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## THE POTENTIAL OF PALEMBANG'S URBAN FOREST AS A NATURAL LABORATORY

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### ABSTRACT

*Urban forest is one of the public open spaces with a minimum area of 0.25 hectares which has various functions, both ecological, social and cultural, economic, and aesthetic functions. The urban forest in Palembang has not been used optimally, especially as a learning space (natural laboratory). This research aims to determine the potential of urban forests in Palembang so that they can be used as a natural laboratory in the Plant Ecology course. The method in this study uses a qualitative approach with applied research. Data collection techniques include (triangulation techniques), including: observation on 6 urban forests in Palembang: Pundi Kayu Natural Tourism Park Forest, Bukit Siguntang Forest, Bumi Perkemahan Pramuka Gandus City Forest, Forest Area of Sri Mulyono Herlambang Palembang Air Base, OPI Retention Pool Area, and Jakabaring Stadium Area; Interview; and documentation. Based on the results of field observations and interviews with the six urban forests in Palembang, they have various functions including ecological, social and cultural functions, as well as aesthetics. Urban forests that have low biodiversity are the Gandus Scout Campground City Forest and the OPI Retention Pond Area Forest. The Urban Forest of the OPI Retention Pool Area and the City Forest of the Gandus Scout Camping Ground have no potential to be used as natural laboratories, especially in the Ecology course on vegetation analysis material. There needs to be good cooperation from the government, the industrial world, and the community to optimize the function of urban forests.*

## **INTRODUCTION**

Physical development in urban areas, which is expected to improve the welfare of human life, in its development has created its own problems due to inadequate planning. Population growth and infrastructure development to support economic activities in urban areas cause environmental damage such as the loss and destruction of Green Open Spaces one of which is urban forests (Subarudi *et al.*, 2014). The rate of forest destruction in Indonesia is largely caused by human activities that directly affect forests, such as agricultural expansion, wood extraction, and infrastructure expansion. Forests are mostly explored for political and personal interests (Austin *et al.*, 2019). The destruction of forests results in the loss of existing biodiversity.

Biodiversity is all the diversity of life that exists on this earth and the diversity of genetic material, ecosystems, and species variations. Biodiversity is a life support system. Biodiversity increases the stability of ecosystem processes in changing environments (Rawat & Agarwal, 2015). One of the important elements contained in biodiversity is vegetation. Vegetation in green open spaces acts as a view control, barrier, climate control, erosion control, habitat for animals, and aesthetics. Good quality green open space must fulfill these vegetation functions optimally. The species composition is close to natural vegetation creating space for native species so they are better able to adapt to living in urban conditions (Winkler *et al.*, 2022).

Green open spaces play an important role in biodiversity conservation, especially for cities with high density, one of which is the city of Palembang. Population density causes inconvenience and imbalance between land conditions and land use. This results in a mismatch between nature and the community's need for land for a place to live which results in various environmental changes (Subarudi *et al.*, 2014). The most important issue in the environment due to loss of forest function is regarding global warming caused by the greenhouse effect (Arif, 2016). During 1977 to 2017 there was an increase in minimum, daily average and maximum air temperatures in South Sumatra. Minimum increase in air temperature of 1.5 °C. The increase in daily average air temperature is 1.3 °C, and the maximum increase in air temperature is 1.2 °C (Sugiarto *et al.*, 2018). Local communities use shared resources and are responsible for the environmental changes that occur in their environment (Al Muhdhar *et al.*, 2019).

At this time, in general, green open space in the development environment is needed in order to maintain the balance of environmental quality in an urban area that has various problems related to complex spatial problems (Imansari & Khadiyanta, 2015). Urban is a city subsystem that aims to become an ecosystem with an open system. Urban foresters strive to maintain healthy tree populations to meet the needs of increasingly diverse urban communities. In general, the aim of urban forest management is to rehabilitate and create harmony and balance in ecosystems that include environmental, social and cultural elements (Derhé *et al.*, 2016).

Urban forests have various functions including: improving and maintaining the microclimate and aesthetic value; absorb water; creating balance and harmony in the physical environment of the city; and support the preservation of Indonesia's biodiversity (Government Regulation of the Republic of Indonesia Number 63, 2002). Urban forests can also be a medium for socializing, to unwind, and even reduce stress due to daily work routines (Tridjono, 2017). Urban forests can improve quality of life through providing recreation and wildlife areas; urban forests provide benefits to the psychological and physical well-being of humans (Wang, 2016).

Each urban forest has its own potential and function. The city forest in Palembang is widely used as a place for recreation and sports. The city forest in Palembang has not been utilized optimally according to its function, especially as a learning space (natural laboratory). Urban forest as open learning space or open learning space can be an ideal place to mingle, face to face with virtual meetings, which allows all students to join in project discussions (Sugianto & Sihotang, 2017). Good urban forest utilization and management will lead to maintaining forest structure and potential over time (Derhé *et al.*, 2016). Based on this description, it is necessary to study the optimization of the function of urban forests, especially in the city of Palembang, to serve as a natural laboratory. This research This research aims to determine the potential of urban forests in Palembang so that they can be used as a natural laboratory in the Plant Ecology course.

## **MATERIALS AND METHODS**

This research was carried out at Universitas Muhammadiyah Palembang and in an urban forest in Palembang, among others: Pundi Kayu Natural Tourism Park Forest, Bukit

Siguntang Forest, Bumi Perkemahan Pramuka Gandus City Forest, Forest Area of Sri Mulyono Herlambang Palembang Air Base, OPI Retention Pool Area, and Jakabaring Stadium Area.

The method in this study uses a qualitative approach with applied research. Data collection techniques include (triangulation techniques), including: observation (observation sheet); interview (the interview guideline is aimed at lecturers of the Plant Ecology course at the Faculty of Teaching and Education, Muhammadiyah University of Palembang); and documentation.

Data were obtained by conducting field observations on urban forests in Palembang and interviewing urban forest managers and lecturers of Plant Ecology courses as parties who know information about the supply and use of urban forests. The analysis technique in this study is descriptive in nature, that is to describe in writing the results of observations in the field with the theory obtained from the results of the literature.

## **RESULTS AND DISCUSSION**

Based on the results of field observations and interviews regarding the provision and function of urban forests in Palembang, the following results are obtained (**Table 1**)

**Table 1.** Potential Provision and Function of Palembang City Forest

No	Location	Forest Area (Hectares)*	Urban Forest Functions**
1.	Punti Kayu Natural Tourism Park Forest	40	Recreation, research, fieldwork, wildlife areas, the lungs of the city
2.	Bukit Siguntang Forest	7	Research, field practice, city lungs, tours, pilgrimages
3.	Bumi Perkemahan Pramuka Gandus City Forest	20	Scout training for elementary school, junior high school and senior high school students
4.	Forest Area of Sri Mulyono Herlambang Palembang Air Base	10	Research, field practice, recreation, the lungs of the city
5.	OPI Retention Pool Area	8	Recreation, Lung of the city, sports
6.	Jakabaring Stadium Area	30	Recreation, the lungs of the city, sports, fieldwork, research

Information

\* : Palembang city regional regulation document number 15 of 2012

\*\* : Results of observations and interviews

Based on the results of field observations and interviews the six urban forests in Palembang have various functions including ecological functions as the lungs of the city,

oxygen producers, rainwater absorbers, and animal habitat providers. The social and cultural function is that it can be used as a place for recreation, tourism, educational objects, and research. The aesthetic function is to provide comfort and beauty to the environment. Besides that, the urban forest in the OPI retention pond area and the Jakabaring Stadium area is often used as a place to exercise. Urban forests that are included in the Green Open Space have two functions, namely the main function (intrinsic) and additional (extrinsic) functions: the main function (intrinsic) is an ecological function, this function guarantees the provision of urban forests as an air circulation system (lungs) city), regulator of microclimate, as a shade, oxygen producer, absorber of rainwater, provider of animal habitats, absorbent of air, water and soil pollutants, as well as windbreaks. Additional (extrinsic) functions, namely: (1) social and cultural functions; (2) economic function; (3). aesthetic function (Sugianto & Sihotang, 2017). In terms of social functions, urban forests can have a positive impact on physical and mental health, for example by providing a setting for physical exercise, reducing ultraviolet radiation and air pollution. In terms of economic function, urban forests play an important role in urban agriculture which provides a source of livelihood, for example supplying wood from trees in urban forests. The function of the environment in urban forests is to minimize air pollution, protect the soil, cool the air, reduce wind speed, and provide shade (Wang, 2016).

Forests that are used as ecotourism sites, introduction to the forest environment, and research can cause changes in the shape of herbaceous characteristics (Fanani *et al.*, 2013). Plants in green open spaces including in urban forests play an important role in improving the environment and urban aesthetics (Winkler *et al.*, 2022). Well-managed urban forests can be used to improve ecosystem health and promote a better quality of life for city dwellers (Kim, 2016).

Urban forests in Palembang have different biodiversity. Urban forests that have high diversity of vegetation, among others: Punti Kayu Natural Tourism Park Forest, Bukit Siguntang Forest, Forest Area of Sri Mulyono Herlambang Palembang Air Base, and Jakabaring Stadium Area. While the other two urban forests have low biodiversity, namely Bumi Perkemahan Pramuka Gandus City Forest and OPI Retention Pool Area. The high and low diversity of vegetation in the urban forest is caused by factors that affect plant growth, both abiotic and biotic factors. According to Auliandari, *et al* (2018), that

the diversity of vegetation that composes urban forests in Palembang varies, from the lowest to the highest sequentially based on diversity level 1 ( $q = 1$ ), namely 1.384 for Bumi Perkemahan Pramuka Gandus City Forest, 2.531 for the OPI Retention Pool Area, 12,942 for the Forest Area of Sri Mulyono Herlambang Palembang Air Base, 20,322 for Pundi Kayu Natural Tourism Park Forest, 25,885 for the Jakabaring Stadium Area, and 26,743 for the Bukit Siguntang Forest.

Based on the results of field observations and interviews regarding the diversity of urban forest vegetation in Palembang, the following results were obtained (Table 2):

**Table 2.** Vegetation Diversity in Palembang City Forest as a Natural Laboratory

No	Location	Vegetation Diversity
1.	Pundi Kayu Natural Tourism Park Forest	High diversity of vegetation. Plants found in Pundi Kayu include: Pine, mahogany, <i>Acacia</i> , Pulai, <i>Asystasia gangetica</i> , bungur, <i>Imperata cylindrica</i> , <i>Urochlea mutica</i>
2.	Bukit Siguntang Forest	High diversity of vegetation. The plants found on Siguntang Hill include: Teak, Angsana, Bamboo, Mahogany, Jengkol, Banyan, Pulai, Calincing, <i>Drymaria cordata</i> , Elephant grass, <i>Mimosa pudica</i> .
3.	Bumi Perkemahan Pramuka Gandus City Forest	Low vegetation diversity. The dominating plants are <i>Acacia</i> , pulai, <i>Mimosa pudica</i> , weeds.
4.	Forest Area of Sri Mulyono Herlambang Palembang Air Base	High diversity of vegetation. The dominating plants are: Bungur, Pulai, <i>Acacia</i> , Palm, Mahogany, <i>Asystasia gangetica</i>
5.	OPI Retention Pool Area	Low vegetation diversity. The dominating plants are: Oil palm, <i>Acacia</i> , <i>Borreria alata</i>
6.	Jakabaring Stadium Area	High diversity of vegetation. The dominating plants are: Ketapang, Bungur, Pine, Legumes, <i>Acacia</i> , Flamboyant

The Bukit Siguntang Forest has various undergrowth which are identified as the dominating species with their aesthetic potential such as *Asystasia gangetica*, *Bidens pilosa*, *Borreria laevis*, *Drymaria cordata*, dan *Mimosa pudica* (Auliandari *et al.*, 2019). The criteria that need to be considered in selecting tree species for urban forests are: 1. tree species that are endemic in the framework of preserving germplasm while minimizing tree species leading to scarcity and extinction; 2. the trees used must take into account the local ecological conditions; 3. Availability of seeds that are easy to obtain and inexpensive; 4. Types of trees that are not easily overturned, and are not easily attacked by pests and diseases; 5. Does not require intensive care; 6. Non-invasive; 7. Does not compete with other plants; 8. trees that produce a lot of oxygen and can absorb pollutants according to their location; 9. Does not harm people or animals; and 10. Attracts lots of wildlife (Subarudi *et al.*, 2014).

Based on the results of interviews conducted with the lecturers of the Plant Ecology course, the Biology Education Study Program, that several urban forests have been used as places for field practicums to be carried out, including: Pundi Kayu Natural Tourism Park Forest, Bukit Siguntang Forest, Forest Area of Sri Mulyono Herlambang Palembang Air Base, and Jakabaring Stadium Area. The practicum was carried out on material on vegetation analysis, tropical biodiversity, introduction to floristic elements of vegetation, introduction to ecosystems and populations. According to all lecturers in the Plant Ecology course, all urban forests have the potential to be used as natural laboratories depending on the management of the urban forests. but if viewed in terms of the diversity of vegetation from the six urban forests then Bumi Perkemahan Pramuka Gandus City Forest and OPI Retention Pool Area does not have the potential to be used as a natural laboratory, especially in Plant Ecology courses, especially vegetation analysis material. This is because the plants that live in the two urban forests are more homogeneous compared to other urban forests. According to Kim (2016), different urban forest structures produce different green ecosystem benefits and infrastructure. Understanding the characteristics of urban forests will provide planners with the detail needed for effective urban forest management and give them a solid basis for estimating the required green infrastructure. According to Wang (2016), the scientific understanding of how urban forests benefit has grown substantially in recent years to include social, environmental, and economic benefits. Although scientifically there are many delays in city policy responses. Urban forests are part of a 'green' infrastructure community that can be designed deliberately and successfully provide a myriad of benefits for society.

Based on the results of field observations and interviews regarding the potential provision and function of urban forests in Palembang as a natural laboratory in the Plant Ecology course, the following results were obtained (**Table 3**):

**Table 3.** Potential Provision and Function of Palembang City Forest as a Natural Laboratory in Plant Ecology Courses

No	Location	Potency
1.	Pundi Kayu Natural Tourism Park Forest	Potentially
2.	Bukit Siguntang Forest	Potentially
3.	Bumi Perkemahan Pramuka Gandus City Forest	No Potential
4.	Forest Area of Sri Mulyono Herlambang Palembang Air Base	Potentially
5.	OPI Retention Pool Area	No Potential
6.	Jakabaring Stadium Area	Potentially

The following results of observations on various urban forests in Palembang can be seen in **Figure 1**.



**Figure 1.** Various urban forests in Palembang: (a) Bukit Siguntang Forest; (b) Jakabaring Stadium Area; (c) Forest Area of Sri Mulyono Herlambang Palembang Air Base; (d) Bumi Perkemahan Pramuka Gandus City Forest; (e) OPI Retention Pool Area; (f) Pundi Kayu Natural Tourism Park Forest

Urban forests can have an optimal function if they are supported by all elements, including the government, business and industry, and the community. The efforts made can be in the form of planting various trees in the urban forest which have good benefits from an ecological, economic, social and cultural perspective. According to Tamalene *et al.* (2014), that in order to save the ecological crisis, the ethics of indigenous peoples need to be regained, for example in conservation practices based on local wisdom which take the form of the sacred forests of Gosimo, Matakau, Trees of Birth and Trees of Death



(are part of local knowledge that continues to be taught to generations next. According to Tamalene *et al.* (2016), that Canariums (walnuts) in Halmahera have high utility value. Canariums have economic, ecological, medical, and cultural benefits. According to Hariani *et al.* (2015), that the Education Program for Sustainable Development (EfSD) can be included in the curriculum in schools as well as in non-formal and informal education. Urban forest researchers and the government need to work together to provide education and outreach to the community to grow and increase conservation and ecosystem awareness among the public.

### **CONCLUSION**

Urban forests in Palembang have various functions including ecological functions as the lungs of the city, oxygen producers, rainwater absorbers, and animal habitat providers. The social and cultural function is that it can be used as a place for recreation, sports, tourism, educational objects, and research. The aesthetic function is to provide comfort and beauty to the environment.

Urban forests that have high diversity of vegetation, among others: Punti Kayu Natural Tourism Park Forest, Bukit Siguntang Forest, Forest Area of Sri Mulyono Herlambang Palembang Air Base, and Jakabaring Stadium Area. While the other two urban forests have low biodiversity, namely Bumi Perkemahan Pramuka Gandus City Forest and OPI Retention Pool Area.

Bumi Perkemahan Pramuka Gandus City Forest and OPI Retention Pool Area does not have the potential to be used as a natural laboratory, especially in Plant Ecology courses, especially vegetation analysis material. Urban forests can have an optimal function if they are supported by all elements, including the government, business and industry, and the community.

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