

RESEARCH ARTICLE



Urban Green Open Space in Metro, Lampung, Indonesia: Vegetation Structure, History, and Function

Anisatu Z. Wakhidah^a, E. Anggraini, M. Hanifah, Revi Nurillah, Selly Mulyani

Biology Education Program, Islamic State Institute Metro - Jl. Ki Hajar Dewantara No. 15A, Iringmulyo, Kec Metro Timur, Kota Metro, Lampung. ZIP Code: 34112

Article Info:

Received 18 December 2023

Revised 19 February 2024

Accepted 17 April 2024

Corresponding Author:

Anisatu Z. Wakhidah

Department of Biology Education

Islamic State Institute Metro

E-mail:

anisatuzwakhidah@metrouniv.ac.id

© 2024 Wakhidah et al. This is an open-access article distributed under the terms of the Creative Commons Attribution (CC BY) license, allowing unrestricted use, distribution, and reproduction in any medium, provided proper credit is given to the original authors.



Abstract

Green open space (GOS) is an open land with plant vegetation as a constituent needed to support ecological functions and improve environmental quality in urban areas. Metro city has a number of GOS that haven't been reported about its plant structure and composition. The purpose of this study was to determine the GOS' composition of plants and structure in Metro City; describe the history, social, and ecological function of GOS; and the last to report about conservation function of GOS in Metro City. The research was conducted at a number of GOS in Metro city with quantitative and survey methods. Data collected by direct observation and exploring each location point. This study observed two types of GOS which have different structures in Metro City, namely field and parks. The results showed that before the area became GOS, it was vacant land as government property. Recorded as many as 1,198 individual plants identified as 112 species belonging to 43 families plant composed the vegetation in GOS' area. Fabaceae was the most occurred family, while *Acacia auriculiformis* A. Cunn ex Benth and *Imperata cylindrical* (L.) were dominant species in the observed GOS. The diversity index (H') in all observed GOS were medium, the highest evenness index (J) is found in GDR (0.92) while the lowest is in KHD (0.57). Generally, GOS in Metro city utilized as research field, social interaction medium, recreation, economy activity, and functions ecologically as a buffer for the urban ecosystem.

Keyword: GOS, Metro city, plant composition diversity, urban ecosystem

1. Introduction

Green open space (GOS) is open land filled with plants, herbs and vegetation to take advantage of ecological, socio-cultural and aesthetic functions [1]. According to Indonesian Law no. 26 of 2007; GOS is part of open space in an urban area in the form of an elongated area and grouped in a certain area unit containing plants, plants, and green vegetation both that grow naturally and intentionally. The green open spatial system apart from being the lungs of the city can also function as a place for various kinds of activities of living things including as a sports facility, maintaining land availability, and creating a balance between the built environment and the natural environment [2].

Metro City is the second largest city in Lampung Province, which is 52 km from Bandar Lampung City. This city located in the middle of Lampung Province, that bordered by Central Lampung Regency in the north and west, and East Lampung Regency in the north, south and east. The size area of Metro city approximately 68.74 km² and stretched on high of 25-75 meters asl and slope of 0%--15%. The total population Metro City in 2021 was 172,934 people with population density of 2500 people/km². Metro City divided into 5 Districts namely East Metro, South Metro, West Metro, North Metro, and Central Metro. This city is designed as blueprint by the Ministry of Public Works and Public Housing of the Republic of Indonesia, namely as a strategic area and a target for the development of a metropolitan city after Bandar Lampung City [3]. The level of air pollution in Metro City based IQAir January 2024 is classified as moderate with an air pollution concentration range of 12.1—35.4 $\mu\text{g}/\text{m}^3$. Thus, the number of residents in Metro City will increase in line with the increasing demand for oxygen and reduced green open land can reduce the supply of oxygen availability (Ramaiah and Avtar 2019). Spatial

planning that is problematic due to urban development will have a negative impact on the biodiversity in GOS.

Research on plant diversity in GOS has been carried out, one of which is at Smart Park, Samarinda City. The vegetation structure that makes up the park consists of trees, shrubs, and herbs. With the existence of a structured arrangement of vegetation and adjusting its function, Samarinda City Smart Park is a supporting infrastructure for the city's ecology [4]. Several public GOS in Metro City have not been supported by data on the diversity of their constituent vegetation. For example, the Mulyojati Park (MUL), Ki Hajar Dewantara Park (KHD), Iringmulyo Field (LIR), Garuda Field (GDR), West Hadimulyo Field (LHB), and East Hadimulyo Field (LHT). Whereas data on vegetation diversity is useful in managing GOS and supporting biodiversity management and planning efforts. Based on existing research, cities that have studied the diversity of vegetation in GOS are Bandar Lampung, Depok, Jakarta, Singkawang [5], Manado [6] and Palembang [7]. GOS composed of vegetation are very important because they have effective functions including reducing the temperature of city lungs, climate control, reducing pollution, and reducing the greenhouse effect. Therefore, research to find out the composition of plants in GOS is important, so that the function of the GOS can run well and provide benefits to the community.

By paying attention to those backfields, the study in structure and composition of vegetation in the GOS of Metro City is important. Therefore, the purposes of this study are first to described structure and composition of plants vegetation in GOS in Metro City; second to investigate the history and function of GOS in Metro City; third to report about conservation function of GOS in Metro City. Hopefully, this study is able to add give insight and knowledge to Metro citizenship about their city. The finding of this research is also to strengthen Metro City mission as a comfortable, environmentally friendly, and sustainable city. Last but not the least, the research data can become a database for various environmentally and contextual development models in Metro City.

2. Materials and Methods

2.1 Location and Time of Research

This research was conducted in several GOS in Metro city, Lampung including Mulyojati Park (MUL), Ki Hajar Dewantara Park (KHD), Iringmulyo Field (LIR), Garuda Field (GDR), West Hadimulyo Field (LHB), and East Hadimulyo Field (LHT) (Figure 1). The research was conducted from October 2022 – February 2023.

2.2 Data Collection Method

The method used was survey with direct observation and exploring each location point (Hartini, 2011). This free roaming was carried out by exploring each GOS that will be examined in turn, by identifying one by one the existing plant species. During the research each group member has their own task. Some served as documentation using a camera and smartphone and drew a research location map. The plant composition was collected in each GOS and documented the general characteristics and habitus of plants. If there are plants whose local names were not known, then at the time of documentation the plants will be given a separate code name to distinguish between plants whose local names are known and those whose local names are not known. The history data of GOS was collected used interview method. We interviewed the local resident around the GOS that we observed. The informant was chosen by purposive method with condition having more knowledge about history of observed GOS with aged 45-70 years old.

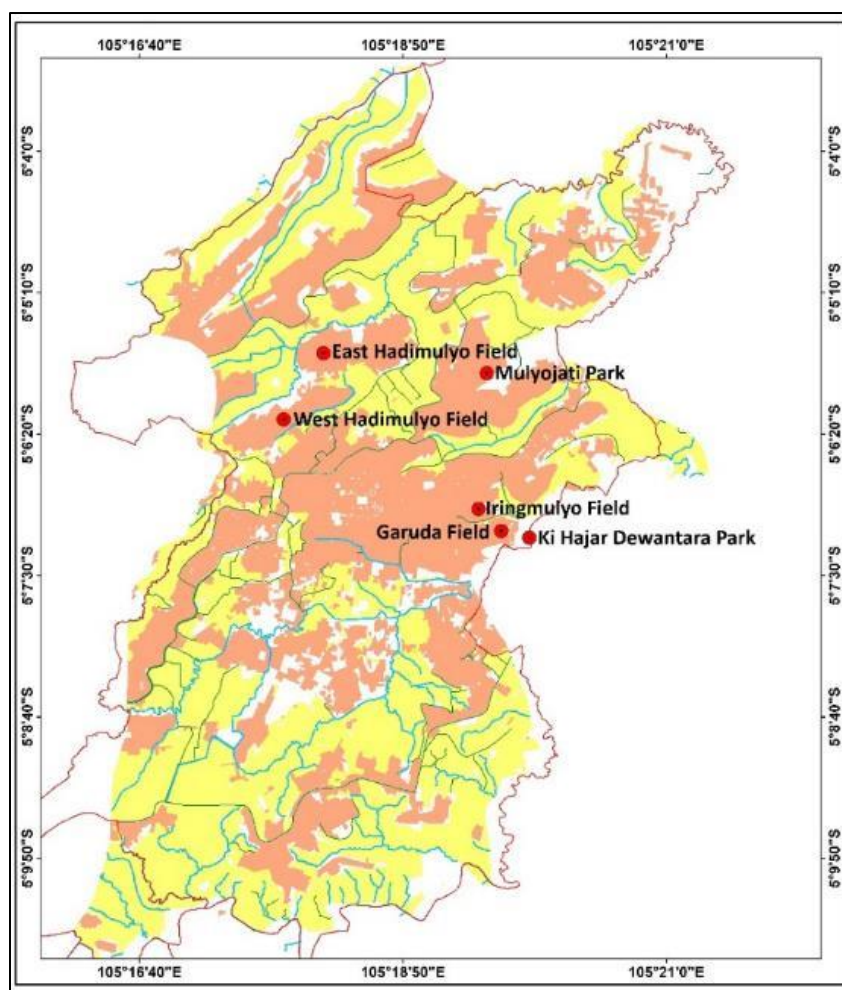


Figure 1. Data collection locations for plant species diversity in 6 GOS in Metro City, Lampung; Mulyojati Park (MUL), Ki Hajar Dewantara Park (KHD), Garuda Field (GDR), Iringmulyo Field (LIR), West Hadimulyo Field (LHB), and East Hadimulyo Field (LHT)

2.3 Data Processing

In the identification stage of each plant that were found in every GOS have been taken its morphological characteristics by photos. If the plants species were unknown the identification stage it will be carried out with the help of identification book; *Tumbuhan Berbiji Di Jakarta Jilid 2: 100 Jenis – Jenis Non-pohon Terpilih* was written by Silalahi & Mustaqim [8]. We also used <https://powo.science.kew.org/> to validate the plant species name and its author. The identified plant species classified according to their family and presented alphabetically in table with local names and conservation status based on <https://www.iucnredlist.org>. Beside it, plants' habitus also observed and grouped into trees, shrubs, herbs, or bush then presented in table.

2.5 Quantitative Analysis

The structure and composition of the plants in each GOS were analyzed using species diversity analysis. The abundance of species in each GOS can be determined by calculating abundance values using the Margalef Index (DMg) [9][10].

$$DMg = ((s-1))/(\ln(n))$$

Information:

S = Number of taxa

n = Total number of all taxa

Species diversity in each GOS was calculated using the Shannon-Wienerindex (H) [9];[10].

$$H = -\sum ni/n \ln(ni/n)$$

Information:

N_i = Number of taxa

i and n = Total number of all taxa

Furthermore, the level of similarity between species is calculated using the Pielou index (J) [9];[10].

$J = H/\ln S$

Information:

H = Result of the Shannon Wiener index

S = The total number of taxa

The results of calculating the index value for each GOS are displayed in tabular form This aims to make it easier to identify if there is the same species name in the observed GOS.

3. Results and Discussion

3.1 The History of GOS in Metro City

Based on our investigation, there are various kinds of history before the formation of each GOS in Metro City. First, KHD that was located on Ki Hajar Dewantara St. Iringmulyo 15A East Metro District (Figure 2A). This area used to be crooked land (*embung*) previously. KHD was founded in the 2000s which was pioneered by the Sports and Tourism Youth Service (DISPARAPAR). Assisted by the surrounding community, especially youth, this area developed into park and planted many plants species. In August 2021 DISPARAPAR add facilities such as outlets for residents to facilitate them to do economy activity. For example, selling food street or simple beverages. That activity increases the park visitors so the function of GOS to sustain urban activity can be fulfilled.

The MUL was in the Mulyojati sub-district, West Metro sub-district, Metro City. Based on the interview results, previously the area is an empty field that is usually used for sports venues. MUL was a Green City Development Project by Metro Government which has its own function for the construction of GOS. This park was inaugurated in 2014. It provides many facilities and one of the best parks in Metro City. The facilities include gazebos, therapy streets, signage boards, plazas, basketball courts, parking areas, toilets, park benches, volleyball courts, solar lights, and mosques (Figure 2B).

In the 1983, LIR was land owned by one of the Iringmulyo residents. Before it became a field, this land was a plantation area with trees. Then it was donated to the Iringmulyo Government. The plantation area was cleared from shrubs and trees by the residents. Several plants were planted on the edge of the field and a few years later, grass was planted. The residents called this field a Campus Field because it was located near campus area (Figure 2C). GDR is located on Tongkol St. 21, Yosodadi, Metro, Lampung with size area around 600 m². This location is near to LIR. Since 1937 GDR has existed and become government-owned land, also used by the public. In 1974 the tennis court which was still covered by the GDR was established and used by public (Figure 2D). In 2010 GDR underwent renovation, such as installation of fence around the field and construction of the Garuda monument. After that, in 2016 the GDR became one of the two points that were planned to provide information held by the local government, many residents, and outsiders carried out activities at Garuda's GOS.

LHB located in Metro Center with the eastern boundary of the field is the West Hadimulyo police station, while the western, southern, and northern boundaries are residential areas for West Hadimulyo villagers (Figure 2E). LHB is one of the open fields in Metro City. LHB has been formed since the colonial era with size area around 9000m². Recently the field was reduced due to road widening. The LHT was founded in the 1980s. The area used to be a garden before functioned as GOS (Figure 2F). The Hadimulyo GOS is quite wide before. Therefore, it was divided into two areas, namely LHT and LHB.

3.2 Metro City GOS Structure

GOS as urban green infrastructure is part of the open spaces of an urban area filled with plants and vegetation (endemic, introduced) to support the direct or indirect benefits generated by

GOS in the city is the safety, comfort, welfare, and beauty of the urban area. Meanwhile, physically GOS can be divided into natural GOS in the form of natural wild habitats, protected areas, and national parks, as well as non-natural or built open space such as parks, sports fields and flower gardens (Department of Public Works, 2006). This study observed 2 types of GOS, namely parks and fields. The parks design in Metro City represented by KHD and MUL (Figure 2A and 2B). The MUL has areas for sports, but another park designed like KHD for example Merdeka Park, Medicinal Plants Park, and Kamtibnas Park. The development of GOS was certainly not separated from the arrangement of locations, some GOS have different functions, benefits, and design arrangements. From the floor plans that have been made we can distinguish the arrangement of each GOS in Metro City, there are several different aspects of arrangement of GOS in city parks and fields. Internal aspects of urban park arrangement obtained from studies regarding design aspects which include: (1) landscape materials, (2) scale, (3) spatial planning, (4) circulation system, (5) green planning, (6) parking, (7) lighting, (8) floor patterns, comfort, (9) drainage, (10) landscape engineering, and (11) retaining walls [11].

Apart from those criteria, the park also has supporting facilities such as a playfield, open stage, jogging track, foot reflexology track, futsal field, skateboard area, food court and toilets. These facilities are found in KHD and MUL, but facilities such as jogging tracks, reflection paths, futsal courts and toilets are more commonly found in MULs. Meanwhile, in KHD, the facilities are a playfield, skateboard area, open stage, food court, parking, and toilets. Meanwhile, the aspects of GOS arrangement in the field only include: (1) green layout, (2) lighting, (3) food court (4) futsal field. Also, the aspects of the arrangement of GOS in the fields are also found in each field in the Metro City.

The structure of the distribution of plants between park and field are also very different. The plants are not only on the edge of the park, but nicely and neatly arranged, or spread out and more densely than in the field (Figure 3 and Figure 5). Meanwhile, in the field the plants are only on the edge of the field. That arrangement is understandable since the public activity usually done in the middle of field. The vegetation structure in the garden includes trees, herbs, and shrubs. Meanwhile, in the field is only trees and shrubs. In addition, the diversity of plant species in the field are too diverse. The number of plants in the field is less than the plants in the park (Table 1.). It's just that some RTH in metro city have less regular arrangement of vegetation structure and so the function of the vegetation structure is lacking. Research on the diversity of plants in GOS has been carried out in Indonesian, such as in Malang [12], Smart Park, Samarinda City [4], and Mataram University, West Nusa Tenggara [13]. Those study also discusses the structure of the vegetation that makes up the park with trees, shrubs, and herbs. The existence of a structured arrangement of vegetation that adjusting its function support infrastructure for the city's ecology.



Figure 2. The view of GOS in Metro City (A) KHD in East Metro; (B) MUL in West Metro; (C) LIR in East Metro; (D) GDR f.om above; (E) LHB in Center Metro; (F) LHT near main road

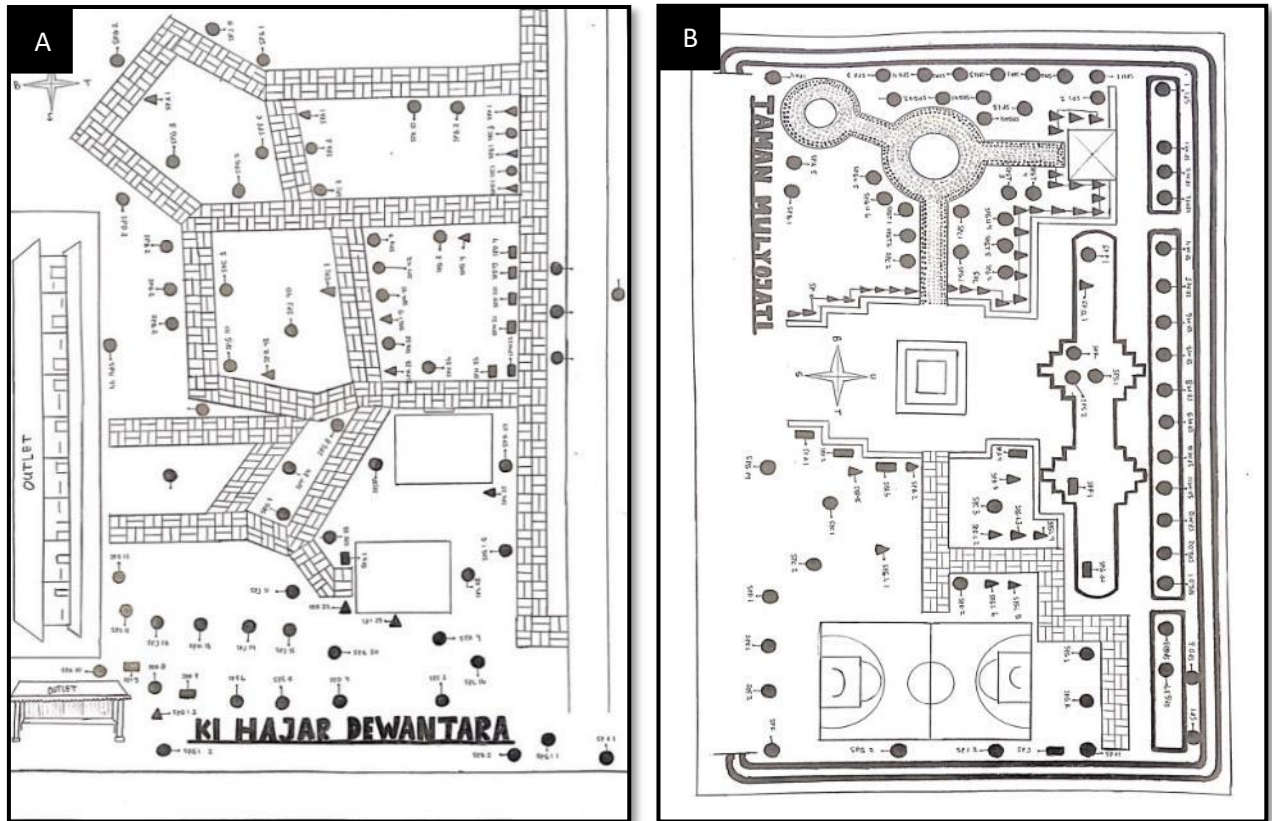


Figure 3. The Map and plant habitus arrangement in Metro City's GOS park type; (A) Ki Hajar Dewantara park - KHD; (B) Mulyojati Park - MUL (Drawn by RA Istiqomah 2022)

3.3 Plant Composition

A study observed the GOS in Metro City, namely MUL, KHD, GDR, LIR, LHT and LHB. As many as 1,198 individual plants identified as 112 species belonging to 43 families (Figure 4). The habitus plant distribution can be seen in Figure 3 and 5. The study found that the dominating family is Fabaceae (13 species; (223 individual plants) (Figure 4). The second highest families are Myrtaceae and Malvaceae (7 species respectively) (Myrtaceae: 94 individuals; Malvaceae 43 individual). This finding is different compared to the GOS's plant composition from another city, [4] that observed Samarinda's GOS reported that Annonaceae dominates diversity of trees (34 individual), Asparagaceae dominates diversity of shrubs (217 individual), and Acanthaceae dominate the diversity of herbaceous (886 individual). In Medan, [14] stated that Euphorbiaceae dominates the Beringin Park in Medan City (15 individual). From the data above, it can be concluded that each park has a different composition of plants and dominant families. The composition of these plants and families can be adapted to the needs of the park, both from an aesthetic point of view and the needs to support community activities. So that the types and levels of diversity will be different both in parks and GOS with one another.

Plant species from Fabaceae are the most widely planted in the GOS area because they have several advantages such as being easy to grow and have flowers that have good aesthetic value [15][16]. Plant species from Fabaceae that found in Metro City's GOS have various forms of habitus which can include herb, shrub, liana, and tree. The second most common families found are Myrtaceae and Malvaceae. Myrtaceae is one of the many families whose distribution is in the subtropics and tropics. The main feature of the family Myrtaceae is its stature or habitus in the form of trees and shrubs, with a taproot, woody stems, the bark in this family easily peels off, has a single leaf and contains essential oils. [17]. Malvaceae is spread across temperate and tropical regions. According to [18]. Malvaceae can be regarded as a family that has a high level of diversity in Indonesia. Malvaceae have members species which include cultivated plants, textile fiber producers, ornamental plants to wild plants [19].

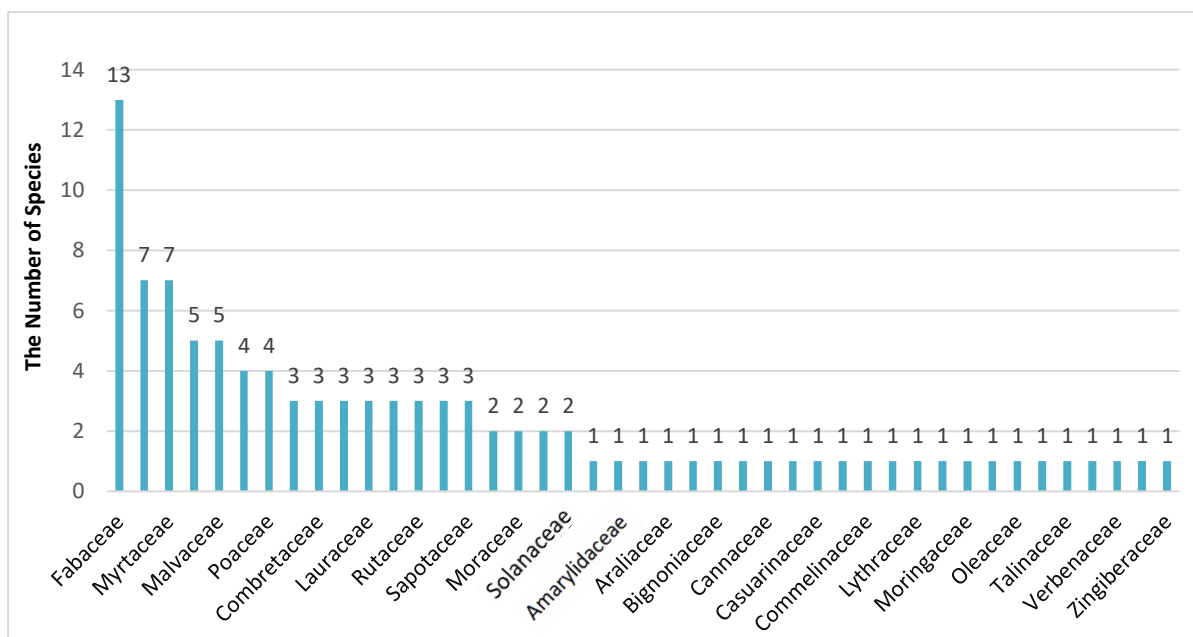


Figure 4. Diagram of a plant family with the dominating species of 6 open spaces (MUL, KHD, GDR, LIR, LHB, and LHT) in Metro City, Lampung, Indonesia.

In addition to the most common species found from the observed GOS are *Acacia auriculiformis* A. Cunn. ex Benth. and *Imperata cylindrica* (L.) (46 individu respectively). *A. auriculiformis* commonly found in KHD while *I. cylindrica* commonly found in MUL and LHB. *A. auriculiformis* (akasia) is used as a shade, preventing abrasion, erosion protection, absorbing CO₂ and O₂ producer. In general *Acacia* itself is a type of plant with a tree stature that is classified as fast growing and its ability to tolerate various types of soil and the environment [20]. This species is very suitable for planting around GOS because of its potential and advantages. Meanwhile, *I. cylindrica* is species that also occurred in most Metro City GOS area. especially often found in MUL and LHB. Those locations are directly exposed to sunlight so that this plant can grow well in these locations. This grass plant that lives wild and can be spread in rice fields, open environments, and even in the yard of the house. *I. cylindrica* has morphological characteristics in the form of herbs, herbs, grows upright with a plant height of 30-180 cm.

3.4 Habitus Composition and Dominant Species

The habitus composition that consisted GOS in Metro City include tree, shrub, bush and herb plants. That composition arrangement was drawn into GOS map which circle was tree (○), rectangular was bush (□), triangular represented bush (△), and heart sign was herb plant (♡) (Figure 3 and 5). Based on that map and strengthened by habitus data composition in Table 1, could be concluded that tree dominates habitus in Metro City’s GOS. This was because the Metro City’s GOS located close to human activities, motorized vehicles, and traffic which produce huge amount of air pollution. The trees that planted in GOS area function as absorber for CO₂ and CO emission from motor vehicle fumes and they strongly produce oxygen for organism lived in city. The highest species abundance index (DMg) was occurred in MUL (8.44) and the lowest species abundance index (DMg) was found in the LHT (3.19). The variation in species abundance index (DMg) values was caused by the number of species per area of observation. The number of species found was directly proportional to the value of plant species richness with the Margalef Index. The wider the GOS used as an observation, the greater the Margalef Index value and indicates the higher the diversity [21].

Table 1. The habitus composition of plant diversity in 6 GOS in Metro City, along with species abundance index (DMg), diversity (H'), evenness (J) and species that dominate each GOS.

Green Open Space	Type	Number of Habits				DMg	H'	J	Dominant species
		Tree	Shrub	Bush	Herbs				
MUL	Park	24	5	6	1	8.44	3.01	0.82	<i>Imperata cylindrica</i>
KHD	Park	25	3	7	-	6.25	2.57	0.57	<i>Acacia auriculiformis</i>
LIR	Field	9	5	3	4	4.94	2.57	0.77	<i>Mimosa pudica</i>
GDR	Field	17	3	-	-	4.59	2.76	0.92	<i>Moringa oleifera</i> <i>Filicium decipiens</i>
LHB	Field	12	5	2	7	4.75	2.77	0.84	<i>Imperata cylindrica</i>
LHT	Field	8	3	2	-	3.19	1.97	0.77	<i>Tradescantia spathacea</i>

According to Panjaitan (2021) $H' < 1.5$ = little or low species diversity, $1.5 \leq H' \leq 3.5$ = medium species diversity, and $H' > 3.5$ = high species diversity. The calculation resulted of the diversity index (H') in all observed GOS tend to the medium category (Table 1). High community species diversity index indicates a community structure composed of many species [22]. Communities with a high index of diversity will survive more with environmental disturbances [23]. While the highest evenness index (J) was found in GDR (0.92), and the lowest value was found in the GOS of KHD (0.57). According to [9] an evenness value that is close to 1 indicates that a community was more evenly distributed, whereas if the value was close to 0 then it was more unequal. Therefore, the plant community in GDR was distributed more evenly than in the other GOS in Metro City. Research on plant composition and diversity was also carried out in GOS in Depok City. Based on the results of the study, the vegetation diversity index (H') was found in the Tahura Pancoran Mas (2.535), Lembah Gurame Park (1.287) and Juanda St. (0.967) respectively (Syahadat, 2017).

Imperata cylindrica was dominating species that found in MUL and LHT. Since *I. cylindrica* is a weed that able reproduce quickly by produce light seed that easily carried away by the wind. So, the seed spreading process could be wider. Besides that, the rhizome roots of this weed will put out new shoots in the soil which will later become reeds [24]. *I. cylindrica* also produces allelopathic substances that can inhibit the growth and development of surrounding plants [25]. *Acacia auriculiformis* more commonly found in the KHD because acacia trees could grow fast, have a dense root system, can adapt to various conditions in which they grow and include evergreen which are widely planted in land rehabilitation activities (Nurrohmah *et al.*, 2020). *A. auriculiformis* is often planted in GOS areas to overcome flooding, this is because acacia plants have high evapotranspiration abilities (Utami *et al.* 2018).

The LIR was dominated by shrub habitus (Figure 5A). Species that dominated was *Mimosa pudica*. since the sun's light will hit the field exactly where *M. pudica* grown, it provides good environment for plant to grow optimally. *M. pudica* usually grows wild on the side of the road or in open places exposed to the sun (Bisay *et al.*, 2019). When this plant bears fruit then the fruit is ripe then it will break, and the seeds will spread in all directions [26]. That's why *M. pudica* more dominant in LIR. *Moringa oleifera* and *Filicium decipiens* often found in the GDR. *M. oleifera* was deliberately planted by the local community in the field edge area. *M. oleifera* usually used as land boundaries, living fences or vines [27]. Besides, *M. oleifera* often found in various regions in Indonesia because it can grow in various climates [28]. While *F. decipiens* was also deliberately planted on the outskirts of the GDR. According to [29] *F. decipiens* widely planted on roadsides, office and school yards as a shade tree, aesthetic purposes, noise reduction and wind breaker. LHT was mostly dominated by *Tradescantia spathacea*. *T. spathacea* many are planted in the front of the field so that its function is to beautify GOS. Pratiwi & Harlia (2017) stated *T. spathacea* is a type of ornamental plant that usually grows in moist soil, has fibrous roots and is easy to grow for propagation.

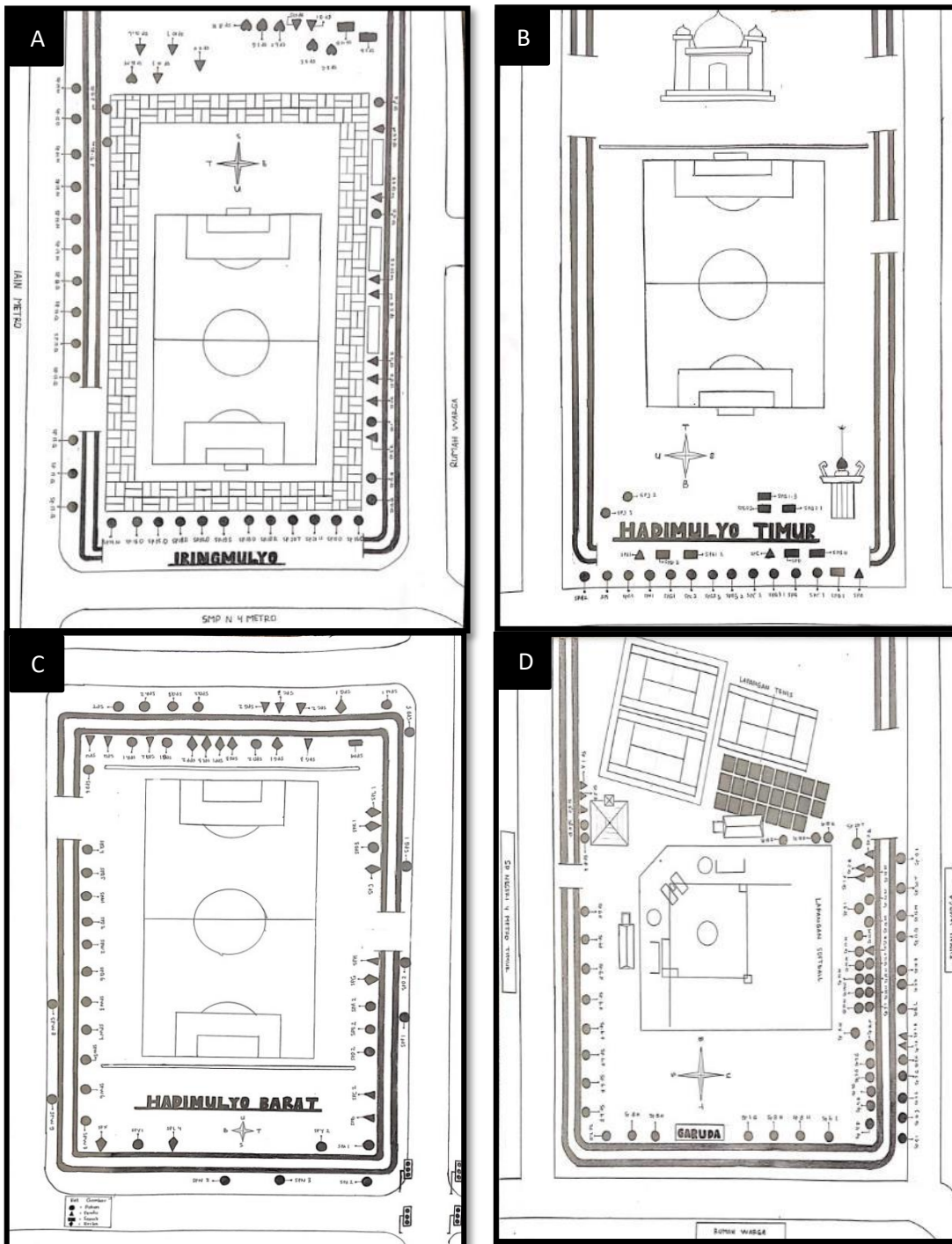


Figure 5. Map of Metro City GOS field type completed with distribution of plant habitus at the field; (A) LIR; (B) GDR; (C) West Hadimulyo Feld; (D) LHT. (Drawn by RA Istiqomah 2022)

3.5 The Function of GOS in Metro City

In accordance with the provisions contained in the Regulation of the Minister of Home Affairs No. 1 of 2007 concerning planning of GOS in urban areas, the main function of GOS was stated to be ecological functions and the additional functions was architectural, social, and economic functions. In general, GOS in metro cities were crowded with people visiting in the morning or evening (Figure 6). This function was the same as an observational study on GOS in Manado City, which explains the various functions of GOS [30]. Each GOS had different facilities and benefits. The following are the types, facilities, and functions of GOS in Metro city (Figure 6).

GOS in Metro City had important role to provide convenience for urban society life. For example, MUL is strategically located, which close to elementary school educational institutions, so students often use it as a place for sports or out bonding. The Park provides several sport facilities often used as a place for foot massage therapy and as a place of livelihood for traders. KHD is also quite strategic, that located in the campus environment so that KHD is often used by students as a place of study. The vicinity community also use this place for traders. LHT and LHB are often used by residents for various activities, such as trading or being used by residents for sports such as football. Both fields were also used for events such as camping, competitions on Independence Day and religious events. While LIR and GDR located close to Vocational High School and elementary school educational institution so that many students use it to carry out sports activities such as playing soccer or other school activities.



Figure 6. Community Activities in GOS in Metro City (A) GDR is usually for softball; (B) LIR is often for group gymnastics and school activities; (C) MUL is often for joint gymnastic activities; (D) LHT is used by the community for soccer; (E) LHB is used for football; (F) KHD used to as a place to study.

In general, the function of Metro City's GOS are used for community activities. As the same case with research conducted on GOS in Rantau City [31] GOS are used for plant conservation, environmental education, sports, and as recreational destinations with family. Besides that, there is also research on GOS around the Bandung State Polytechnic campus [32]. GOS are used as socio-cultural, namely, to accommodate the various activities of campus residents so that they can be used as public spaces and open learning spaces to carry out learning activities outside the classroom. The functions of GOS for urban communities are resemble the socio-cultural functions of homegarden for local communities [33]. As we know, the yard space in the city is very limited, so urban community looking for more space to do other activities in GOS. Meanwhile, for local communities their homegarden is spacious enough. So, they don't need GOS as much as urban communities.

3.6 GOS in Metro City Ecological Functions

The existence of urban GOS with various types of trees and ornamental plants is an important element in supporting the creation of a beautiful and ecological city. Mabikafola (2019) stated that the existence of GOS was important in controlling environmental quality and conditions. Controlling urban development must be carried out proportionally and in a balance between development and environmental functions. GOS in the Metro City has a variety of plants including trees, shrubs, shrubs, and herbs. Metro city has a humid tropical climate with temperatures between 21—33°C which is sufficient to support the growth of plant vegetation. Plants with a tree habit predominate in GOS (RTH), Metro City so that they can help maintain the climate balance around the environment, the more trees planted, the better the balance of the ecosystem, but not only trees can help balance the environment, but all types of plants also play a role in this process.

Broadly speaking, GOS functions as the lungs of a city or region. The carbohydrates from photosynthesis are stored in stems, leaves, flowers, twigs and fruit. The carbon stored in plants can describe the amount of CO₂ absorbed by plants [34]. Furthermore, with the large diversity of plants that exist in GOS, it can carry out ecological functions which include, habitat of organism; CO₂ absorber and O₂ producer; preservation of field water; tree as windbreaker which can reduce wind speed by 75-80% [35]; and the most important to climate amelioration - GOS were built to manage the urban environment by lowering the temperature during the day and conversely at night it can be warmer because trees can withstand back radiation from the earth [36].

Beside all those ecological functions, GOS also has a role as ex-situ conservation site. Based on IUCN conservation status, plant species invented in Metro city's GOS categorized into several conservation statuses (Figure 6). There were several plant species that are on the verge of extinction (VU), namely sonokeling (*Dalbergia latifolia*) and mahoni (*Swietenia macrophylla*) found in MUL and LHB. These plant species decreased by 30-50% in the last 10 years. This was caused by the large number of public requests for the creation of furniture, while its growth required quite a long time (Santoso *et al.*, 2020)[37] Many people like these woods because they have superior physical properties (color, texture, and fiber) as well as mechanical properties that meet the requirements of class II-III (Kamudjo 2008). The conservation status of *gaharu* (*Aquilaria malaccensis* Benth.) is critically endangered (CR), this species was found in MUL. *Gaharu* wood is blackish in color and contains a special resin which used in the perfume industry because it smells good. Since the beginning of the modern era (2000 years ago) it has been a trade commodity from the Indonesian archipelago to India, Persia, the Arabian Peninsula and East Africa [38].

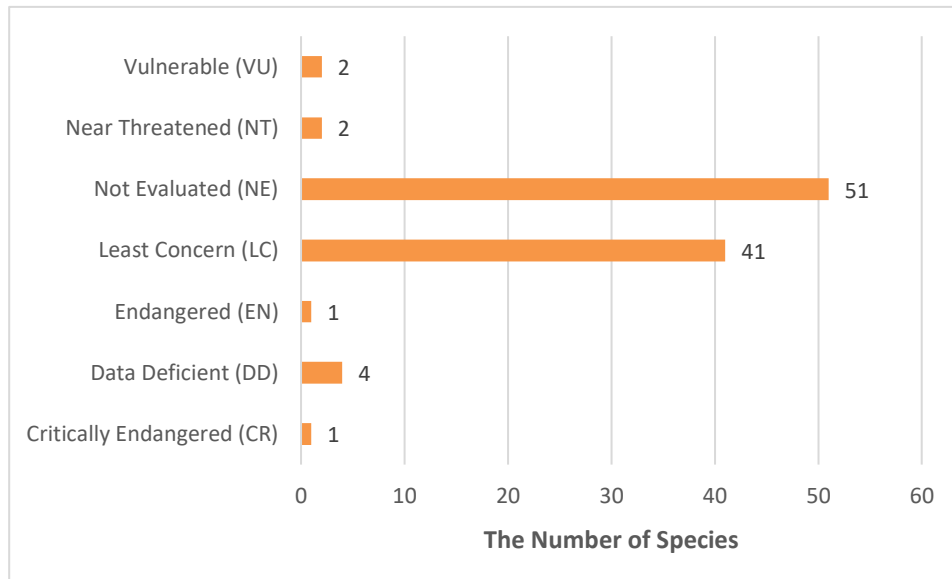


Figure 6. Diagram of conservation status with the number of plants found in GOS in Metro City, Lampung. Species that have not been evaluated (NE) is the highest number. An endangered species (EN) was found, namely teak (*Tectona grandis*L.f.) and gaharu (*Aquilaria malaccensis* Benth.) listed as critically endangered species.

Teak (*Tectona grandis* L.f.) is categorized as endangered species (EN). This plant is found in a limited number in some region such as, Sulawesi, Muna, Sumbawa, Bali, Sumatera, and Kalimantan (Murtinah *et al*, 2015). The existence of teak currently threatened with extinction due to the large market demand for teak wood. This is not comparable to the long time it takes for teak trees to grow. This plant’s stem also used in Begawi Traditional in Buyut Ilir Village, Central Lampung [39]. The role of GOS for conservation of *T. grandis* was to preserve and reproduce teak trees. Therefore, GOS does not only function for public activities but also functions as a conservation site that preserves local species that are endangered.

As many 51 individual plants with NE conservation status found in Metro City’ GOS (Figure 6), banana tree (*Musa paradisiaca* L.) was one of them. This plant was often planted and cultivated intentionally by the community, banana trees which are generally planted in the yard of the house or on plantation land are often used for daily needs ranging from leaves, fruit to other parts [40]. Its leaves and fruit are also used as ceremonial plants for Balinese culture. Pancha Phala use 5 types of fruit adjusted for the 5 cardinal directions, the west direction, which is symbolized in yellow, namely for the Gods of the Gods, and the fruit used is *M. paradisiaca* L. [41]. Therefore, this species existence is still abundant in nature, this can be proven that these plants are plants that are easy to grow and are used by the community both for consumption of their fruit and for cultural activities in several regions in Indonesia.

4. Conclusion

Based on research that has been carried out in Metro City’s GOS which includes MUL, KHD, LIR, GDR, LHT, and LHB there are 1,198 individual plants with 112 species belonging to 43 families. The highest species abundance index was in the MUL (8.44) and the lowest species abundance index in the LHT (3.19). GOS in Metro City are used for recreation, economy activity, medium of social interaction, and functions ecologically as a buffer for the urban ecosystem. Furthermore, GOS also has a role as ex situ conservation site. There are several plant species that are on the verge of extinction (VU), namely sonokeling (*Dalbergia latifolia*) and mahoni (*Swietenia macrophylla*) found in MUL and LHB.

Author Contributions

AZW: Conceptualization Research, Methodology, Writing - Review & Editing; **EA:** Writing & Editing, Data Collection; **MH:** Writing & Editing, Data Collection; **RN:** Writing & Editing, Data Collection; and **SM:** Writing - Review & Editing.

Conflicts of interest

There are no conflicts to declare.

Acknowledgements

This research will never be conducted perfectly without support from students of Biology Education Program Class 2021, our gratitude presented to all of you; especially RA Istiqomah for her creativity in drawing the maps of GOS in Metro, Thank you.

References

1. Escobedo, F.J.; Kroeger, T.; Wagner, J.E. Urban Forests and Pollutions Mitigation Analyzing Ekosystem Services and Disservices. *J. Environ. Pollut.* **2011**, *159*, 2078–2087, doi:<https://doi.org/10.1016/j.envpol.2011.01.010>.
2. Arifiyanti, H.N.; Awaluddin, M.; Sabri, L.M. Analisis Ruang Terbuka Hijau Kota Semarang Dengan Menggunakan Sistem Informasi Geografis. *J. Geod. Undip* **2014**, *3*.
3. Suryadi, A. *Menapak Indonesia*; CV Jejak: Jawa Barat, 2021;
4. Azizah, N.; Utami, S. Keanekaragaman Jenis Tumbuhan Di Taman Cerdas Kota Samarinda. *Bioma Berk. Ilm. Biol.* **2021**, *23*, 18–24, doi:<https://doi.org/10.14710/bioma.23.1.18-24>.
5. Kemal, R.A.; Yulita, A.; Nufadianti, G.; Rosadi, I.; Muthmainah, S.I. Tumbuhan Di Kota Urban Indonesia: Nilai Bioteknologis Dan Proyeksi Keragaman Pada 2050. In Proceedings of the Pros. Seminar Nasional Masyarakat Biodiversitas Indonesia; 2015.
6. Wuisang C., E. V. Konsevasi Biodiversitas Di Wilayah Perkotaan: Evaluasi Lanskap Koridor Hijau Di Kota Manado. *Media Mantrasains* **2015**, *12*, 47–60.
7. Auliandari, L.; Lensari, D.; Angraini, E. Keanekaragaman Vegetasi Di Hutan Kota Sebagai Salah Satu Ruang Terbuka Hijau Publik Kota Palembang. *JBIO J. Biosains (The J. Biosci.)* **2020**, *6*, 1–10.
8. Silalahi, M.; Mustaqim, W.A. *Tumbuhan Berbiji Di Jakarta Jilid 2: 100 Jenis-Jenis Nonpohon Terpilih*; UKI Press: Jakarta, 2021;
9. Magurran, A.E. *Ecological Diversity and Its Measurements*; Princeton University Press: London (GB), 1988;
10. Magurran, A.E. *Measuring Biological Diversity*; Blackwell Publishing: London (GB), 2003;
11. Hakim, R. *Komponen Perancangan Arsitektur Lansekap: Prinsip-Unsur Dan Aplikasi Desain, Edisi Revisi*; Bumi Aksara: Jakarta, 2012;
12. Basri, S.; Leksono, A.S.; Yanuwidi, B. Profile and Function of GOS Vegetation in Malang. *Species Divers.* **2020**, *2*, 3–5.
13. Latifah, S.; Valentino, N.; Sari, D.P.; Sari, B.S.A. Species Composition, and Diversity of Mataram University GOS, West Nusa Tenggara. In Proceedings of the IOP Conference Series: Earth and Environmental Science; IOP Publishing, 2021; Vol. 891, pp. 12–26.
14. Marbun, N.H. Keanekaragaman Jenis Tanaman Hias Di Taman Beringin Kota Medan Sebagai Bahan Pembuatan Modul Pembelajaran Biologi. *Best J. (Biology Educ. Sci. dan Technol.)* **2022**, *5*, 113–119.
15. Dahlan, E.N. *Membangun Kota Kebun Bernuansa Hutan Kota*; IPB Press: Bogor, 2004;
16. Purwasih, H.; Latifah, S.; Sukmana, A. Identifikasi Jenis Tanaman Di Beberapa Jalur Hijau Jalan Kota Medan (Identification of Plant Species at a Few Street Green Belt of Medan City). *Peronema For. Sci. J.* **2013**, *2*, 108–116.
17. Lutfiasari, N.; Darmono Keanekaragaman Spesies Tumbuhan Famili Myrtaceae Di Hutan Pantai Tabanio, Kecamatan Takisung, Kabupaten Tanah Laut. *3* **2018**, *1*, 186–190.
18. Christenhusz, M.J.M.; Byng, J.W. The Number of Known Plants Species in the World and Its Annual Increase. *Phytotaxa* **2016**, *261*, 201, doi:<https://doi.org/10.11646/phytotaxa.261.3.1>.

19. Masnadi, M. Keanekaragaman Family Malvaceae Di Hutan Taman Eden 100 Sebagai Bahan Perangkat Pembelajaran Biologi. *Best J. (Biology Educ. Sains Technol.* **2019**, *2*, 32–41, doi:<https://doi.org/10.30743/best.v2i2.1816>.
 20. Krisnawati, H.; Kallio, M.; Kanninen, M. *Acacia Mangium Willd.: Ekologi, Silvikultur Dan Produktivitas*; CIFOR, 2011;
 21. Boontawee, B.; Plengkai, C.; Kao-Sa-Ard, A. Monitoring and Measuring Forest Biodiversity in Thailand. In Proceedings of the IUFRO Symposium, Chiang Mai (Thailand); 1995.
 22. Indriyanto *Ekologi Hutan*; PT Bumi Aksara: Jakarta, 2006;
 23. Wahyudi, A.; Harianto, S.P.; Darmawan, A. Keanekaragaman Jenis Pohon Di Hutan Pendidikan Konservasi Terpadu Tahura Wan Abdul Rachman. *J. Sylva Lestari* **2014**, *2*, 1–10, doi:<https://doi.org/10.23960/jsl321-10>.
 24. Setiawan, K.; Hartono Efek Ekstrak Alelopati Terhadap Pembibitan Kelapa Sawit (Pre Nursery). *J. Ahli Muda Indones.* **2020**, *1*, 25–33, doi:<https://doi.org/10.46510/jami.v1i1.10>.
 25. Ratna, Y.; Swari, E.I.; Firmansyah, A. Pertumbuhan Gulma Alang-Alang (*Imperata Cylindrica* L. Beauv.) Pada Berbagai Kondisi Kepadatan Setelah Pemotongan Di Petrochina International Jabung Ltd. *J. Media Pertan.* **2022**, *7*, 50–60, doi:<https://doi.org/10.33087/jagro.v7i1.135>.
 26. Bisay, E.E.; Mofu, W.Y.; Rahawarin, Y.Y. Identifikasi Jenis-Jenis Bank Benih Pada Hutan Pendidikan Anggori-Manokwari. *J. Kehutan. Papuasiasia* **2019**, *5*, 1–14, doi:<https://doi.org/10.46703/jurnalpapuasiasia.vol5.iss1.105>.
 27. Hamdany, M.I.S.; S., A. Eksplorasi Dan Analisis Hubungan Kekerabatan Tanaman Kelor (*Moringa Oleifera* Lam.) Di Kabupaten Probolinggo. *J. Produksi Tanam.* **2022**, *10*, 218–225, doi:<https://doi.org/10.21776/ub.protan.2022.010.04.02>.
 28. Auliya D., D.; Saptadi, K.; Kuswanto Eksplorasi Tanaman Kelor (*Moringa Oleifera* Lam.) Di Kabupaten Banyuwangi Jawa Timur. *J. Produksi Tanam.* **2018**, *6*, 2874–2882.
 29. Prinajati, P.D. Analisis Ruang Terbuka Hijau Terhadap Penyerapan Emisi Karbondioksida. *J. Tek. Lingkung.* **2019**, *2*, 34–41.
 30. Longaris, S.; Octavianus, H.A.; Rogi & Esli, D.T. Identifikasi Dan Evaluasi Eksistensi Ruang Terbuka Hijau Di Kecamatan Wenang Kota Manado. *J. Perenc. Wil. dan Kota* **2019**, *6*.
 31. Sari, I.T.; Hidayat, D.; Biyatmok, S. Peran Dan Fungsi Ruang Terbuka Hijau Rantau Baru Di Kota Rantau Kabupaten Tapin. *EnviroScintee* **2019**, *15*, 317–326, doi:<https://doi.org/10.20527/es.v15i2.6978>.
 32. Suciyani, W.O. Analisis Potensi Pemanfaatan Ruang Terbuka Hijau (RTH) Kampus Politeknik Negeri Bandung. *J. Planol.* **2018**, *15*, 17–33, doi:<https://doi.org/10.30659/jpsa.v15i1.2742>.
 33. Wakhidah, A.Z.; Chikmawati, T.; Purwanto, Y. Homegarden Ethnobotany of Two Saibatin Villages in Lampung, Indonesia: Species Diversity, Uses, and Values. *For. Soc.* **2020**, *4*, 338–357.
 34. Yustiningsih, M. Intensitas Cahaya Dan Efisiensi Fotosintesis Pada Tanaman Naungan an Tanaman Terpapar Langsung Cahaya Matahari. *J. Pendidik. Biol.* **2019**, *4*, 44–49, doi:<https://doi.org/10.32938/jbe.v4i2.385>.
 35. Dahlan, E.N. *Hutan Kota: Untuk Pengelolaan Dan Peningkatan Kualitas Lingkungan Hidup*; APHI: Jakarta, 1992;
 36. Grey, G.W.; Deneke, F.J. *Urban Forestry*; John Wiley and Sons, Inc.: New York (US), 1978;
 37. Purwanto, D. Pemanfaatan Kayu Akasia *Mangium* (*Acacia Mangium* Willd) Untuk Mebel. *J. Ind. Has. Hutan* **2012**, *4*, 1–8, doi:<https://doi.org/10.24111/jrihh.v4i1.1195>.
 38. Halim, A.; Siregar, M.N.; Hasibuan, M. Pengobatan Menggunakan Kayu India (Gaharu) Dalam Perspektif Hadis Dan Sains. *SHAHIH-Jurnal Kewahyuan Islam* **2021**, *4*, 18–39.
 39. Ulfa, D.M.; Yudiyanto, Y.; Hakim, N.; Wakhidah, A.Z. Ethnobiology Study of Begawi Traditional Ceremony by Pepadun Community in Buyut Ilir Village, Central Lampung, Indonesia. *Biodiversitas J. Biol. Divers.* **2023**, *24*.
 40. Wakhidah, A.Z.; Silalahi, M. Inventarisasi Tanaman Pekarangan Dan Pemanfaatannya Sebagai Bahan Pangan Oleh Masyarakat Tanjungan, Di Kabupaten Tanggamus, Lampung. *J. Pendidik. Mat. dan IPA* **2020**, *11*, 243–256.
 41. Adiputra, I.N. Fungsi Buah Dan Daun Tanaman Dalam Budaya Bali Sebuah Kajian Terhadap Tanaman Upacara. *Bumi Lestari J. Environ.* **2017**, *17*, 118, doi:<https://doi.org/10.24843/blje.2017.v17.i02.p03>.
- Hartini, S. Tumbuhan paku di beberapa kawasan hutan di Taman Nasional Kepulauan Togean dan Upaya Konservasinya Di Kebun Raya Bogor. Berk Penelitian Hayati Edisi Khusus. 2011. 7A:35-40
- Ramaiah, M., & Avtar, R. Urban green spaces and their need in cities of rapidly urbanizing India: A review. *Urban science.* **2019**, *3*(3), 94. <https://doi.org/10.3390/urbansci3030094>

- Directorate General of the Department of Public Works. Green Open Space as a Main Element of City Spatial Planning, **2006**, Page. 6
- Syahadat, R. M., Putra, P. T., Ramadanti, P., Radnawati, D., & Nurisjah, S. Identifikasi Keanekaragaman Hayati RTH Di Kota Depok. *NALARS*, **2018**, 17(1), 29-38.
- Nurrohmah, S. H., Hidayati, N., & Rimbawanto, A. Inventarisasi penyakit pada tanaman Acacia mangium PT Bina Silva Nusa, Kalimantan Barat. In *Talanta Conference Series: Agricultural and Natural Resources (ANR)*, **2020**, 3 (1).
- Utami, L., Priatna, S.J. & Purnama, D.H. Identifikasi dan Evaluasi Kawasan Ruang Terbuka Hijau (RTH) Berdasarkan Kondisi Sifat Tanah di Wilayah Kota Palembang Provinsi Sumatera Selatan. *Jurnal Penelitian Sains*, **2018**. 19(3), 112-118.
- Bisay, E. E., Mofu, W. Y., & Rahawarin, Y. Y. Identifikasi jenis-jenis bank benih pada Hutan Pendidikan Anggori-Manokwari. *Jurnal Kehutanan Papuasiasia*, **2019**, 5(1), 1-14.
- Pratiwi, R. & Harlia, M.A.W. Aktivitas Antiinflamasi dan Toksisitas Dari Ekstrak Daun Nanas Kerang (*Rhoeo discolor*). *Jurnal Kimia Khatulistiwa*, **2017**, 6(2).
- Mabikafola, C. Green open space as human rights fulfillment standard a study of surabaya. *European Journal of Research in Social Sciences*, **2019**, 7(4), 46--53.
- Santoso P, Ris Hadi Purwanto, W. Wardhana & Dwi T Adriyanti. Potensi Kayu Sonokeling (*Dalbergia latifolia* Roxb) dan Jenis Kayu Lain di Hutan Rakyat Kecamatan Dlingo, Bantul Yogyakarta. *Jurnal of Forest Science Avicennia*, **2021**, 4(3) :1-14.
- Kamudjo. Teknologi dan Proses Produksi Industri Pengolahan Kayu. Makalah disampaikan pada workshop teknologi bersih untuk peningkatan nilai tambah industri furnitur dan kerajinan kayu kerjasama KNRT. **2008**, BTCSW dan FPESD di Semarang.
- Murtinah, V., Marjenah, A. R., & Ruhayat, D. Pertumbuhan hutan tanaman jati (*Tectona grandis* Linn. f.) di Kalimantan Timur. *Agrifor: Jurnal Ilmu Pertanian dan Kehutanan*, **2015**, 14(2), 287-292.