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THE ROLES OF VEGETATION IN OPEN GREEN SPACES IN KUPANG EAST NUSA TENGGARA

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ABSTRACT

Open green spaces are crucial for urban landscapes, providing huge benefits such as biodiversity conservation and promoting human health. They can be found in various forms like parks, gardens, and natural reserves. In Indonesia, open green spaces are a trend and prioritized by local authorities because the increasing number of buildings, roads, and vehicles in urban areas that potentially decrease air quality due to contamination of dust, CO_2, and other pollutants. A study on the vegetation composition in Kupang open green spaces is needed to understand its potential benefits and serve as a baseline for developing extensive open green spaces with specific vegetation composition. The results reveal that from the 26 plant species that planted to green the areas, over 69% vegetation is suitable to be planted while 31% vegetation is moderately suitable. The majority of these plants are from the *Fabaceae*, with 34% of the vegetation in the green areas, followed by *Anacardiaceae* at 31%. The remaining species are moderately suitable, with *Verbenaceae* having 7% and the rest at 4% each. The vegetation in these areas plays various roles, such as filtering solid particles, absorbing cement dust, suppressing noise, reducing acid rain impacts, increasing water infiltration, improving aesthetics, and conserving groundwater. These roles are crucial for Kupang's urban environment, which faces potential environmental issues such as air pollution, solid particle pollution, drought, and noise pollution. The results indicate that the vegetation used to green the areas can create significant roles for the urban environment and the people.

Keywords: vegetation; open green spaces; urban; suitability level

1. INTRODUCTION

Despite building-based supporting facilities, one of the pivotal elements of urban landscapes is the presence of open green spaces (Kabisch et al., 2016). It benefits not only the environment but also the communities that utilize it in various different ways. Within an open green space area, plant vegetation is the core of many open green spaces that offer various advantages, ranging from biodiversity conservation to promoting human health and well-being (Ferrini et al., 2020).

The creation of open green spaces covers various forms of parks, gardens, green side-walks, green highways, or natural reserves (Rakhshandehroo et al., 2017). One characteristic that is possessed by all of them is the occurrence of vibrant and diverse plant life. This is not only to improve aesthetic aspects but also to provide ecologically positive feedback and societal value (Dimoudi & Nikolopoulou, 2003).

In many populated cities and towns across Indonesia, open green spaces have been a trend. It is such an integral part of city development and is often prioritized by local authorities (Ajrina & Kustiwan, 2019; Werner, 2014). This open green space has also been built in Kupang, the capital of East Nusa Tenggara province.

Along with the physical development of the city, a decline in the quality of the environment as an impact is always inevitable (Raman, 2010; Shukla & Parikh, 1992). This phenomenon also occurs in Kupang, where many more buildings, roads, bridges, and especially vehicles could potentially decrease the quality of the air. Clean natural air is often soiled by dust, either generated from natural activities or man-made activities (Cho & Choi, 2014; Krzyzanowski et al., 2014). One of the causal factors for the decrease in air quality is the increasing number of people moving, which is mediated by vehicles (Zhang & Batterman, 2013).

A study the vegetation composition in Kupang open green spaces is necessary to elucidate potential benefits possessed by the vegetation. Further implication of this study can be used as a baseline in developing an extensive open green space with certain vegetation composition.

2. METHODS

2.1 Research Sites

The research location is situated in Kupang, East Nusa Tenggara. The data collection was undertaken in open green space areas around the city, including Nostalgia City Park and Green Roads. The data was collected in March 2024.

2.2 Data Collection

Data collection was undertaken by employing direct observation combined with purposive sampling to record tree vegetation occurring in the open green spaces in Kupang. All tree vegetation on the sampling sites was observed and recorded, including its morphological characteristics. We recorded the tree with a diameter breast height (DBH) of more than 10 cm and a height more than 3 meters. We used a pita meter to measure the DBH and a hagameter to measure tree height.

2.3 Data Analysis

The data was descriptively analyzed to assess the suitability level of the species as planted vegetation in open green spaces. According to Indriyanto (2006), the analysis of suitability level is categorized into three main levels, namely Suitable, Moderately Suitable, and Not Suitable, by measuring the class interval.

$$\text{Class interval} = \frac{\text{Highest Score} - \text{Lowest Score}}{\text{Total class}} \quad (1)$$

Suitability criteria

Class interval	>	23.00 – 30.33	=	Not suitable
Class interval	>	30.33 – 38.33	=	Moderately suitable
Class interval	>	38.33 – 46.00	=	Suitable

(Indriyanto, 2006).

Several following aspects of the vegetation are assessed, namely silvicultural-related aspects, tree management-related aspects, and esthetical-related aspects.

The silvicultural-related aspects consists of several parameter and criteria as a part of the suitability assessment, including 1) ability to maintain nutrient-rich soil conditions; 2) resistance to pests; 3) strong main stem and branches; and 4) Rooting system that don not destruct road structures (Indriyanto, 2006). The vegetation should also possess high tolerance on high temperature and unsupporting climate conditions and drought resistance (Saebo et al., 2005).

The tree management-related aspects consists of several parameter and criteria, including cultivation methods, cultivation maintenance, protection methods, utilization

methods, crown as shading, crown as wind barrier, and absorbing pollutants. Last, the esthetical-related aspects consist of other parameter and criteria, including Habitus (crown, branching, leaves, flower, and tree architecture), Educational purposes, Fruit sizes, Poisonous sap, and Allergenic pollen.

Table 1. Depicting suitability aspects of vegetation in open green spaces, including three main aspects of silvicultural-related aspects, tree management-related aspects, and esthetical-related aspects (Indriyanto, 2006; Saebo et al., 2005).

Parameter	Criteria	Score
Silvicultural-related aspects		
Altitude	0 – 5000 mdpl	2
	> 5000 mdpl	1
Rainfall	1200 – 2000 mm/year	2
	< 1200 and > 2000 mm/year	1
Infertile soil tolerance	Tolerant	2
	Not tolerant	1
Soil fertility improvement	Capable	2
	Not capable	1
Pest and disease resistance	Resistant	2
	Not resistant	1
Defoliation in dry season	Evergreen	2
	Defoliated	1
Tree trunk and branches wind resistance	Resistant	2
	Not resistant	1
Rooting impact on building structure	Not damaging	2
	Damaging	1
Extreme temperature tolerance	Tolerant	2
	Not tolerant	1
Extreme sunlight exposure tolerance	Tolerant	2
	Not tolerant	1
Long drought tolerance	Tolerant	2
	Not tolerant	1
Tree management-related aspects		
Cultivation methods	Simple	2
	Complicated	1
Cultivation maintenance	Easy and affordable	2
	Difficult and expensive	1
Protection methods	Simple	2
	Complicated	1
Utilization methods	Simple	2
	Complicated	1
Crown as shading	Good	2
	Bad	1
Crown as wind barrier	Good	2
	Bad	1
Absorbing pollutants	Good	2
	Bad	1
Esthetical-related aspects		
Habitus (crown, branching, leaves, flower, tree architecture)	Esthetic	2
	Not esthetic	1
Educational purposes	Yes	2
	No	1
Fruit sizes	Large	2
	Small	1
Poisonous sap	Yes	2
	No	1

Allergenic pollen	Yes	2
	No	1

3. RESULTS AND DISCUSSION

3.1 Vegetation Suitability in Open Green Space in Kupang

Kupang, a capital city of East Nusa Tenggara Province, is the center for numerous activities, ranging from economy, education, to trade. As its status as a capital city and one of the post popular urban area in the province, it possesses potential as the main urbanization destination and therefore has a potential to trigger various environmental issues, such as pollution due to populated vehicles. Due to that reason, Kupang has been developed towards future green city with the occurrence of open green spaces that can be found in form of green roads and city parks.

The green roads and city parks have been vegetated with variety of plant species which possess a lot of ecological benefits. The Table 2 highlights tree vegetation composition in Kupang within two main green spaces, namely green roads and Nostalgia City Park. These two locations were intentionally developed as green areas by the local authorities.

We recorded 26 plant species that belong to 10 families. According to Table 2, it is seen that most plant species occur in green roads, from El Tari Road to Piet A. Tallo Road, while only some species occur in Nostalgia City Park. From the 26 plant species that planted to green the areas, over 69% vegetation is suitable to be planted while 31% vegetation is moderately suitable (Figure 1). This indicates that the vegetation used to green the areas can create significant roles for the urban environment and the people.

Table 2. Highlighting vegetation composition and its suitability level in open green spaces in Kupang East Nusa Tenggara.

Family	Scientific name	Indonesian name	Location		Class interval Score	Suitability
			Road	Nostalgia City Park		
Anacardiaceae	1. *Lannea coromandelica*	Kayu reo/ kayu jawa	+	-	36.67	Moderately Suitable
	2. *Mangifera indica*	Mangga	-	+	43.33	Suitable
	3. *Agathis dammara*	Damar	+	-	40.00	Suitable
	4. *Casuarinaceae*	Cemara norfolk	+	-	40.00	Suitable
	5. *Casuarina equisetifolia*	Cemara laut	+	-	40.00	Suitable
	6. *Terminalia catappa*	Ketapang	+	-	33.33	Moderately Suitable
	7. *Terminalia mantaly*	Ketapang kencana	+	-	33.33	Moderately Suitable
	8. *Macaranga tanarius*	Mara	+	+	43.33	Suitable
Fabaceae	9. *Acacia auriculiformis*	Akasia	+	+	43.33	Suitable
	10. *Albizia chinensis*	Sengon	-	+	40.00	Suitable
	11. *Delonix regia*	Flamboyan	+	+	33.33	Moderately Suitable
	12. *Gliricidia sepium*	Gamal	+	+	43.33	Suitable
	13. *Leucaena leucocephala*	Lamtoro	+	-	43.33	Suitable
	14. *Pterocarpus indicus*	Angsana	+	-	40.00	Suitable
	15. *Samanea saman*	Trambesi	+	+	43.33	Suitable

Family	Scientific name	Indonesian name	Location		Class interval Score	Suitability
			Road	Nostalgia City Park		
	16. Senna siamea	Johar	+	-	40.00	Suitable
	17. Tamarindus indica	Asam	+	+	40.00	Suitable
Malvaceae	*18. Hibiscus tiliaceus*	Waru	+	-	36.67	Moderately Suitable
Meliaceae	*19. Swietenia mahagoni*	Mahoni	+	+	40.00	Suitable
Moraceae	*20. Atrocarpus heterophyllus*	Nangka	-	+	43.33	Suitable
Myrtaceae	*21. Syzygium cumini*	Jamblang	+	-	43.33	Suitable
Polyalthia	*22. Polyalthia longiolia*	Glodokan tiang	+	+	36.67	Moderately Suitable
Rubiaceae	*23. Neolamarckia cadamba*	Jabon	+	-	43.33	Suitable
Sapindaceae	*24. Schleichera oleosa*	Kesambi	+	-	43.33	Suitable
Verbenaceae	*25. Gmelina arborea*	Jati putih	+	+	36.67	Moderately Suitable
	26. Tectona grandis	Jati	+	-	36.67	Moderately Suitable

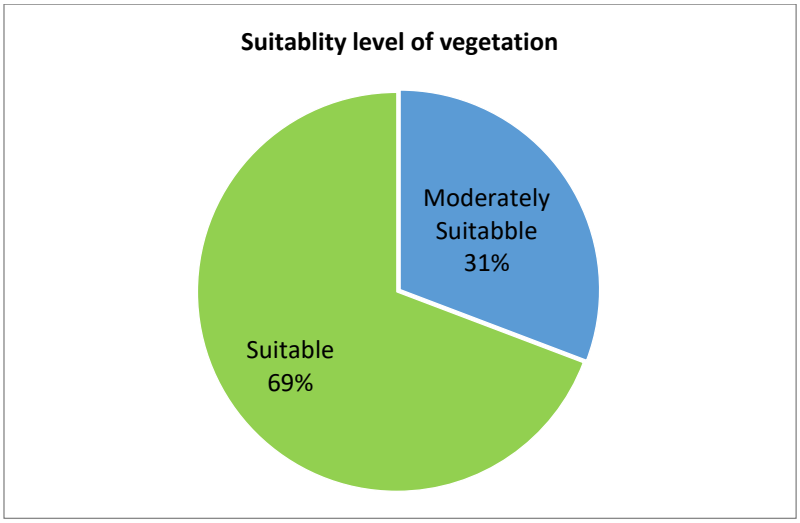

Figure 1. Depicting the proportion of vegetation with its suitability level. Almost 70% of the vegetation is suitable to be planted in open green spaces, while only 31% is moderately suitable level.

The most dominant family that structures the green open areas is Family *Fabaceae*, with 34%, followed by Family *Anacardiaceae*, with 31%. While other families show a small proportion, Family *Verbenaceae* has 7%, and the rest share 4% each. This indicates that most of the vegetation that is planted in the open green areas is vegetation with dense branching and a wide canopy with dense leaves. However, some species within those families are also at a moderately suitable level because some parameters show some weakness. For example, *Delonix regia* has dense branching and a wide canopy but a less strong branching system that makes it sometimes vulnerable to strong wind. Another important aspect of the *Fabaceae* and *Anacardiaceae* is their ethical aspects. Some species, such as *Delonix regia*, regularly flower, creating breathtaking views on the road or in parks (Soimin, 2023). Others, such as *Terminalia catapa* and *Terminalia mantali*, show their

unique tree architecture (Soimin, 2023). This is an opportunity in the future times that the open green areas in urban areas can favorite tourist attractions (Soimin, 2023).

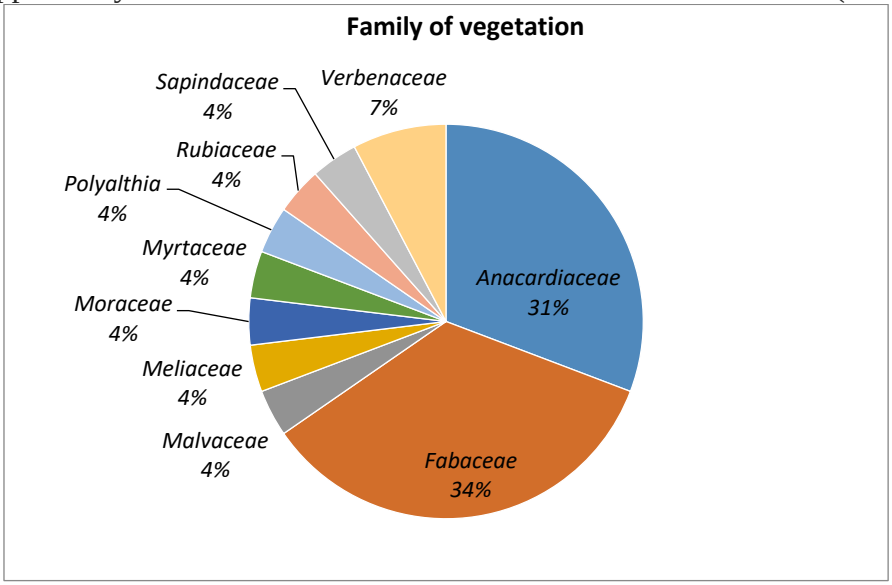

Figure 2. Depicting the proportion of each family of the vegetation. The composition is dominated by vegetation species belonging to *Fabaceae* with 34% and *Anacardiaceae* 31%, while other families are less than 8%.

Few other species with fewer occurrences in open green spaces show a suitable level, such as *Sweitenia macrophylla, Atrocarpus heterophyllus, Neolamarckia cadamba,* and *Schleichera oleosa.* These species not only possess high shading and blocking sunlight but also have strong tree trunks and branching systems that can act as barriers from strong wind and heat waves.

3.2 The Roles of Vegetation in Urban Areas

Different species that are planted in open green spaces in Kupang have a variety of roles for the betterment of the environment. We categorized the roles of vegetation based on Dahlan (1992), including holding and filtering solid particles, absorbing cement dust, suppressing noise, reducing the impact of acid rain, increasing water infiltration, improving aesthetics, and groundwater conservation. These roles are crucial for Kupang as an urban area with potential environmental issues such as air pollution, solid particle pollution in the air, drought during the dry season, and noise pollution.

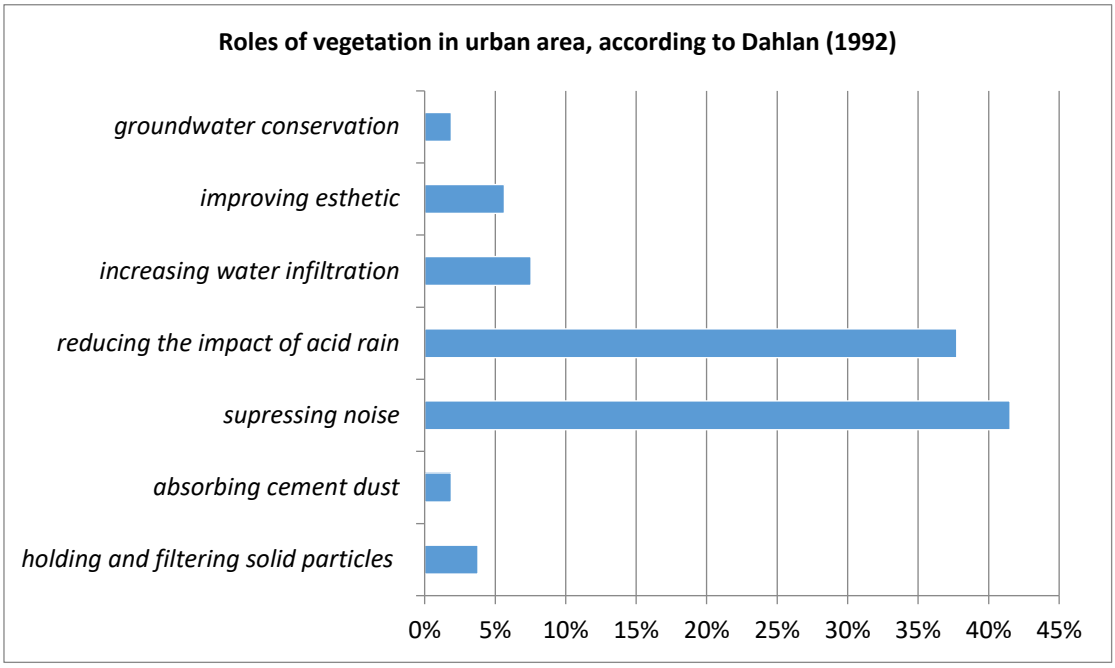

Figure 3. Depicting the proportion of species with different roles as vegetation occurring in open green spaces in Kupang. This category of roles refers to Dahlan (1992). Most of the vegetation planted in Kupang open areas act as noise pollution suppressor and acid rain reducer.

According to Figure 3, it can be seen that Most of the tree species planted in Kupang Open areas act as noise pollution suppressor and acid rain reducer while other roles are possessed by small proportion of the vegetation with less than 10%. A tree species of *Sweitenia macrophylla* can act for several roles in the environment such as absorbing cement dust particles, reducing the impacts of acid rain, and increasing water infiltration (Dahlan, 1992). Suppressing noise from vehicles consists of all species occurring in the green open areas.

4. CONCLUSION

All recorded species in open green spaces in Kupang occurring in road and city parks possess the fitness as preferred urban area species with suitable and moderately suitable level. Among 26 plant species that planted to green the areas, over 69% vegetation is suitable to be planted while 31% vegetation is moderately suitable. The majority of these plants are from the *Fabaceae* family, with 34% of the vegetation in the green areas, followed by *Anacardiaceae* at 31%. The remaining species are moderately suitable, with *Verbenaceae* having 7% and the rest at 4% each. The vegetation in these areas plays various roles, such as filtering solid particles, absorbing cement dust, suppressing noise, reducing acid rain impacts, increasing water infiltration, improving aesthetics, and conserving groundwater. These roles are crucial for Kupang's urban environment, which faces potential environmental issues such as air pollution, solid particle pollution, drought, and noise pollution. The results indicate that the vegetation used to green the areas can create significant roles for the urban environment and the people. It can also be used as a baseline for developing extensive open green spaces with specific vegetation composition.

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