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RESEARCH ARTICLE

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Biodiversity of fruit plants (edibles) at the Kentingan Campus of Universitas Sebelas Maret, Surakarta, Central Java, Indonesia

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Abstract

Urban areas have the potential to support food supply even in limited quantities due to limited green open land, including edible fruits. This study aims to determine the biodiversity of edible fruit plants at the Kentingan Campus of UNS, Surakarta, Central Java, Indonesia. Data were collected by survey methods with cruising techniques, accompanied by a calculation of the ecological index in December 2022. Survey methods with cruising techniques by exploring the campus area to collect the primary data, including the name of plant species, the number of individuals, coordinates, and fruit documentation found from each species. Data was processed and analyzed using the calculation of the ecological index. Meanwhile, secondary data was obtained from IUCN and POWO to determine conservation status and species authenticity. The results obtained there were 55 species from 25 family fruit plants with the Shannon-Wiener, Margalef, and Simpson Dominance Indexes with medium (3.17), high (7.30), and low (0.077) categories, respectively. Some species have the highest number of individuals, namely *Musa x paradisiaca* L. (Musaceae) (327 individuals). Aside, *Mangifera indica* L. (Anacardiaceae) is a species found in all locations. From the data obtained, there were several fruit plants with 23 species of LC and DD conservation statuses, as many as two species. Meanwhile, based on data from POWO, several fruit plants were native to Indonesian plants, namely *Durio zibethinus* Murray, *Averrhoa bilimbi* L., and *Averrhoa carambola* L.

Keywords: Family, Margalef Index, Shannon-Wiener Index, Simpson Index, species

Introduction

Biodiversity is the appointment of the term variation in the variability of living things on earth. Biodiversity includes habitat diversity, species diversity, to genetic diversity[1]. Biodiversity is a gift from God as a natural wealth that can provide various benefits in today life until the end. Plants, animals, microorganisms, genetics, and ecosystems built in it, which become the environment, are biodiversity[2]. Plants are biodiversity that has great potential in their utilization to support the high needs of human life. Indonesia has a high biodiversity of plants. Therefore, a region's high level of biodiversity will provide higher opportunities for utilization because more and more choices and reserves can be utilized[3]. Humans can use plants as raw materials for buildings, cosmetics, drugs, flavorings, food, etc. In the biodiversity of plants, some plants bear fruit, and some do not bear fruit. However, not all fruit plants can be eaten; some fruit cannot be eaten or must be processed first[4].

One area that has a biodiversity of fruit plants are in urban areas. Biodiversity in urban areas acts as a vital resource, buffer, and balance of the environment played by the character of its ecosystems. Therefore, if urban areas are damaged, the city ecosystem will permanently change the type of habitat and diversity[5]. An urban area is where the community does activities[6]. Urban areas are the center of trade, social, and government activities. The dense activity in urban areas increases carbon emissions from fuel combustion[7]. The resulting emissions fly loose and accumulate in the free air. Amid urban density, some areas have a high potential for biodiversity. That is because the vegetation in urban areas generally aims to absorb carbon, aesthetics, and use fruiting. Plants that aim the main to absorb carbon can be easily found on the side of the road. At the same time, plants with aesthetic functions can be found in the yard or government area, while residents in their home yards usually cultivate fruiting plants. Various plants can be found in urban forest areas, city parks, green open spaces, residential homes, offices, roadside, and campus areas.

In Indonesia, fruiting plants can grow very well because of their location in the tropics. One location that potentially has many biodiversities of fruiting plants in Indonesia is the Universitas Sebelas Maret (UNS) Campus[8]. The Kentingan Campus of the UNS area is the main campus located on the street of Ir. Sutami No. 36, Kentingan, Jebres District, Surakarta City, Central Java Province, Indonesia, with an area of approximately 60 hectares. In 2014, UNS was established as a model of Green Campus development in Indonesia by the Minister of Environment, together with five other universities in Indonesia. UNS was rank seventh of ten of the most reviewed campuses in Indonesia[9]. This status makes UNS create a green campus environment, a large land to grow various plants, especially fruiting plants. Trees that have grown in the campus area include fruiting plants that have grown naturally since the campus's beginning, and some are deliberately planted in the campus area[10]. Fruiting plants in the campus area greatly benefited humans, especially campus residents. Their benefits can be used directly or indirectly. Direct benefits of fruiting plants, namely fruits that can be consumed and beneficial for health, that range from providing nutrition for the body and use as medicinal[11]. In addition, the indirect benefits from the presence of fruit plants in the UNS campus area, including; as the creator of green space, food providers, improvement of microclimate, absorption of air pollution, reducing noise, and provide shading for humans, animals, and surrounding plants[12]. However, the biodiversity data on the Kentingan Campus of UNS is still limited. Even information about the species of fruit-producing plants is minimal, so research is needed, especially regarding the diversity of fruit-producing plants on the

Kentingan Campus. The result could be used to further development and utilized by campus residents. Therefore, this study aims to determine the biodiversity of fruit plants (edibles) at the Kentingan Campus of UNS.

Materials and methods

Study area

Data was collected in December 2022 at the Kentingan Campus of UNS on -7.559414682775181, 110.85644487064242 (**Figure 1**). The data collection area covered the Kentingan Campus of the UNS area, both plants in the building and building-free areas (**Figure 2**). Data collection included all plants that thrive in the campus area, both wild and deliberately planted plants.

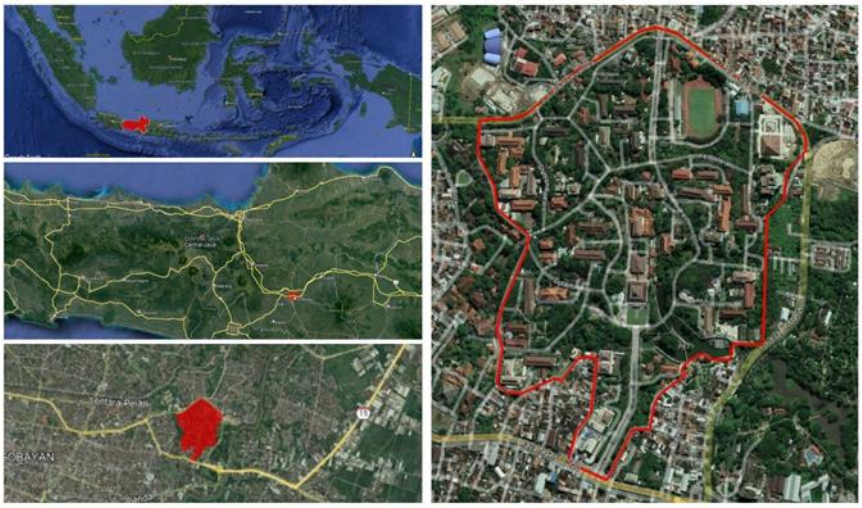

Figure 1. Research locations at Kentingan Campus of UNS, Surakarta, Central Java, Indonesia

Data collection

Survey methods with cruising techniques have been conducted in this research. According to the National Library of Medicine site, the survey method was a research method that aimed to collect large amounts of data in the form of variables, units, or individuals at the same time. Besides, data were collected through certain individuals or physical samples to generalize what was studied. Meanwhile, cruising techniques apply an exploration, observation, experiment, and discussion approach[13]. Therefore, to collect the necessary data, the survey method with the cruising techniques has been carried out by exploring UNS area. Furthermore, team observed with recording; naming plant species, number, and plant coordinates; and documenting each species (**Figure 5**). Specific species identified were recorded based on the location and number. Additionally, secondary data was taken from International Union for Conservation of Nature (IUCN) and Plant of the World Online (POWO) to find out the conservation status and the origin of plants at UNS. The certainty of the scientific name was based on POWO. Subsequently, ecological index calculation was also obtained from the Shannon-Wiener Diversity Index (H'), Simpson Dominance Index (D), and Margalef Species Richness Index (E).

Ecological index calculation

From the species data, the number of species and individuals that have been obtained were then calculated using the H' for the diversity of fruit plant species, D to determine species richness as well the

balance of the number of individuals in each species, and E to determine the evenness of each species in community encountered in UNS, with the following explanation[14]:

Shannon-Wiener Diversity Index (H')

$$H' = \sum pi \times \ln pi$$

Where:

H' = Shannon-Wiener diversity index

Pi = number of individuals of the *i* species divided by the total number of individuals

According to Krebs (1989)[15], the higher the value of H ', the higher the value of diversity, with the total classification, namely low (H' <1.5), medium (1.5<H'<3.5), and high (H' >3.5) diversity.

Simpson Dominance Index (D)

$$D = \sum_1^s \frac{ni\ (ni-1)}{N\ (N-1)}$$

Where:

D = Simpson dominance index

ni = number of individuals of the *i* species

N = total number of individuals

According to Odum (1971)[16], D ranges from 0-1.0 if the smaller dominant index value shows the absence of species that dominates and vice versa. The D has three categories including: low (D <0.5), medium (0.5<D<0.75), and high (0.75<D<1.0) dominances.

Margalef Species Richness Index (E)

$$R = \frac{s-1}{\ln(N)}$$

Where:

R = Margalef richness index

S = total number of species

N = total number of individuals found

According to Magurran (1998)[17], the classification of determining the type of wealth for E, consisted low (R <3.5), medium (3.5<R<5), and high (R >5.0) richness.

Data analysis

The results of the biodiversity data of the fruit plants obtained will be analyzed descriptively with the tables, graphs and result of Ecological index calculation that have been made and the images obtained (**Figure 5**). According to Kim et al. (2017)[18], descriptive analysis aims to describe better or describe factually, accurately, and systematically facts, nature, or relationships between phenomena being studied.

Table 1. Ecological index calculation results of edible fruit plants at Ketingan Campus, UNS, Surakarta, Central Java, Indonesia

Index	Result	
	Value	Category
H"	3.17	Medium
D	0.077	Low
R	7.30	High

Results

Biodiversity

The biodiversity of fruit plants found on the Kentingan Campus UNS had 55 species that deliberately planted by campus residents (**Table 2**). Fifty five species found consisted of 25 families (**Figure 3**). Of the 55 species, most were *Musa x paradisiaca* L. (Musaceae) of 327 trees (**Figure 4**) found in 9 points. On the other hand, *Mangifera indica* L. (Anacardiaceae) is a species found in all locations with 237 trees. Fruit trees were mostly found on the Faculty of Agriculture, as many as 224 individuals (**Figure 4**) 36 species among them were fruit plants (**Table 2**).

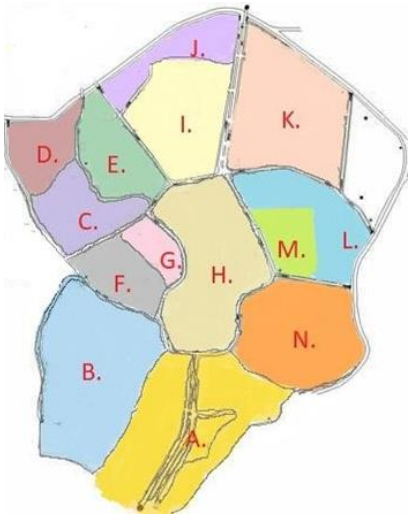

Figure 2. Map of the station located at Kentingan Campus of UNS, Surakarta, Central Java, Indonesia. Note: A. UNS INN-LPPM-SPMB-Menwa-LPPM, B. Faculty of Engineering, C. Faculty of Business Economics, D. Faculty of Social and Political Sciences, E. Faculty of Law, F. Faculty of Fine Art Design-UPTP2B, G. Faculty of Language Sciences, H. Rectorate-Auditorium-Integrated Library-Laboratory, I. Faculty of Teacher Training and Education-Pasca, J. Religion, K. Portsima-Gor-Stadium-Javanology, L. Faculty of Medicine, M. Faculty of Mathematics and Science Natural Knowledge, and N. Faculty of Agriculture

Moreover, most species come from Moraceae, Myrtaceae, and Sapindaceae (**Table 2**, **Figure 3**). The Moraceae consisted of *Artocarpus altilis* (Parkinson) Fosberg, *A. camansi* Blanco, *A. integer* (Thunb.) Merr., *Ficus retusa* L., and *Morus alba* L. (**Figure 5**). Like Moraceae, the Myrtaceae was also the most found consisting of 5 species, including *Syzygium malaccense* (L.) Merr. & L.M.Perry, *Psidium guajava* L., *S. aqueum* (Burm.fil.) Alston, *S. cumini* (L.) Skeels, and *S. polyanthum* (Wight) Walp (**Figure 5**). In addition, Sapindaceae was consisted of *Blighia sapida* K.D.Koenig, *Dimocarpus longan* L., *Nephelium lappaceum* L., *Pometia pinnata* J.R.Forst. & G.Forst., and *Schleichera oleosa* (Lour.) Oken. Meanwhile, the survey conducted at the Kentingan Campus also found a few families consisting of only one species, namely in the Apocynaceae, Burseraceae, Caricaceae, Cactaceae, Cucurbitaceae, Ebenaceae, Lauraceae, Muntingiaceae, Musaceae, Phyllanthaceae, Rubiaceae, and Vitaceae families (**Table 2**, **Figure 3**). Furthermore, 3 fruit plants were included in the Deficient Data (DD) and other 23 were categorized as Least Concern (LC) (**Table 2**). Also, found 3 Indonesian endemic fruit plants like *Durio zibethinus*[19], *Averrhoa bilimbi*[20], and *A. carambola*[21].

Ecological index

Based on the calculation of the H', the fruit plant diversity index on the Kentingan Campus obtained an index value of 3.17. Thus, the diversity of fruit plants was categorized as moderate[15]. This calculation is obtained from the total individual found multiplied by the difference in the species. Aside that, the species dominant index value (D) of the site was 0.077 which means it is in low category. Meanwhile, E calculation found a value of 7.30 meaning the species' wealth is relatively high (**Table 1**).

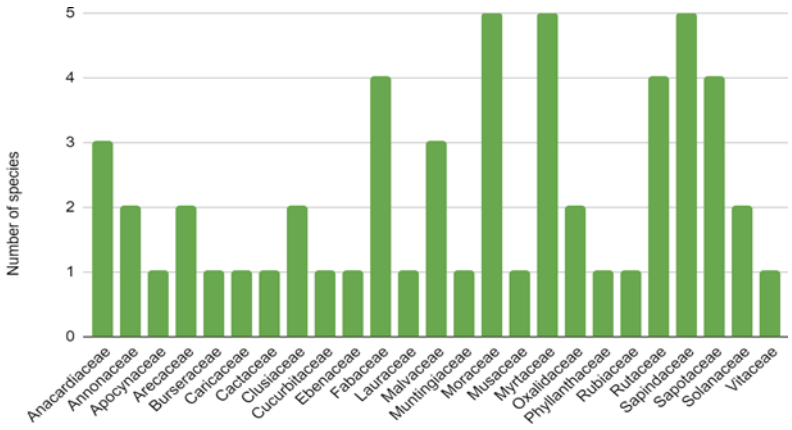

Figure 3. The large number of species in the family plant at the Kentingan Campus of UNS, Surakarta, Central Java, Indonesia

Discussion

The study results identified 55 species of fruit plants from 25 families in the field (**Table 2**, **Figure 3**). Moraceae, Myrtaceae, and Sapindaceae families had the highest number of species compared to others: each of 5 consisted a total of individuals of respective 20, 155, and 144 individuals (**Figure 4**). The Moraceae is the family of tropical forest plants[22]. Additionally, it is relatively large so it is easily found in tropical regions, consisting of 60 genera covering 1,400 species[23]. Fruit plants in the Moraceae found at the site include on **Figure 5R-5V** and **Table 2**. Family Moraceae has various benefits for human life, such as being food, fruit, medicinal sources, ornamental plants, rubber, animal feed, wood, silkworm feed, and rigging[24]. Myrtaceae is also classified as large family with most tropical region inhabitants[25]. Various members of them produce essential oils with medicinal properties; others are fruit trees. Myrtaceae is one of the world's leading commercial fruit tree families. It has a broad species of around 5,800 trees that can be eaten with excellent nutritional values and distributed around the tropical and subtropical regions. Therefore, this family has great health and economic potential[26]. The Myrtaceae fruit plants found at the study site could be seen on **Figure 5X-5AB** and **Table 2**. Then, the Sapindaceae was also found in many fruit plants with more than 1,000 species by extensive distribution in the tropical and warm subtropical regions and most species originated from Asia[27]. The Sapindaceae found at the study site include on **Figure 5AJ-5AN** and **Table 2**. This family is used by many fruits.

The diversity of fruit plants in Indonesia has also been proven in several locations, such as research conducted in the campus yard of the Universitas Kristen Indonesia (UKI) with fruit plants found, namely 16 species from 8 families. Starfruit plant (*A. carambola*), mango (*M. indica*), guava (*P. guajava*), and water guava (*S. aqueum*) were the most common fruit-producing plants found[28]. The diversity of fruit plants was also found at campus 2 of the Universitas Islam Negri (UIN), Walisongo,

Semarang, with 4 zones29. Fruit plants at that location include *M. x paradisiaca*, *Muntingia calabura* L., and *Physalis angulata* L., located in the 3rd zone[29]. That zone had the most fruit plant species compared to other zones because it was incessantly carried out the Green Campus action. Also, several new fruit plant seeds have been planted, such as *M. indica*, *D. zibethinus*, *P. pinnata*, *D. longan*, and *N. lappaceum*. In addition, other fruit plant diversity was found at the Universitas Bangka Belitung Campus. In that location, the frequent found fruit plant consisted *A. integer* (Moraceae). That plant dominated and was 76 observed at all points[30]. The *A. integer* was scattered with the highest amount because including plants that can grow well in the lowlands to a height of 1,000 meters above sea level. Furthermore, *A. integer* seeds can also be cooked and consumed besides using the fruit.

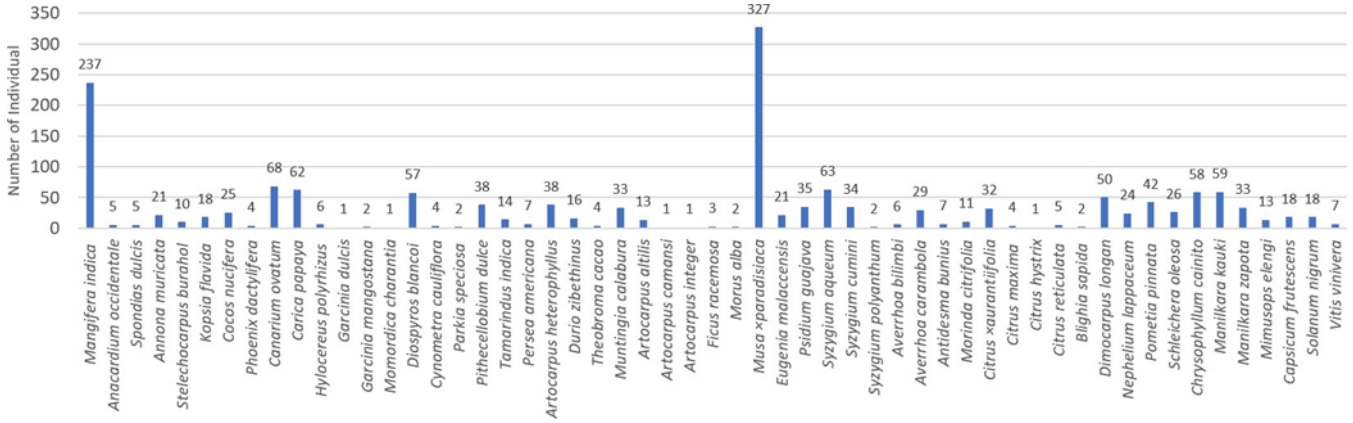

Figure 4. The large number of individuals per species at the Kentingan Campus of UNS, Surakarta, Central Java, Indonesia

Not only in Indonesia, was biodiversity of fruit plants also found at the University of Port Harcourt in Nigeria. There were 18 species from 14 families, with the most species being *M. indica* (Anacardiaceae) as many as 91 individuals[31]. The *M. indica* is an easily reproduced species and has become Nigeria's first fruit to be eaten as a dessert. Ugese et al. (2012)[32] emphasized that *M. indica* produced a sufficient amount of household income for farmers in Nigeria, causing planting to be spread with a large numbers. Then, at Imam Abdulrahman bin Faisal University, Saudi Arabia had a diversity of fruit plants that are most commonly found, namely *Carissa macrocarpa* (Eckl.) A.DC. (Apocynaceae) with a total of 102 individuals[33]. The *C. macrocarpa* is a plant that easily spreads in tropical and subtropical regions in Africa, Asia, and Australia and grows in various habitats worldwide, including Saudi Arabia[34].

Environmental factors, including human and biological characteristics of organisms influence fruit plant distribution and biodiversity growth. In the Kentingan Campus of UNS area, the average temperature ranges from 28-30°C with 75% humidity and an average height of 157 meter above sea level (masl)[35]. That makes the Kentingan Campus suitable for growing tropical fruit plants such as bananas, mangoes, sapodilla, guava, oranges, and matoa. From the whole research data, some species have the highest number, namely banana (*M. x paradisiaca*) with a total of 327 individuals. Bananas are folk plants that can grow in almost all types of agroecosystems so these plants occupy the first position of extensive term compared to other fruit plants[36]. Bananas can be consumed directly and processed into processed

foods such as fried bananas, chips, jams, and others. The other study was taken at the Institut Pertanian Bogor (IPB), Indonesia, which obtained *M. x paradisiaca* but did not species with the highest number[37].

Table 2. Species of edible fruit plants at Kentingan Campus, UNS, Surakarta, Central Java, Indonesia

Family	Name		Found at UNS		Conservation status	
	Scientific	Local	Individual	Station location	IUCN	POWO
Anacardiaceae	*Mangifera indica* L.	Mangga	237	A, B, C, D, E, F, G, H, I, J, K, L, M, N	DD	-
	Anacardium occidentale L.	Jambu mete	5	A, K, N	LC	-
	Spondias dulcis Sol. ex G.Forst.	Kedondo-ng	5	A, C, E	-	-
Annonaceae	*Annona muricata* L.	Sirsak	21	A, B, C, E, H, K, L, M	LC	-
	Stelechocarpus burahol (Blume) Hook.f. & Thomson	Kepel	10	A, E, H, K, M	-	-
Apocynaceae	*Kopsia flavida* Blume	Pronojiwo	18	A, E, N	-	-
Arecaceae	*Cocos nucifera* L.	Kelapa	25	H, J, N	-	-
	Phoenix dactylifera L.	Kurma	4	J	LC	-
Burseraceae	*Canarium ovatum* Engl.	Kenari	68	A, E, F, G, H, N	LC	-
Caricaceae	*Carica papaya* L.	Pepaya	62	A, B, D, E, H, I, J, L	DD	-
Cactaceae	*Hylocereus polyrhizus* (F.A.C.Weber) Britton & Rose	Buah naga	6	A, I, K, M	-	-
Clusiaceae	*Garcinia dulcis* (Roxb.) Kurz	Mundu	1	A	LC	-
	Garcinia mangostana L.	Manggis	2	A, H	-	-
Cucurbitaceae	*Momordica charantia* L.	Peria/pare	1	B	-	-
Ebenaceae	*Diospyros blancoi* A.DC.	Bisbul	57	A, B, C, D, F, H, I J, K, L, M, N	-	-
Fabaceae	*Cynometra cauliflora* L.	Namnam	4	A, F, K, M	-	-
	Parkia speciosa Hassk.	Petai	2	A, L	LC	-
	Pithecellobium dulce (Roxb.) Benth.	Asam londo	38	B, D, E, F, H, K, L, M, N	LC	-
	Tamarindus indica L.	Asam jawa	14	B, D, F, H, I, K, M, N	LC	-
Lauraceae	*Persea americana* Mill.	Alpukat	7	B, K, M	LC	-

Malvaceae	*Artocarpus heterophyllus* Lam.	Nangka	38	B, C, E, G, H, I, K, M, N	-	-
	Durio zibethinus Murray	Durian	16	A, B, C, D, E, H, I, J, M, N	-	NI
	Theobroma cacao L.	Kakao	4	M, N	-	-
Muntingiaceae	*Muntingia calabura* L.	Kersen	33	B, D, G, H, I, J, K, L, N	-	-
Moraceae	*Artocarpus altilis* (Parkinson) Fosberg	Sukun	13	B, J, L, M, N	-	-
	Artocarpus camansi Blanco	Kluwih	1	A	-	-
	Artocarpus integer (Thunb.) Merr.	Cempedak	1	A	-	-
	Ficus retusa L.	Iprik/preh	3	C, E, I	-	-
	Morus alba L.	Murbei	2	D	-	-
Musaceae	*Musa x paradisiaca* L.	Pisang	327	A, B, G, H, I, J, L, M, N	LC	-
Myrtaceae	*Syzygium malaccense* (L.) Merr. & L.M.Perry	Jambu dersono	21	A, E, K, L, M, N,	LC	-
	Psidium guajava L.	Jambu biji	35	A, B, C, G, H, I, K, M, N	LC	-
	Syzygium aqueum (Burm.fil.) Alston	Jambu air	63	A, B, C, D, E, G, H, I, J, M, N	-	-
	Syzygium cumini (L.) Skeels	Duwet	34	A, B, D, F, H, I, K, M, N	LC	-
	Syzygium polyanthum (Wight) Walp.	Salam	2	A, B	-	-
Oxalidaceae	*Averrhoa bilimbi* L.	Belimbing sayur/wu-luh	6	A, E, G, I, M	-	NI
	Averrhoa carambola L.	Belimbing	29	A, B, C, F, H, I, K, L, M, N	-	NI
Phyllanthaceae	*Antidesma bunius* (L.) Spreng.	Buni	7	E, K	LC	-
Rubiaceae	*Morinda citrifolia* L.	Mengkudu	11	A, F, I, K, N	-	-
Rutaceae	*Citrus ×aurantiifolia* (Christm.) Swingle	Jeruk nipis	32	A, B, C, E, G, H, I, J, K	-	-
	Citrus maxima (Burm.) Merr.	Jeruk bali	4	B, D	LC	-
	Citrus hystrix DC.	Jeruk purut	1	N	-	-

	Citrus reticulata Blanco	Jeruk keprok	5	B	-	-
Sapindaceae	*Blighia sapida* K.D.Koenig	Buah Ackee	2	N	LC	-
	Dimocarpus longan L.	Kelengke-ng	50	A, B, C, E, F, G, H, I, M, N	DD	-
	Nephelium lappaceum L.	Rambutan	24	A, B, H, I, K, M, N	LC	-
	Pometia pinnata J.R.Forst. & G.Forst.	Matoa	42	A, B, C, E, F, G, H, I, K, L, M, N	LC	-
	Schleichera oleosa (Lour.) Oken	Kesambi	26	A, G, H, K, M, N	LC	-
Sapotaceae	*Chrysophyllum cainito* L.	Kenitu/ sawo duren	58	A, B, C, D, E, G, H, I, J, K, L, N	LC	-
	Manilkara kauki (L.) Dubard	Sawo Kecik	59	A, B, C, E, G, H, I, K, N	-	-
	Manilkara zapota (L.) P.Royen	Sawo manila	33	A, B, F, H, I, J, K, L, M, N	LC	-
	Mimusops elengi L.	Tanjung	13	A, B, E, F, K, L, M, N	LC	-
Solanaceae	*Capsicum frutescens* L.	Cabai	18	A, B, C, I, K, N	LC	-
	Solanum nigrum L.	Leunca	18	A, B, C, D, F, I, J, N	-	-
Vitaceae	*Vitis vinivera* L.	Anggur	7	N	-	-

Note: A = UNS INN-LPPM-SPMB-Menwa-LPPM, B = Faculty of Engineering, C = Faculty of Business Economics, D = Faculty of Social and Political Sciences, E = Faculty of Law, F = Faculty of Fine Arts Design-UPTP2B, G = Faculty of Science Language, H = Rectorate-Auditorium-Integrated Libratorium, I = Faculty of Teacher Training and Education- Pasca, J = Religion, K = Portsima-Gor-Stadium-Javanology, L = Faculty of Medicine, M = Faculty of Mathematics and Natural Sciences, N = Faculty of Agriculture; LC = Least Concern, DD = Data Deficient, Ni = Native to Indonesia, IUCN = International Union for Conservation of Nature, POWO = Plants of the World Online

However, different results in the plant diversity at the UNG campus and Universitas Tadulako (Untad), which did not obtain *M. x paradisiaca* species[38,39]. In those locations, fruit plants at the site were dominated by *Cocos nucifera* L. with 34 individuals[39] for UNG and *Opuntia elatior* Mill. with 71 individuals[38] for Untad. *C. nucifera* is a plant widely found in humid tropical regions, such as Gorontalo, and has many benefits for human life[40]. Likewise, *O. elatior* can be consumed and act as medicinal plants because they have strong antioxidant and anti-inflammatory contents[41]. The study of fruit plant diversity research was also conducted in the Gayo Plateau, Aceh, and recorded 38 species of fruit plants belonging to 19 families and the most found was the *A. integer*[42]. Then, another Aceh Province in Aceh Tamiang

District, conducted research in 3 villages (Tenggulun, Selamat, and Simpang Kiri Villages) with a total result of 39 species of 17 families with Rutaceae as the most families[43].

The H' is a calculation used to determine the value of species diversity in an area. The calculation results using this index are in the form of a diversity level including low, high, and medium[44]. Based on this level, biodiversity at UNS was at point 3.19 which means moderate diversity or the environment is good for plant to grow[15]. The value of moderate diversity refers to calculating the relative abundance of species at a value of 1.5-3.5. In research on the diversity of plant species in the area of high conservation value of oil palm plantations in Riau Province, the results obtained were the number of plant species in the three companies showed 3.773 point[45]. Moreover, the calculation of the H' was also used in research conducted by Chang et al. (2022)[46] in Changchun, China.

The D is a calculation of biodiversity measuring the centralized community's diversity of specific biodiversity in an area. This study shows the results the index value of 0.077 or low in category. As a result, no specific species dominates the community, as indicated by the dominance index being largely near to the value 0[47]. This was contrast to the research by Rozak et al. (2020)[48], which appeared close to one, meaning that there was a dominant species that used the D calculation in one of the three indexes to compare and predicted the correlation among the three types of the index. Instance, calculating the D on trees showed a value of 0.91 in submontane, 0.92 in montane, and 0.84 in subalpine.


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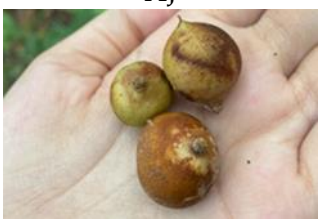
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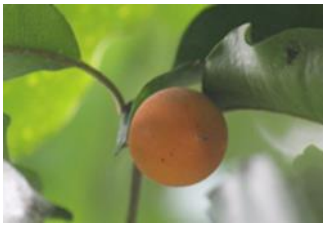
AR

AS

Figure 5. Some of edible fruits were documented during data collection at Kenting Campus, UNS, Surakarta, Central Java, Indonesia. Note: A = *Mangifera indica*, B = *Anacardium occidentale*, C = *Spondias dulcis*, D = *Annona muricata*, E = *Stelechocarpus burahol*, F = *Kopsia flavida*, G = *Cocos nucifera*, H = *Carica papaya*, I = *Garcinia dulcis*, J = *Diospyros blancoi*, K = *Cynometra cauliflora*, L = *Parkia speciosa*, M = *Pithecellobium dulce*, N = *Tamarindus indica*, O = *Artocarpus heterophyllus*, P = *Theobroma cacao*, Q = *Muntingia calabura*, R = *Artocarpus altilis*, S = *Artocarpus camansi*, T = *Artocarpus integer*, U = *Ficus retusa*, V = *Morus alba*, W = *Musa x paradisiaca*, X = *Syzygium malaccense*, Y = *Psidium guajava*, Z = *Syzygium aqueum*, AA = *Syzygium cumini*, AB = *Syzygium polyanthum*, AC = *Averrhoa bilimbi* , AD = *Averrhoa carambola*, AE = *Antidesma bunius*, AF = *Morinda citrifolia*, AG = *Citrus* × *aurantiifolia*, AH = *Citrus maxima*, AI = *Citrus reticulata*, AJ = *Blighia sapida*, AK = *Dimocarpus longan*, AL = *Nephelium lappaceum*, AM = *Pometia pinnata*, AN = *Schleichera oleosa*, AO = *Manilkara kauki*, AP = *Manilkara zapota*, AQ = *Mimusops elengi*, AR = *Capsicum frutescens*, AS = *Solanum nigrum*

The R is a calculation in finding the wealth of a species in an area. This study demonstrated the on the Kentingan Campus obtained 7.30, meaning the species wealth is relatively high. This condition illustrated that the campus environment had a high species of fruit trees. The high R indicates the species high diversity and showed that the environment suitable for plant that location[49]. The same research was also conducted by Rahayu et al. (2017)[50], results R index in 3.20 for the community, whereas the ecosystem level was 2.10-2.33. Thus, this study included the overall R in the Rambut Island Wildlife Research was in the medium category.

The conservation status category in IUCN Red List is used by the IUCN, the Red List of Threatened to classify various species that are threatened with extinction[51]. In accordance with data on threatened fruit plants and conservation status from IUCN, Kentingan Campus of UNS showed that some fruit plants have LC and DD conservation status (**Table 2**). The status LC code or has a low risk unveiled the plant species have been evaluated but do not meet critical criteria[52]. There were fruit plants with LC status as many as 23 species that were the exceptionally fruit trees found on Kentingan Campus and come from the Sapindaceae. Besides that, the status of DD fruit plants on the Kentingan with three species of family like *M. indica*, *C. papaya*, and *D. longan* (**Table 2**). However, from the results of identification and IUCN website, there were also 29 species of fruit plants not included in the IUCN Red List list.

Per data from the POWO, several fruit plants on the Kentingan Campus are native to Indonesia including *D. zibethinus*, *A. bilimbi*, and *A. carambola*. According to Samantha et al. (2020)[53], original plants can be defined as plants that grow and develop naturally in the original conditions of these plants. Plant *D. zibethinus* is a native species of Borneo and Sumatra, Indonesia, suitable for growing in the tropical climate. The *D. zibethinus* is found in Southeast Asia which has a humid and shady environment for its growth[54]. Therefore, the Kentingan Campus of UNS area is very suitable for overgrown *D. zibethinus*.

Durian is a fruit plant that is beneficial for health because it contains many antioxidants and bioactive compounds[55]. Moreover, regarding Damayanti et al. (2020)[56], *A. bilimbi* and *A. carambola* are from the Oxalidaceae family, indigenous plants from Indonesia (**Figure 5AC**, **5AD**). Rahardhian et al. (2019)[57] also argue that *A. bilimbi* also original from Indonesia. This plant is rich in vitamin C. This plant suits the tropical climate can grow throughout Indonesia and many are cultivated in Southeast Asia and various other tropical countries. Therefore, *A. bilimbi* and *A. carambola* can grow well and spread with a large amount in the UNS campus area because it is under their habitat. In addition to these three species, 52 are non- original from Indonesia. These fruit plants can grow well in Indonesia because of the structure of environmental conditions are suitable due to tropical climate so they are easily to be planted, grow, and adapt[58–60].

The existence of fruit plants increases biodiversity at Kentingan Campus of UNS. In addition to being a source of food, it can be a supplier of oxygen and carbon absorbers. Flower and fruit plants can do higher photosynthesis activities to exchange carbon into oxygen faster and more effective. They found are in various regions, ranging from the park around the building, near the official buildings, and the parking lot. Besides, the fruit plants found and identified by the majority are woody that have the potential to filtering polluted substances in the soil and the air. Also, many areas are free of buildings embedded in much vegetation that makes the high water catchment area. Furthermore, the high vegetation cover can affect the microclimate of the campus which causes the temperature to be cooler and the high humidity level because plants can reflect sunlight.

Conclusions

In conclusion, 55 species of fruit plants from 25 families are found on the Kentingan Campus of UNS. The results of the H', D, and R calculations were in the medium, low, and high categories, which were 3.17, 0.077, and 7.30, as well. The Moraceae, Myrtaceae, and Sapindaceae families had the highest number of species compared to others, each of 5 species with a total in each family, 20, 155, and 144 individuals. Meanwhile, the species with the highest number is *M. x paradisiaca* (Musaceae) with 327 members. Aside, *M. indica* (Anacardiaceae) became a species found in all locations with 237 individuals. According to IUCN, 22 species had LC status and the other 2 had DD status. Besides, three fruit plants were native to Indonesia (*D. zibethinus*, *A. bilimbi*, and *A. carambola*) based on the POWO. These plants can grow well and spread in numerous numbers in the Kentingan Campus of UNS area due to their their suitable habitat.

Acknowledgments

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Conflicts of Interest

The authors declare no conflict of interest.

References

1. Naem S, Duffy J, Zavaleta E. The functions of biological diversity in an age of extinction. *Sci*. 2012;336(6087):1401-1406. doi:10.1126/science.1215855

2. Rao V. Ecosystem functions, services, and biodiversity: past, present, and future implications—I. *Asian Agrihist*. 2018;22(3):187-196.
3. Magris R, Costa M, Ferreira C, et al. A blueprint for securing Brazil's marine biodiversity and supporting the achievement of global conservation goals. *Divers Distrib*. 2021;27(2):198-215. doi:10.1111/DDI.13183
4. Goldschmidt E. The evolution of fruit tree productivity: a review. *Econ Bot*. 2013;67(1):51-62. doi:10.1007/S12231-012-9219-Y/TABLES/1
5. Simkin R, Seto K, McDonald R, et al. Biodiversity impacts and conservation implications of urban land expansion projected to 2050. *Proc Natl Acad Sci U S A*. 2022;119(12):e2117297119. doi:10.1073/PNAS.2117297119/SUPPL_FILE/PNAS.2117297119.SD02.XLSX
6. Yalcin G. Urban activities in the view of the sustainable development. *Procedia Technol*. 2014;12:566-571. doi:10.1016/J.PROTCY.2013.12.530
7. Zainordin N, Zahra D. Factors contributing to carbon emission in construction activity. *Adv Eng Res*. 2020;200:176-182. doi:10.2991/AER.K.201229.025
8. Muhtianda I, Lailasari M, Astuti A, et al. Preliminary survey of herpetofauna in Universitas Sebelas Maret area. *Konserv Hayati*. 2022;18(2):80-87. doi:10.33369/HAYATI.V18I2.24030
9. Pujiati A, Bowo A, Nadya R, et al. Strategy to actualize green campuses through sustainable transportation. *Econ Dev Anal J*. 2021;10(2):143-152. doi:10.15294/EDAJ.V10I2.43974
10. Sharma R, Pradhan L, Kumari M, Bhattacharya P. Assessment of carbon sequestration potential of tree species in Amity University Campus Noida. *Environ Sci Proc*. 2021;3(1):52. doi:10.3390/IECF2020-08075
11. Suwardi A, Navia Z, Harmawan T, et al. Ethnobotany and conservation of indigenous edible fruit plants in South Aceh, Indonesia. *Biodiversitas*. 2020;21(5):1850-1860. doi:10.13057/BIODIV/D210511
12. Kazemi F, Abolhassani L, Rahmati E, et al. Strategic planning for cultivation of fruit trees and shrubs in urban landscapes using the SWOT method: a case study for the city of Mashhad, Iran. *Land use policy*. 2018;70:1-9. doi:10.1016/J.LANDUSEPOL.2017.10.006
13. Patel M, Patel N. Exploring research methodology: review article. *Int J Res Rev*. 2019;6(3):48-55.
14. Irwansyah R, Azzahra S, Darmastuti S, et al. Crab diversity and crab potential as support ecotourism in Teleng Ria, Grindulu and Siwil Beaches, Pacitan, East Java, Indonesia. *Int J Bonorowo Wetl*. 2021;11(2):75-83. doi:10.13057/BONOROWO/W110204
15. KREBS C. *Ecology: The Experimental Analysis of Distribution and Abundanceo Title*. 5th ed. Benjamin Cummings; 2001.
16. Odum E, Barrett G. *Fundamental of Ecology*. 3rd ed. WB Saunders Co; 1993.
17. Magurran A. *Ecological Diversity and Its Measurement*. Springer Dordrecht; 1988. doi:10.1007/978-94-015-7358-0
18. Kim H, Sefcik J, Bradway C. Characteristics of qualitative descriptive studies: a systematic review. *Res Nurs Heal*. 2017;40(1):23-42. doi:10.1002/NUR.21768
19. Mursyidin D, Daryono B. Genetic diversity of local durian (*Durio zibethinus* Murr.) cultivars of South Kalimantan's province based on RAPD markers. *AIP Conf Proc*. 2016;1755(1):040008. doi:10.1063/1.4958483/822596
20. Ismail S, Marliana E, Kosala K. Aktivitas vasodilatasi jus buah belimbing wuluh (*Averrhoa bilimbi*) pada organ terpisah aorta tikus. In: *Seminar Nasional Biodiversitas*. Masyarakat Biodiversitas Indonesia; 2018.
21. Ramadan N, Wessjohann L, Mocan A, et al. Nutrient and sensory metabolites profiling of *Averrhoa carambola* L. (Starfruit) in the context of its origin and ripening stage by GC/MS and chemometric analysis. *Molecules*. 2020;25(10):2423. doi:10.3390/MOLECULES25102423
22. Somanshekar M, Nayeem N, Sonnad B. A review on Family Moraceae (mulberry) with a focus on *Artocarpus* species. *World J Pharm Pharm Sci*. 2013;2(5):2614-2626.

23. Wang H, Xu X, Cheng X, Al E. Spatial patterns and determinants of Moraceae richness in China. *J Plant Ecol*. 2022;15(6):1142-1153. doi:10.1093/JPE/RTAC025
24. Samsudin S. *Ex situ* conservation of the Moraceae Family in the Bogor Botanical Gardens, West Java. In: *Prosiding Seminar Nasional Masyarakat Biodiversitas Indonesia*. Vol 6. Masyarakat Biodiversitas Indonesia; 2019. doi:10.13057/PSNMBI/M060109
25. Hardstaff L, Sommerville K, Funnekotter B, et al. Myrtaceae in Australia: use of cryobiotechnologies for the conservation of a significant plant family under threat. *Plants*. 2022;11(8):1017. doi:10.3390/plants11081017
26. De Paulo D, Neri-Numa I, de Araújo F, et al. A critical review of some fruit trees from the Myrtaceae family as promising sources for food applications with functional claims. *Food Chem*. 2020;306:125630. doi:10.1016/J.FOODCHEM.2019.125630
27. Buerki S, Callmander M, Acevedo-Rodriguez P, et al. An updated infra-familial classification of Sapindaceae based on targeted enrichment data. *Am J Bot*. 2021;108(7):1234-1251. doi:10.1002/AJB2.1693
28. Silalahi M. Keanekaragaman dan distribusi tumbuhan bermanfaat di pekarangan Kampus Universitas Kristen Indonesia (Uki) Cawang, Jakarta Timur. *J Biol*. 2016;20(2):75-82.
29. Surur M, A'tourrohman B, Purnamaningrum A. Hubungan Keanekaragaman jenis burung dan komposisi pohon di Kampus 2 UIN Walisongo Semarang. *Jambura Edu Biosf J*. 2020;2(2):57-64. doi:10.34312/jebj.v2i2.6895
30. Saputra A, Hidayati A, Mardiastuti A. Keanekaragaman burung pemakan buah di Hutan Kampus Universitas Bangka Belitung. *Ekotonia J Penelit Biol Bot Zool dan Mikrobiol*. 2020;5(1):1-8. doi:10.33019/EKOTONIA.V5I1.1943
31. L L, Oladele A. Edible fruit trees diversity in a peri-urban centre: implications for food security and urban greening. *J Environ Ecol*. 2014;5(2):234. doi:10.5296/jee.v5i2.6847
32. Ugese F, Iyango P, Swem T. Mango (*Mangifera indica* L.) fruit production and production constraints in Gboko Local Government Area of Benue State. *Prod Agric Technol J*. 2012;8(1):164-174.
33. Al-Sulbi A, Alghanem A. Synchronous management of public green spaces: the case of Imam Abdulrahman bin Faisal University's eastern campus – Dammam, Saudi Arabia. *Ain Shams Eng J*. 2022;13(3):101605. doi:10.1016/J.ASEJ.2021.09.030
34. Khalil H, Mohamed M, Morsy M, et al. Flavonoid and phenolic compounds from *Carissa macrocarpa*: molecular docking and cytotoxicity studies. *Pharmacogn Mag*. 2018;14(57):S304-S310. doi:10.4103/pm.pm_104_18
35. Nisa K, Roziaty E. *Ekologi Pohon Angsana di Kawasan Kampus Universitas Sebelas Maret (UNS) Surakarta*. Universitas Muhammadiyah Surakarta; 2018.
36. Rahman H, Akter A. Evaluation and morphological diversity study of plantain (*Musa paradisiaca* L.) genotypes at Jamalpur Region of Bangladesh. *Search Rev J Crop Sci Technol*. 2019;8(1):133-23. doi:10.13140/RG.2.2.10416.58885
37. Arief H. Keanekaragaman hayati Kampus IPB Baranangsiang. *Media Konserv*. 2014;19(3):141-145.
38. Anaputra D, Miswan, Pitopang R. Komposisi jenis tumbuhan herba di areal Kampus Universitas Tadulako Palu. *Biocelebes*. 2015;9(2):1978-6417.
39. Mokodompit R, Kandowangko N, Hamidun M. Keanekaragaman tumbuhan di Kampus Universitas Negeri Gorontalo Kecamatan Tilong Kabila Kabupaten Bone Bolango. *Biosf J Biol dan Pendidik Biol*. 2022;7(1):75-80. doi:10.23969/BIOSFER.V7I1.5651
40. Sudha R, Rajesh M, Niral V, et al. Analysis of genetic diversity and population structure in worldwide coconut germplasm (*Cocos nucifera* L.) using microsatellite markers. *Sci Hortic*. 2023;309:111681. doi:10.1016/J.SCIENTA.2022.111681
41. Sutariya B, Saraf M. Betanin, isolated from fruits of *Opuntia elatior* Mill attenuates renal fibrosis in

diabetic rats through regulating oxidative stress and TGF-β pathway. *J Ethnopharmacol*. 2017;198:432-443. doi:10.1016/J.JEP.2016.12.048

42. Navia Z, Suwardi A, Harmawan T, Al E. The diversity and contribution of indigenous edible fruit plants to the rural community in the Gayo Highlands, Indonesia. *J Agric Rural Dev Trop Subtrop*. 2020;121(1):89-98. doi:10.17170/KOBRA-202004061145
43. Elfrida, Mubarak A, Suwardi A. Short communication: the fruit plant species diversity in the home gardens and their contribution to the livelihood of communities in rural area. *Biodiversitas*. 2020;21(8):3670-3675. doi:10.13057/BIODIV/D210833
44. Omaiyo D, Mzungu E. Modification of Shannon-Wiener Diversity Index towards quantitative estimation of environmental wellness and biodiversity levels under a non-comparative scenario. *J Environ Earth Sci*. 2019;9(9):46-57. doi:10.7176/JEES/9-9-06
45. Nahlunnisa H, Zuhud E, Santosa Y. Keanekaragaman spesies tumbuhan di arealnilai Konservasi Tinggi (Nkt) Perkebunan Kelapa Sawit Provinsi Riau. *Media Konserv*. 2016;21(1):91-98. doi:10.29244/MEDKON.21.1.91-98
46. Chang Y, Wang Z, Zhang D, et al. Analysis of urban woody plant diversity among different administrative districts and the enhancement strategy in Changchun City, China. *Sustainability*. 2022;14(13):7624. doi:10.3390/SU14137624
47. Odum E, Barrett G. *Fundamental of Ecology*. Thomson Brooks Cole Publishing Co; 2005.
48. Rozak A, Astutik S, Mutaqien Z, et al. Efektivitas penggunaan tiga indeks keanekaragaman pohon dalam analisis komunitas hutan: studi kasus di Taman Nasional Gunung Gede Pangrango, Indonesia. *J Penelit Hutan dan Konserv Alam*. 2020;17(1):35-47. doi:10.20886/JPHKA.2020.17.1.35-47
49. Hillebrand H, Blasius B, Borer E, et al. Biodiversity change is uncoupled from species richness trends: consequences for conservation and monitoring. *J Appl Ecol*. 2018;55(1):169-184. doi:10.1111/1365-2664.12959
50. Rahayu N, Hikmat A, Tjitrosoedirjo S. Characteristics of climbing plants community in Rambut Island Wildlife Reserve. *Media Konserv*. 2017;22(1):1-10. doi:10.29244/MEDKON.22.1.1-10
51. Conand C, Polidoro B, Mercier A, et al. The IUCN red list assessment of aspidochirotid sea cucumbers and its implications. *SPC Beche-de-mer Inf Bull*. 2014;34:3-7.
52. Mertens A, Swennen R, Rønsted N, et al. Conservation status assessment of banana crop wild relatives using species distribution modelling. *Divers Distrib*. 2021;27(4):729-746. doi:10.1111/DDI.13233
53. Samantha R, Nurhayati, Syartinilia. Preservation of nutmeg tree (*Myristica fragrans* Houtt) used as Bogor's local culinary ingredient for the strengtheness of urban landscape identity. *IOP Conf Ser Earth Env Sci*. 2020;556(1):012013. doi:10.1088/1755-1315/556/1/012013
54. Rahmawaty, Situmorang L, Rauf A, et al. GIS based: mapping of multy purpose tree species (*Durio zibethinus*) in Perkebunan Tambunan Village, Langkat District, North Sumatera Province, Indonesia. *IOP Conf Ser Earth Env Sci*. 2020;454(1):012147. doi:10.1088/1755- 1315/454/1/012147
55. Yee, SYY. Medicinal properties of bioactive compounds and antioxidant activity in *Durio zibethinus*. *Malaysian J Sustain Agric*. 2021;5(2):82-89. doi:10.26480/mjsa.02.2021.82.89
56. Damayanti F, Astuti I, Zulkarnaen R, et al. Nutritional contents and the utilization of Indonesian native starfruits: *Averrhoa dolicocarpa* and *A. leucopetala*. *Biodiversitas*. 2020;21(4):1303-1309. doi:10.13057/BIODIV/D210405
57. Rahardhian M, Suharsanti R, Sugihartini N, et al. *In vitro* assessment of total phenolic, total flavonoid and sunscreen activities of crude ethanolic extract of belimbing wuluh (*Averrhoa bilimbi*) fruits and leaves. *J Glob Pharma Technol*. 2019;11(4):308-313.
58. Nasution A, Wibowo E, Ramdani R, et al. Urgensity of environmental management system implementation on oil palm plantation management policies in North Sumatera. *J Soc Transform Reg Dev*. 2021;3(1):1-6. doi:10.30880/jstard.2021.03.01.001

59. Valentino F, Cenggoro T, Pardamean B. A design of deep learning experimentation for fruit freshness detection. *IOP Conf Ser Earth Env Sci*. 2021;794(1):012110. doi:10.1088/1755-1315/794/1/012110
60. Uda S, Hein L, Adventa A. Towards better use of Indonesian peatlands with paludiculture and low-drainage food crops. *Wetl Ecol Manag*. 2020;28(3):509-526. doi:10.1007/S11273-020-09728-X/FIGURES/3