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Conserving Flora Biodiversity: A Study of Elderly Park in Rahayu Village, Soko District, Tuban Regency, East Java

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Abstract

The consideration of elderly welfare is paramount for achieving prosperity across all segments of society. To enhance the well-being of the elderly, providing green open spaces is imperative. These areas serve as places for relaxation and recreation and foster a sense of togetherness and harmony in the relationship between humans and the environment. Creating an Elderly Park aligns with these objectives, additionally serving as a locus for biodiversity conservation in rural settings. Conducted in Rahayu Village, Soko District, Tuban Regency, East Java, this research, executed in August-September 2023, employed field survey methods, encompassing interviews and non-transect vegetation analysis to catalog plant species. The primary goal of this investigation is to scrutinize plant species composition, ascertain biodiversity indices, compute estimated carbon biomass, and delineate the potential and conservation status of flora in Taman Lansia, Rahayu Village. The Elderly Park benefits 3,808 individuals from 1,298 families. The study revealed a plant composition of 61 species across 33 families, totaling 6,623 individuals. The flora biodiversity index (H') is 3.381 (High Category), and the flora species evenness index (E) is 0.8226 (High Category). The overall volume of flora carbon biomass measures 32.3741 m3, with a total biomass above the surface of 37.8453 kg. Of the identified plant species, 58 have potential applications in food and medicine, while 8 species possess LC, DD, and CD Conservation Status, necessitating preservation efforts within the Elderly Park.

Keywords: Biodiversity conservation, elderly park, elderly welfare, green open spaces

INTRODUCTION

The safeguarding and administration of biodiversity in Indonesia face significant environmental threats, particularly in species extinction and habitat loss (Kuspriyanto, 2015). In addition to proactive measures aimed at conserving existing forests, the government must promote the cultivation of diverse plant species in rural areas. This initiative is crucial for fostering equilibrium and synergy with the surrounding environment by establishing green open spaces (Samsudi, 2010). By integrating these strategies, a comprehensive approach to biodiversity conservation can be achieved, addressing the preservation of existing ecosystems and the cultivation of new, harmonious green spaces (Kuspriyanto, 2015; Samsudi, 2010).

A crucial requirement is the provision of green open spaces for all village residents, with particular consideration for the elderly demographic (Van Den Berg et al., 2007). Within the framework of village development activities, the diminishing availability of green land poses a significant challenge to community engagement in residential areas. Residents remain unaware of the diverse natural resources with potential applications in food or medicine, as these resources are frequently sacrificed for alternative purposes (Opier et al., 2023). Addressing this challenge involves identifying and repurposing abandoned lands to establish productive green open spaces, strategically located in proximity to village infrastructure for easy accessibility by all residents. Simultaneously, there is a growing awareness of nature conservation and a heightened understanding of healthy living through organic food consumption among the broader community (Sudjoko, 2019).

In November 2022, the establishment of a green open space named "ELDERLY PARK" was initiated in Rahayu Village, Sukowati District, Tuban Regency, East Java. The primary objective of introducing this green open space is to offer recreational opportunities for all Rahayu Village residents, thereby enhancing the overall quality of the living environment. In addition to serving as a recreational area, the Elderly Park functions as a catchment zone, effectively mitigating pollutants resulting from human activities (Guo et al., 2020). Furthermore, it serves as a revitalization space, equipped with sports facilities catering to the diverse recreational needs of village residents, as exemplified by the PEP Field Sukowati initiative in 2022.

This study aims to determine the composition of plant species in the Elderly Park, assess the Flora biodiversity index, estimate carbon biomass, and create a comprehensive mapping of Flora's potential and conservation status within the Elderly Park located in Rahayu Village.

METHODS

The Flora Biodiversity Protection Study was conducted in Taman Lansia, Rahayu Village, Soko District, Tuban Regency, from August to September 2023. This comprehensive investigation involved collecting interview data and plant census data within Taman Lansia, focusing on calculating biodiversity indices and carbon biomass specifically for tree-type plants. The selection of the survey location was informed by regional considerations, including the insufficient availability of green open spaces for enhancing environmental quality, challenges in accessing clean water-essential for maintaining residents' health, the absence of health facilities such as hospitals within a 20 km radius of settlements, and a notably high proportion of elderly individuals, making Rahayu Village the sub-district's second-highest in terms of elderly population.

Study Instruments

The study on Flora biodiversity protection in Rahayu Village was conducted through plant observation and identification, encompassing deep-interview surveys with selected residents and supported by environmental observations of significant findings in the field. Additionally, a plant inventory/census was carried out in Taman Lansia, covering an area of 1,750 m2, to assess the level of plant diversity and the carbon biomass of tree-type plants in that location. The instruments employed included data tabulation, a measuring tape, writing tools, a digital camera, and labels.

Procedure and Data Analysis

The data collection phase employed a survey method, primarily involving interviews with internal stakeholders of the village, serving the purpose of processing essential information. Additionally, environmental observation, verification, and secondary data from the village monograph and direct field findings were integrated. Subsequently, determining flora data collection points utilized the non-transect vegetation analysis method. Each identified plant species was recorded and categorized (tree type, pole, stake, seedling). In conjunction with the census, diameter, height, and plant biomass measurements were conducted for tree-type plants. The flora status and the potential efficacy of these plants, such as medicinal properties or air pollutant reduction (free radicals), were then mapped. The calculation of biodiversity and evenness indices, as well as plant carbon biomass, were analyzed as follows:

a) Diversity and Evennes of Species

To determine the biodiversity index, the Shannon-Wiener formula was employed (Magurran, 2014):

$$H' = -\sum Pi \cdot \ln Pi$$

Where:

H' = biodiversity index
Pi = ni/N
ni = number of individuals for each species
N = total number of individuals found

Magurran from 2004 indicates the range of biodiversity index values as follows:

Low if H' < 1.0, Moderate if 1.0 < H' < 3.0, High if H' > 3.0

The evenness index formula is:

$$E = H' / \ln S$$

Where:

S = total number of species in the sample
E = evenness indeks

According to Krebs from 1999, the evenness index (E) is categorized into three levels:

$0 < E \leq 0.4$ indicates low population evenness;
$0.4 < E < 0.6$ indicates moderate population evenness;
$E \geq 0.6$ indicates high population evenness.

b) Carbon Biomass of Tree Categories

Afforestation is one of the primary strategies for reducing Greenhouse Gas (GHG) concentrations in residential areas. The essence of GHG reduction involves minimizing CO_2 emissions into the atmosphere. Therefore, controlling the amount of CO_2 in the air is crucial, achieved by enhancing plant CO_2 absorption and minimizing GHG emissions. To assess the absorbed carbon and effectively reduce environmental emissions, an estimation of carbon reserves (biomass) is essential. The calculation of carbon biomass involves determining tree volume, which is then used to calculate biomass using the following formula:

$$\textbf{Tree volume (m}^3\textbf{)} = \pi r^2 t$$

$$\textbf{Bap} = v \times \textbf{BEF} \times \textbf{F}$$

Where:

Π = 22/7 or 3.14
r = tree radius (m)
t = tree height (m)
Bap = Biomass above the survace, (kg)
BEF = Biomass expansion factor (1.67)
F = Form factor (0.7)

RESULTS AND DISCUSSION

Profile of Elderly Park in Rahayu Village

The Elderly Park in Rahayu Village is one of the village's green open spaces initiated by PT. Pertamina EP Asset 4 Field Sukowati, demonstrating a commitment to impart positive impacts on environmental sustainability in the company's vicinity. This commitment aligns with the environmental development policies outlined in Law Number 32 of 2009 on Environmental Protection and the Indonesian Ministry of Environment Regulation Number 3 of 2014 concerning the company's environmental performance rating assessment program. The latter specifies that performance evaluations exceeding compliance are conducted concerning biodiversity protection activities.

In its implementation, the company has established an environmental protection program based on community empowerment to preserve biodiversity and enhance the residents' quality of life. The Elderly Park spans an area of 1.750 m^2, featuring a Medicinal and Family Vegetable Planting Area (TOSGA) and a garden with various plant species, complemented by refreshing and sports areas for the residents of Rahayu Village. Two representatives from each of the 27 neighborhoods (RT) spread across four hamlets (Kayunan, Sarirejo, Mudiharjo, and Nggandu) in Rahayu Village actively participate in managing the Elderly Park. Other residents contribute to supporting aspirations and material resources for the sustainability of the Elderly Park. This initiative indirectly impacts the residents of Rahayu Village, as the Elderly Park is accessible to the entire village population, consisting of 3.808 individuals from 1.298 households.

Protection of Flora Biodiversity

The success and stability of a community structure can be assessed by measuring biodiversity indices, specifically the diversity index (H') and evenness index (E). In the Elderly Park area, the calculated values of these indices are as follows:

Diversity Index (H') = 3.381 (High Category)   Evenness Index (E) = 0.8226 (High Category)

Based on the field findings, there are 61 plant species in the Elderly Park, comprising 33 families with 6.623 individuals. The Shannon-Wiener Diversity Index (H') from 1987 and Magurran from 2004 indicate that the Elderly Park area has high flora diversity. The high diversity value suggests that the plants in the Elderly Park are characterized by a variety of species, with only a few dominating, indicating a balanced plant composition. The plant community forming the ecosystem structure in the 1.750 m^2 Elderly Park serves as an initial foundation for further biodiversity protection development. Communities with higher diversity values indicate complex relationships among the components, influencing the stability of the community when disturbances occur among its constituent elements (Valencia et al., 2020).

The species diversity index in the Elderly Park serves as a solid foundation for biodiversity protection development. However, given that the existing plants are annual and short-lived, proper maintenance and management are crucial. Regular cleaning, rejuvenation, and adding new species are necessary to enhance community complexity. Some ground plants show signs of drying, indicating the need for replacement and replanting near the Elderly Park (Ma et al., 2023; Mexia et al., 2018; Wood et al., 2018).

This situation is also reflected in the evenness index, which falls into the high category. This means the community structure is more evenly distributed, with the evenness index approaching 1. The evenness of plant species in the Elderly Park is high, as the number of individuals for each species is relatively balanced, with no significant dominance. The evenness index will be uniform when all plant species in the study location are evenly distributed, with the number of individuals in each species nearly equal.

Flora Carbon Biomass

The carbon biomass for the Green Open Space (Ruang Terbuka Hijau, RTH) area in the Elderly Park consists of decorative and medicinal plant plots. The inventory results used for carbon biomass estimation include Bonsai Beringin Dollar (*Ficus microcarpa*), Bonsai Cemara Udang (*Casuarina equisetifolia*), Kamboja (*Adenium obesum*), Singapore Silver Flower (*Bougainvillea variegata*), Squirrel Tail Palm (*Wodyetia bifurcata*), Yellow Tabebuia (*Tabebuia aurea*), Pink Tabebuia (*Tabebuia rosea*), White Tabebuia (*Tabebuia riparia*), and Green Tea (*Camellia sinensis*). These plants are classified as trees due to having a diameter at breast height (dbh) > 10 cm. Here is the total carbon reserve absorbed by the standing trees in the Elderly Park:

Tabel 1. Carbon Biomass of Tree Category Stands in the Elderly Park, Rahayu Village

No	Local Name	Scientific Name	Family	K (cm2)	D (m)	t (m)	V (m3)	Bap (kg)
1	Bonzai Beringin Dollar	*Ficus microcarpa*	Moraceae	21.5	0.137	3.0	0.0442	0.0516
2	Bonzai Beringin Dollar	*Ficus microcarpa*	Moraceae	34.0	0.217	2.0	0.0736	0.0861

3	Bonzai Beringin Dollar	*Ficus microcarpa*	Moraceae	23.0	0.146	1.5	0.0253	0.0295
4	Bonzai Beringin Dollar	*Ficus microcarpa*	Moraceae	24.0	0.153	1.5	0.0275	0.0322
5	Bonzai Beringin Dollar	*Ficus microcarpa*	Moraceae	21.0	0.134	1.5	0.0211	0.0246
6	Bonzai Cemara Udang	*Casuarina equisetifolia*	Casuarinaceae	28.0	0.178	1.5	0.0375	0.0438
7	Bonzai Cemara Udang	*Casuarina equisetifolia*	Casuarinaceae	25.0	0.159	1.5	0.0299	0.0349
8	Bonzai Cemara Udang	*Casuarina equisetifolia*	Casuarinaceae	23.0	0.146	2.5	0.0421	0.0492
9	Bonzai Cemara Udang	*Casuarina equisetifolia*	Casuarinaceae	40.0	0.255	1.5	0.0764	0.0894
10	Bonzai Cemara Udang	*Casuarina equisetifolia*	Casuarinaceae	34.0	0.217	1.5	0.0552	0.0646
11	Bunga Kamboja	*Adenium obesum*	Apocynaceae	18.0	0.115	1.5	0.0155	0.0181
12	Bunga Kamboja	*Adenium obesum*	Apocynaceae	22.0	0.140	1.5	0.0231	0.0270
13	Bunga Kamboja	*Adenium obesum*	Apocynaceae	21.5	0.137	3.0	0.0442	0.0516
14	Bunga Kamboja	*Adenium obesum*	Apocynaceae	19.0	0.121	1.5	0.0172	0.0202
15	Bunga Perak Singapura	*Bougenvillea varigata*	Nyctaginaceae	34.0	0.217	2.5	0.0920	0.1076
16	Mangga	*Mangifera indica*	Anacardiaceae	121.0	0.771	7.0	3.2639	3.8155
17	Mangga	*Mangifera indica*	Anacardiaceae	137.0	0.873	7.0	4.1842	4.8913
18	Mangga	*Mangifera indica*	Anacardiaceae	123.0	0.783	8.0	3.8545	4.5059
19	Mangga	*Mangifera indica*	Anacardiaceae	117.0	0.745	9.0	3.9236	4.5867
20	Mangga	*Mangifera indica*	Anacardiaceae	123.0	0.783	8.0	3.8545	4.5059
21	Mangga	*Mangifera indica*	Anacardiaceae	104.0	0.662	10.0	3.4446	4.0267
22	Mangga	*Mangifera indica*	Anacardiaceae	160.0	1.019	11.0	8.9682	10.4838
23	Palem Ekor Tupai	*Wodyetia bifurcata*	Aracaceae	22.5	0.143	2.5	0.0403	0.0471
24	Tabebuya Kuning	*Tabebuia aurea*	Bignoniaceae	26.0	0.166	3.0	0.0646	0.0755
25	Tabebuya Pink	*Tabebuia rosea*	Bignoniaceae	24.0	0.153	2.5	0.0459	0.0536
26	Tabebuya Pink	*Tabebuia rosea*	Bignoniaceae	28.5	0.182	3.0	0.0776	0.0907
27	Tabebuya Pink	*Tabebuia rosea*	Bignoniaceae	26.5	0.169	1.5	0.0335	0.0392
28	Tabebuya Putih	*Tabebuia riparia*	Bignoniaceae	23.0	0.146	3.0	0.0505	0.0591
29	Tabebuya Putih	*Tabebuia riparia*	Bignoniaceae	21.0	0.134	3.0	0.0421	0.0493
30	Tabebuya Putih	*Tabebuia riparia*	Bignoniaceae	23.5	0.150	3.0	0.0528	0.0617
31	Teh Hijau	*Camellia sinensis*	Theaceae	29.0	0.185	1.5	0.0402	0.0470

Total Volume = 32.3741 m^3 Bap Total = 37.8453 kg

Based on Table 1, it is evident that the initial data for carbon biomass shows a total volume of 32.3741 m^3 and a total above-surface biomass (Bap) of 37.8453 kg. There are no specific criteria for determining carbon biomass, but the results tend to be better with larger total volume and total Bap. This underscores the relationship between the quantity and size of trees, demonstrating that a higher number and larger diameter of trees lead to greater results. In alignment with Irundu et al., (2023), the carbon biomass of standing trees is strongly influenced by diameter and height, exhibiting a linear relationship. As a starting point, these values must be maintained, and there is a need for an increase in the variety and number of individuals with regular care and monitoring to ensure the uninterrupted growth of each species. This approach ensures the stability of carbon absorption and enhances the ecological quality of the surrounding environment.

Potential of Flora as Food and Medicine

There are 58 plants in the Elderly Park with various medicinal properties and roles in reducing free radicals in the air. All plants cultivated in the Elderly Park have a short life cycle and are easy to replant within a brief period. Plants with medicinal or ripe benefits, such as vegetables and medicinal plants, can be harvested, providing recurring benefits to the surrounding community. Several plants in the Elderly Park, such as *Clitoria ternatea* (Butterfly Pea) for treating visual impairments, *Hibiscus rosa-sinensis* (Hibiscus) for lowering blood pressure, *Costus ignaeus* (Insulin Plant) for reducing blood sugar levels, *Foeniculum vulgare* (Fennel) to aid blood circulation, and *Camellia sinensis* (Green Tea) for treating worm infestations, serve medicinal purposes (Syarif et al., 2015). Additionally, there are plants used to reduce airborne free radicals, including *Sanseviera trifasciata* (Snake Plant), *Bougainvillea glabra* (Bougainvillea), *Crystostachys renda* (Red Sealing Wax Palm), *Wodyetia bifurcata* (Foxtail Palm), and *Mangifera indica* (Mango). Furthermore, there are plants suitable for consumption, such as *Capsicum annuum* (Chili), *Syzygium polyanthum* (Indonesian Bay Leaf), *Moringa oleifera* (Moringa), *Syzygium malaccense* (Java Apple), and *Spondias dulcis* (Ambarella).

Concervation Status of Flora

The conservation status of flora is a category established by the International Union for the Conservation of Nature and Natural Resources (IUCN), signifying that living organisms (flora, fauna, microorganisms, etc.) play a specific ecological role in the sustainability of communities of particular species in nature. However, their existence is diminishing due to various internal/external factors influencing them (IUCN, 2023). One common example leading to a decrease in the number of species is illegal logging or land conversion (Prilyscia et al., 2018). However, for the overall plant composition of specific species in the Elderly Park, the conservation status indicates a low risk of extinction. According to Table 2, some plants, such as Green Tea and Mango, have a conservation status of DD* (Data Deficient), Euphorbia is classified as Least Concern (LC), Adas (LC), Pink Tabebuia (LC), Rombusa Flower (LC), Mondokaki (LC), and Squirrel Tail Palm (Conservation Dependent / CD).

Table 2. Conservation Status of Several Plants in the Elderly Park, Rahayu Village

No	Local Name	Scientific Name	Family	IUCN
1	Teh Hijau	*Camellia sinensis*	Theaceae	DD*
2	Euphorbia	*Euphorbia mili*	Euphorbiaceae	LC
3	Adas	*Foeniculum vulgare*	Apiaceae	LC
4	Mangga	*Mangifera indica*	Anacardiaceae	DD*
5	Tabebuya Pink	*Tabebuia rosea*	Bignoniaceae	LC
6	Bunga Rombusa	*Tabernaemontana corimbosa*	Apocynaceae	LC
7	Mondokaki putih	*Tabernaemontana divaricata*	Apocynaceae	LC
8	Palem Ekor Tupai	*Wodyetia bifurcata*	Aracaceae	CD

Plants with DD* (Data Deficient) conservation status indicate a lack of clear information regarding their extinction or threat risk based on distribution or population status. On the other hand, the LC (Least Concern) conservation status signifies that the plant species, as evaluated by the IUCN, has a low risk of extinction. Meanwhile, the Conservation Dependent (CD) conservation status is assigned to species whose existence relies on conservation efforts to prevent them from facing the threat of extinction.

DISCUSSION

Several points warrant discussion to determine future advancement recommendations for developing the Elderly Park (Guo et al., 2020b; Levinger et al., 2018; Zhai et al., 2020). Considerations include the addition of new plant species with potential medicinal properties and prospects for food processing (Rahman et al., 2021), as well as perennial plants with the highest estimated biomass, such as Trembesi, Beringin, Asam Jawa, Gandaria, and other large-stemmed fruit-bearing plants. This initiative aims to mitigate undesirable environmental impacts effectively.

Establishing an organic fertilizer production center managed from household and agricultural waste is crucial for developing the Elderly Park. The resulting organic fertilizer can be utilized for plant maintenance, serving the dual purpose of minimizing waste accumulation and enhancing the community's empowerment, skills, and creativity. This initiative promotes a sustainable life cycle that can ultimately serve as a solution to reduce Greenhouse Gas (GHG) emissions.

Organic fertilizer production from household and agricultural waste is a sustainable practice that can contribute to environmental conservation and soil productivity. Organic practices, including organic fertilizers, create suitable conditions for soil biotic and abiotic resources, promoting biodiversity and soil biological activity. Preparing organic fertilizer from underused waste materials, such as crop residues and organic manures, can develop quality products that benefit plant growth and soil fertility. Using organic amendments, such as organic fertilizers, has historically been significant for plant nutrient management and soil productivity. Organic amendments contribute to the recycling of nutrients, the improvement of soil physical and chemical properties, and the maintenance of soil organic matter, which is essential for long-term soil productivity (P R Arachchige et al., 2020)

The World Commission on Environment and Development has emphasized the importance of sustainable food security and the potential for global food production in the context of achieving sustainable development. Organic practices, including producing organic fertilizers, align with the commission's goals for sustainable agriculture and environmental conservation. Furthermore, constructing a Farming House or Greenhouse is imperative to empower the youth organization, Karang Taruna, in Rahayu Village to cultivate organic fruit plants. This practice aligns with sustainable agriculture principles, promotes environmental conservation, and contributes to the park's long-term sustainability.

CONCLUSION

Based on this study, the beneficiaries of the Elderly Park amount to 3,808 individuals from 1,298 households distributed across four hamlets in Rahayu Village. The plant composition in the Elderly Park reveals 61 species belonging to 33 families, totaling 6,623 individuals. The Flora biodiversity index (H') is 3.381 (High Category), and the flora species evenness index (E) is 0.8226 (High Category). The carbon biomass of Flora in the Elderly Park is measured at a total volume of 32.3741 m3 and a total biomass above the surface of 37.8453 kg, serving as baseline values for the ongoing enhancement of species diversity and population through regular maintenance and monitoring. Notably, 58 plant species exhibit potential applications as food and medicine, while 8 plant species possess Conservation Status categories LC, DD, and CD, underscoring the imperative need for their preservation within the Elderly Park.

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REFERENCES

Guo, M., Liu, B., Tian, Y., & Xu, D. (2020). Equity to Urban Parks for Elderly Residents: Perspectives of Balance between Supply and Demand. *International Journal of Environmental Research and Public Health*, *17*(22), 8506. https://doi.org/10.3390/ijerph17228506

Irundu, D., Idris, A. I., Sudiatmiko, P., & Irlan. (2023). Biomassa dan Karbon Tersimpan di Atas Tanah Pada Hutan Rakyat Agroforestri di Kecamatan Bulo Kabupaten Polman. *Jurnal Hutan Dan Masyarakat*, *15*(1), 32–41.

IUCN. (2023). *The IUCN Red List of Threatened Species [Internet]*. IUCN.

Kuspriyanto. (2015). Upaya Konservasi Keanekaragaman Hayati di Kawasan Lindung Indonesia. *Metafora: Education, Social Sciences and Humanities Journal*, *1*(4), 134–142.

Levinger, P., Sales, M., Polman, R., Haines, T., Dow, B., Biddle, S. J. H., Duque, G., & Hill, K. D. (2018). Outdoor physical activity for older people—the senior exercise park: Current research, challenges and future directions. *Health Promotion Journal of Australia*, *29*(3), 353–359. https://doi.org/10.1002/hpja.60

Ma, Z., Zhang, P., Hu, N., Wang, G., Dong, Y., Guo, Y., Wang, C., Fu, Y., & Ren, Z. (2023). Understanding the drivers of woody plant diversity in urban parks in a snow climate city of China. *Journal of Forestry Research*, *34*(4), 1021–1032. https://doi.org/10.1007/s11676-022-01535-9

Mexia, T., Vieira, J., Príncipe, A., Anjos, A., Silva, P., Lopes, N., Freitas, C., Santos-Reis, M., Correia, O., Branquinho, C., & Pinho, P. (2018). Ecosystem services: Urban parks under a magnifying glass. *Environmental Research, 160,* 469–478. https://doi.org/10.1016/j.envres.2017.10.023

Opier, C. N. R., Tutuarima, F., & Sapulette, M. S. (2023). Ketersediaan Ruang Terbuka Hijau dalam Pemenuhan Hak Lansia di Kota Ambon. *MOTEKAR: Jurnal Multidisiplin Teknologi Dan Arsitektur*, *1*(2), 131–139.

P R Arachchige, U. S., Ranaweera, S., Ampemohotti, A., Weliwaththage, S. R., Mbdk, S., & Weerakoon, J. (2020). Development of an Organic Fertilizer. *JOURNAL OF RESEARCH TECHNOLOGY AND ENGINEERING*, *1*(1).

Prilyscia, A., Sutarno, & Rahayu. (2018). Hubungan Alih Fungsi Lahan dan Perubahan Iklim terhadap Hasil Komoditas Pertanian di Jumantono. *Agrotech Res Journal*, *2*(1), 28–34.

Rahman, Md. M., Rahaman, Md. S., Islam, Md. R., Rahman, F., Mithi, F. M., Alqahtani, T., Almikhlafi, M. A., Alghamdi, S. Q., Alruwaili, A. S., Hossain, Md. S., Ahmed, M., Das, R., Emran, T. Bin, & Uddin, Md. S. (2021). Role of Phenolic Compounds in Human Disease: Current Knowledge and Future Prospects. *Molecules*, *27*(1), 233. https://doi.org/10.3390/molecules27010233

Samsudi. (2010). Ruang Terbuka Hijau Kebutuhan Tata Ruang Perkotaan Kota Surakarta. *Journal of Rural and Development*, *1*(1), 11–19.

Sudjoko, C. (2019). *Analisis Penerapan Green Marketing Mix Pada CV. Madu Apiari Mutiara Kecamatan Cimanggis Depok*. Universitas Islam Negeri Syarif Hidayatullah.

Syarif, P., Suryotomo, B., & Soeprapto, H. (2015). *Diskripsi dan Manfaat Tanaman Obat di Perdesaan sebagai Upaya Pemberdayaan Apotik Hidup (Studi Kasus di Kecamatan Wonokerto)*. 20–32.

Valencia, E., de Bello, F., Galland, T., Adler, P. B., Lepš, J., E-Vojtkó, A., van Klink, R., Carmona, C. P., Danihelka, J., Dengler, J., Eldridge, D. J., Estiarte, M., García-González, R., Garnier, E., Gómez-García, D., Harrison, S. P., Herben, T., Ibáñez, R., Jentsch, A., … Götzenberger, L. (2020). Synchrony matters more than species richness in plant community stability at a global scale. *Proceedings of the National Academy of Sciences*, *117*(39), 24345–24351. https://doi.org/10.1073/pnas.1920405117

Van Den Berg, A. E., Hartig, T., & Staats, H. (2007). Preference for Nature in Urbanized Societies: Stress, Restoration, and the Pursuit of Sustainability. In *Journal of Social Issues* (Vol. 63, Issue 1).

Wood, E., Harsant, A., Dallimer, M., Cronin de Chavez, A., McEachan, R. R. C., & Hassall, C. (2018). Not All Green Space Is Created Equal: Biodiversity Predicts Psychological Restorative Benefits From Urban Green Space. *Frontiers in Psychology*, *9*. https://doi.org/10.3389/fpsyg.2018.02320

Zhai, Y., Li, D., Wang, D., & Shi, C. (2020). Seniors' Physical Activity in Neighborhood Parks and Park Design Characteristics. *Frontiers in Public Health*, *8*. https://doi.org/10.3389/fpubh.2020.00322