawkoko) (15m) in height class (<15≥10 m). In horizontal structure, basal area provided a better measure of the relative importance of the species than simple stem account. *Samanea saman* (Jacq.) Merr. (Thinbawkoko) (401 cm) in GBH class (<420≥390 cm) was found in the highest girth class in Mandalay University Estate. Tree distribution by GBH intervals showed that among the 489 total number of individuals in the study area, 145 individual (29.65%) belong to <60≥30 cm category, 129 individual (26.38%) in <90≥60 cm, 61 individual (12.47%) in <120≥90 cm, 48individual (9.82%) in <150≥120 cm, 47 individual (9.61%) in <30≥10 cm, 21 individual (4.29%) in <180≥150 cm, 14 individual (2.86%) in <210≥180 cm, 6 individual (1.23%) in <240≥210 cm, 5 individual (1.02%) in<330≥300 cm, 4 individual (0.82%) in <270≥240 cm, 3 individual (0.61%) in <3000≥270 cm, 3 individual (0.61%) in <360≥300 cm.

Tree distribution by height intervals showed that among the 489 total number of individual in Mandalay University Estate, 270 individual (55.2 %) belong to 5-10 m category, 124 individual (25.4%) in < 5 m and 80 individual (16.4%) in 10-15 m. Therefore, the individual characteristics (height and diameter) which are directly related to growth and development are highly influenced by environmental factors such as temperature, rainfall, soil, disturbance etc. as well as the genetics of individuals. The results in the study were in agreement with Mueller-Dombois and Ellenberg (2002) as cited in San Nyunt Nwe (2014). The distribution younger trees (5 -10 m) were considered as potential for the development of larger trees of the species. As the largest and oldest trees were harvested of die, there were always younger trees to replace them.

The present research work on greening trees of Mandalay University Estate highlighted the diversity of greening tree resources. The results of this study confirmed that most of the tree resources and green space was found in Mandalay University Estate. That is

also benefit to the Mandalay City and its residents from the environmental, social and economic status. Making urban areas more aesthetically pleasing improve the quality of life and increasing pedestrian safety are also significant benefits of urban vegetation. Urban vegetation makes urban areas more aesthetically pleasing by reducing visual pollution.

The achievement of the present research is fruitful information to contribute the Mandalay University in creations of more environmentally conscious, pedestrian friendly corridor. The resulting data can provide as a key management tool in the maintenance of Mandalay University Estate to develop the more greening area. This will be helped to manage the development of green Mandalay city.

Acknowledgements

We would like to express or gratitude to Professor Dr Nu Nu Yee, Head of the Department of Botany, University of Mandalay for her kind suggestion and encouragement for this research work. Our thanks are also due to Dr San Nyunt Nwe, Lecturer of Botany Department, Monywa University, for her kind help for the calculation of data to be analysed.

References

Burden D. 2006. Benefits of Urban Street Trees. Rep. Glatting Jackson and Walkabl Communities Inc.

Colwell R. K. 2009. Biodiversity: concepts, patterns, and measurement. The Princeton Guide to Ecology. Princeton University Press, Princeton, NJ.

Curtis, J. T. and R. P. McIntosh. 1950. Ecology, the interrelations of certain analytic and synthetic photosociological characters.

Curtis J.T. 1959. The vegetation of Wisconsin: an ordination of plant communities. University of Wisconsin Press, Madison.

Nowak D. J., R. Hoehn, D.L.E. Crane, J.C. Stevans & J. Walton 2007. New York City's Urban Forest. USDA Forest Service, 11 Campus BLVD. Suite, Newtown Square Pa.

Phillips O.L., R.V. Martinez, M. Ylihalla & S. Rose 2003. Efficient plot-based floristic assessment of tropical forests. Journal of Tropical Ecology 19: 629 – 645.

Raunkiaer, C. 1934. The life form of plant and statistical plant geography. Oxford. Claredon press.

Rogers K., T. Jarratt & D. Hansford 2011. Torbay's Urban Forest Assessing Urban Forest Effects and Values. A report on the findings from the UK i-Tree Eco pilot project. British Library Cataloguing in Publication Data, Treeconomics, Exe Valley Design and Print Ltd., Exeter.

Sabhaswal R. 2005. Flowering trees, shrubs and climbers of India, Pakistan, Sri Lanka, Bhutan and Nepal. Pypinder Khullar.

San Nyunt Nwe 2014. Assessment of plant species diversity and plant community structure in Alaungdaw Kathapa National Park, Moywa District, Sagaing Region**.** PhD. Dissertation. Department of Botany, University of Mandalay, Myanmar.

You M., L. Vasseur, J. Regniere & Y. Zheng 2009. Three Dimensions of Species Diversity. The Open Conservation Biology Journal 3: 82 – 88.