Diversity of fig trees in a tropical urban residential area of Sentul City, Bogor, West Java

Y A Mulyani¹, M D Kusrini¹ and A Mardiastuti¹

¹Department of Forest Resources Conservation and Ecotourism, Faculty of Forestry and Environment, IPB University, Bogor, Indonesia

E-mail: yenimulyani@apps.ipb.ac.id

Abstract. Fig (Ficus spp.) trees have been known as keystone species in the tropics and provide food sources for various species. The study aimed to reveal the diversity of fig trees in a tropical urban residential area of Sentul City, Bogor, West Java, as a part of a bigger study on the wildlife-fig relationship. A purposively selected sample (270 ha of housing, boulevard) and all Ficus were censused. Data on species diversity, height, diameter, and fruiting stage were taken. There were 389 Ficus trees, belonging to 10 species, namely F. benjamina, F. hinnendyki, F. caulocarpa, F. elastica, F. kurzii, F. lyrata, F. macellandii, F. macrocarpa, F. septica, and F. variegata, of which two species (F. lyrata and F. macellandii) were non-native species. Ficus were planted as a border, roadsides, shading trees, or ornament. Based on the number of individuals, the most common species was F. benjamina (63.75%), followed by F. kurzii (14.4%) and F. lyrata (9.5%). As the F. benjamina can grow big, only about half (56.4%) were in full tree condition, while the rest were pruned (15.5%), trimmed (14.7%), or cut off (13.4%). This study showed that the diversity of fig trees in residential areas of Sentul City, Bogor is affected by the area's management.

1. Introduction

Figs (Ficus spp.) belong to the family Moraceae. They are mainly tropical species that are distributed in lowland areas, especially in Asia [1], and occur in different life forms, from trees, shrubs, climbers, hanging roots, hemi-epiphytes (strangler), and holo-epiphytes [2]. Unlike many other fruit bearing trees in the forest that have seasonal fruiting, figs produce fruits at different times of the year (asynchronous fruiting); therefore, they can provide food for wildlife all year long [3, 4] and reserve food supply during periods of general food scarcity. Therefore, figs serve as keystone species that provide food for various animal species thus play an important role in the tropical forest ecosystem.

There are 876 accepted species of figs (http://www.plantsoftheworldonline.org), 252 species of which can be found in a variety of habitats in Indonesia, including in disturbed habitats [5], while [6] reported that there are around 350 species of figs in Indonesia. Based on the life form, it is identified that most figs in Indonesia grow as a tree, shrubs, and hanging roots [5]. Several species of figs was identified in more than one life form, such as F. armitii that was found as treelet and/or epiphyte, and F. gracillima was found as shrub or tree [1, 5].

Figs, especially stranglers, can adapt well in the cities and urban areas [7]. Fig trees have cultural values in some communities, and it is commonly planted for symbolic reasons or ornamental purposes. In Bali, fig trees in urban areas provide ritual and socio-cultural values [8]. Many species of figs can be
used for various purposes, from food and traditional medicine to simple tools [9], for example, the fruit of *Ficus carica* that is popular as food.

Many studies have revealed the importance of figs for wildlife [10, 11, 12], but only a few examined the role of fig trees in urban areas [13, 14, 15]. The study aimed to reveal the diversity of fig trees in a tropical urban residential area of Sentul City, Bogor, West Java, as a part of a bigger study on the wildlife-fig relationship. Information obtained from this study would benefit the Sentul City management to promote green urban development as stated in their advertisement.

2. Methods

2.1. Study site

Sentul City is a satellite township, with a big complex of residential areas located in the outskirt of the city of Bogor (about 5 km to the north of Bogor) (figure 1) in coordinate 06°33’55”- 06°37’45”S, 106°50’20”- 106°57’10” E, and at an altitude of 300–600 m above sea level. It covers an area of 3,001.4 ha [16]. Sentul City has a high rainfall of 3,271.7 mm/year with low permeability soil [17]. The most recent data available for the number of rainy days was 2019, which showed the wet season was from December to April, with the highest rainfall in December (670 mm) and February (568 mm) [18]. Sentul City has a vast green area, about 65% of its total area. Currently, Sentul City consists of 13 housing complexes and will be more in the future, as the developer is still planning to build more housing.

![Map of the study area](image)

**Figure 1.** Map of the study area.

This study is a part of a larger study on the use of figs by wildlife in urban and non-urban habitats. To compare with the other area, only a small part of the Sentul City (of the total ± 3000 Ha) was selected as the study site to make a more or less similar coverage of the study sites. The area purposively selected is three residential clusters and a boulevard that connects the residential clusters, totaling 270 ha. The residential clusters were Victoria, Mediterania 1, and Bukit Golf Hijau. Only a small part was selected as the study area for Mediterania 1 and Bukit Golf Hijau (figure 1). As for Victoria, the entire area of
Victoria Cluster is censused for its fig trees. Based on Landsat image analysis, the size of the Victoria Cluster is 19.6 ha. The boulevard included within the study area was named MH Thamrin Boulevard. Only about 2 km (from the total of 6.2 km) of the MH Thamrin Boulevard lay within the study areas.

2.2. Fig diversity and general features of fig trees
Surveys were conducted from late July to early September 2020 in Sentul City residential complex. Species identification was made with the help of a fig tree identifier (local para-taxonomist). Unidentified samples were taken and brought to the Herbarium of Faculty of Forestry IPB University to be identified. The origin of the trees was assessed based on the research on Ficus diversity and distribution in Indonesia [5].

All fig trees within the selected study area were censused and measured. The daily maintenance of the Sentul City landscape was conducted by a management company (PT Sukaputra Graha Cemerlang). Considering the level of maintenance by the management company, fig tree condition was grouped into four categories: full tree (naturally grown, no maintenance), pruned (overgrown cutting), trimmed (removing unwanted parts, mainly for decorative purposes), and cut-off (cutting some parts of the main trunk).

Tree measurements taken were tree height, the height of branchless trunk (clear bole), and diameter at breast height (dbh). Each stem larger than 10 cm in diameter was treated as an individual stem, although the stems were actually parts of one big tree. Trees with compact aerial roots were considered and measured as one stem. Tree measurement was only done on the tree and pole growth stage. Fruiting status was recorded as well and categorized as no fruit (none), early fruiting, full fruiting, and late fruiting.

2.3. Data analysis
Data were analyzed descriptively. A list of species found was made, and the proportion of each species was calculated to obtain the percentage of each species and types of maintenance. Average values of three measurements were calculated to describe the condition of fig trees in the study site.

3. Results
Ten species of Ficus were observed in Sentul City (table 1, figure 2), almost all were purposively planted by the Sentul City Developer/Management. Fig trees were mostly big trees, except for Ficus septica, found in seedling and sapling stages. Of the 10 fig trees found, species two were non-native species to Indonesia, namely F. lyrata and F. macellandii. These non-native species were specifically planted for certain purposes, for example, F. lyrata that have been planted along the boulevard for shading and ornamental purposes. Native species are categorized as those distributed in Indonesia, and non-native species are distributed abroad and introduced to Indonesia. The information on the distribution followed Plants of The World Online (http://www.plantsoftheworldonline.org), while distribution in Indonesia followed [1]. There is no record of the history of Ficus in Sentul City, but the planted trees were probably started in 1998, not long after the starting of the development in 1994.
**Table 1.** Fig tree species found in the study site, listed in alphabetical order.

| No | Species | Habitus | Common Name | Native/Non-native | Natural Distribution |
|----|---------|---------|-------------|------------------|----------------------|
| 1  | *Ficus benjamina* L. | Tree    | Weeping fig, benjamin fig, ficus tree | Native | Tropical and Subtropical Asia, N. Australia [1] |
|    |         |         |             |                  | Peninsular Thailand, W. Malaysia, Sumatra, Java, Borneo[1] |
|    | *Ficus binnendykyii* (Miq.) Miq. | Tree | 'Alii' long leaved fig | Native | Borneo[1] |
|    |         |         |             |                  | Sumatra, Java, Lesser Sunda Islands, Borneo |
| 2  | *Ficus caulocarpa* (Miq.) Miq. | Tree | Stem-fruit fig | Native | Nepal to China, N. India to Myanmar, W. Malaysia, Sumatra, Java [1] |
| 3  | *Ficus elastica* Roxb. ex Hornem. | Tree | Rubber fig, Indian rubber bush | Native | China (Yunnan) to W. & W. Central Tropical Africa* |
| 4  | *Ficus kurzii* King | Tree | Burmese banyan fig, Fiddle-leaf fig, banjo fig | Native | Assam to China (Yunnan) and Peninsula Malaysia (Kedah)* |
| 5  | *Ficus lyrata* Warb. | Tree | Burmese banyan fig, Fiddle-leaf fig, banjo fig | Non-native | Tropical & Subtropical Asia to the Caroline Islands, Tropical & Subtropical Asia to Caroline Islands*, Sumatra, Lesser Sunda Islands Borneo, Sulawesi, Sangihe and Talaud Islands, Moluccas, New Guinea [1]. Nansei-shoto to Malesia and Vanuatu, including Indonesia [1]. E. India to S. China and N. |
| 6  | *Ficus maclellandii* King | Tree | Alii fig, banana-leaf fig | Non-Native | Tropical & Subtropical Asia to the Caroline Islands, Tropical & Subtropical Asia to Caroline Islands*, Sumatra, Lesser Sunda Islands Borneo, Sulawesi, Sangihe and Talaud Islands, Moluccas, New Guinea [1]. Nansei-shoto to Malesia and Vanuatu, including Indonesia [1]. E. India to S. China and N. |
| 7  | *Ficus microcarpa* L.f. | Tree | Chinese/Malayan banyan, Indian laurel, curtain fig | Native | Tropical & Subtropical Asia to the Caroline Islands, Tropical & Subtropical Asia to Caroline Islands*, Sumatra, Lesser Sunda Islands Borneo, Sulawesi, Sangihe and Talaud Islands, Moluccas, New Guinea [1]. Nansei-shoto to Malesia and Vanuatu, including Indonesia [1]. E. India to S. China and N. |
| 8  | *Ficus septica* Burm.f. | Shrub | White-veined fig | Native | Queensland*, All Malesia region [1] |
| 9  | *Ficus variegata* Blume | Tree | Common red stem fig, green fruited fig, variegated fig | Native | Tropical & Subtropical Asia to the Caroline Islands, Tropical & Subtropical Asia to Caroline Islands*, Sumatra, Lesser Sunda Islands Borneo, Sulawesi, Sangihe and Talaud Islands, Moluccas, New Guinea [1]. Nansei-shoto to Malesia and Vanuatu, including Indonesia [1]. E. India to S. China and N. |

*Source ([http://www.plantsoftheworldonline.org](http://www.plantsoftheworldonline.org))
Figure 2. *Ficus* species were found in the study area. (A) *F. benjamina*, (B) *F. binnendyki*, (C) *F. caulocarpa*, (D) *F. elastica*, (E) *F. kurzii*, (F) *F. lyrata*, (G) *F. maclellandii*, (H) *F. microcarpa*, (I) *F. septica*, (J) *F. variegata*. 
The total number of trees was 389 individuals, clearly dominated by *F. benjamina* (63.75% (table 2). Another common species were *F. kurzii* (14.40%). *Ficus lyrata* is the non-native species that was relatively more common than other species (9.51%), although the other non-native species, *F. maclellandii*, only constituted a very small percentage (0.77%). Some fig trees, including *F. benjamina*, *F. microcarpa*, and *F. binnendykii*, were regularly maintained by pruning, trimming, or cutting-off. Maintenance of the fig trees mostly happened on trees within housing clusters. According to the management of Sentul, interviews with some house owners in Victoria Cluster revealed that they preferred mid-size of *F. benjamina* along the road-sides, and thus big trees might be pruned, trimmed, or cut-off, either by the management company or by the house owners. In addition, *F. benjamina* also has been linked to some superstitious belief that this species may house some unwanted spirit. *F. benjamina* seemed to be very tolerant to tree maintenance (i.e., pruning, trimming, or cutting-off).

### Table 2. *Ficus* species based on maintenance stage in the study site.

| No | Species                  | Full Tree | Pruned | Trimmed | Cut-Off | Total | Percentage (%) |
|----|--------------------------|-----------|--------|---------|---------|-------|----------------|
| 1  | *Ficus benjamina* L.     | 147       | 39     | 35      | 27      | 248   | 63.75          |
| 2  | *Ficus binnendykii* (Miq.) Miq. | 0       | 0      | 0       | 4       | 4     | 1.03           |
| 3  | *Ficus caulocarpa* (Miq.) Miq. | 1       | 0      | 0       | 0       | 1     | 0.26           |
| 4  | *Ficus elastica* Roxb. ex Hornem | 7       | 0      | 0       | 0       | 7     | 1.80           |
| 5  | *Ficus kurzii* King      | 21       | 16     | 9       | 10      | 56    | 14.40          |
| 6  | *Ficus lyrata* Warb      | 37       | 0      | 0       | 0       | 37    | 9.51           |
| 7  | *Ficus maclellandii* King | 3       | 0      | 0       | 0       | 3     | 0.77           |
| 8  | *Ficus microcarpa* L.f.  | 11       | 2      | 0       | 0       | 13    | 3.34           |
| 9  | *Ficus septica* Burm.f.  | 19       | 0      | 0       | 0       | 19    | 4.88           |
| 10 | *Ficus variegata* Blume  | 1        | 0      | 0       | 0       | 1     | 0.26           |
|    | **Total**                | **389**  |        |         |         |       | **100.00**     |

Many fig trees were tall and had reached their full grown. The tallest tree was *F. elastica*, which reached more than 10 m on average. Other tall trees (more than 8 m) were *F. caulocarpa*, *F. benjamina*, and *F. macrocarpa* (table 3). Clear bole was measured from the base of the tree to the first branch. The highest clear bole was found in *F. benjamina*, which was only 2.66 m on average. In addition to being tall, *F. benjamina* trees were also had a big diameter (more than 50 cm on average), although this species was not the biggest. The highest mean diameter was found in *F. binnendykii*. However, because all trees of this species were in cut off condition, the mean height of this species was only 4.30 m (table 3, figure 2). Many *F. benjamina* were planted along the periphery of the Sentul City residential complex in a small gorge, allowing their natural growth without any maintenance.
Table 3. Mean heights, clear boles, and diameter of *Ficus* species at growth stages of trees and poles.

| No | Species                        | Mean Height (m) | Clear Bole (m) | Diameter (dbh) (cm) |
|----|--------------------------------|-----------------|----------------|---------------------|
| 1  | *Ficus benjamina* L            | 9.06 ± 3.25 (n=194) | 2.66 ±1.63 (n=166) | 54.69 ± 32.03 (n=136) |
| 2  | *Ficus binnendykii* (Miq.) Miq | 4.30 ± 1.39 (n=4)     | 0.76 (n=1)      | 61.46 ±13.50 (n=5)   |
| 3  | *Ficus caulocarpa* (Miq.) Miq  | 9.53 (n=1)        | 2.57 (n=1)      | 25.48 (n=1)          |
| 4  | *Ficus elastica* Roxb. ex Hornem | 10.56 ± 2.65 (n=5)  | 1.95 ± 0.56 (n=5) | 44.0 ± 17.86 (n=5)   |
| 5  | *Ficus kurzii* King            | 6.85 ± 3.30 (n=37) | 1.67 ± 0.60 (n=32) | 37.09 ± 15.77 (n=39) |
| 6  | *Ficus lyrata* Warb            | 7.81 ± 1.56 (n=25) | 1.88 ± 0.55 (n=23) | 27.59 ± 5.88 (n=24)  |
| 7  | *Ficus maclellandii* King      | 2.11 ± 0.21 (n=3)  | 0.44 ± 0.11 (n=3) | 20.91 ± 0.97 (n=3)   |
| 8  | *Ficus microcarpa* L.f.        | 8.89 ± 3.26 (n=7)  | 1.90 ± 0.39 (n=6) | 28.49 ± 4.71 (n=8)   |
| 9  | *Ficus septica* Burm.f.        | N.A              | N.A             | N.A                 |
| 10 | *Ficus variegata* Blume        | 6.8 (n=1)         | 1.5 (n=1)       | 15.29 (n=1)          |

Note: different samples (n) for each species were due to the condition of the trees, for example, trimmed or cut-off; all *F. septica* were at the sapling stage, so no measurement was taken. N.A= not available because *F. septica* were in saplings and seedling stages, so no measurement was taken.

In the study area where planting has been conducted by the management company, tree regeneration obviously depends on the planting plan. Unfortunately, there is no information on the source of seedlings. Most figs (about 70%) (table 4) were already mature, planted when the housing complex was developed in 1994. Saplings were very minimal (about 4%). Poles were mostly stunted trees in less fortunate condition (e.g., heavy shading, constantly inundated), or those were planted quite recently to replace dead trees.

The fruiting stage and fruiting synchrony among all species are important to ensure that the fruits are available at any time of the year. July to September, coincided with late dry season) was not a fruiting time for fig trees in general. Most trees (84%; table 4) were not fruiting, except for *F. lyrata*, which showed the peak fruiting season. For *F. benjamina*, a big proportion (90.44%) of the population was not fruiting. However, the remaining small population was in the early, full, and late fruiting stage, suggesting a fruiting asynchrony pattern.

Looking at the number of trees in the residential clusters and the main boulevard, it was very clear that Victoria Cluster had the highest number of fig trees (almost 50%), closely comparable to the main boulevard (43%) (table 5). Each cluster within Sentul City residential complex was planted by certain species as the theme of the cluster. For Victoria Cluster, the theme happened to be *Ficus*, including *F. benjamina, F. kurzii, and F. microcarpa*. Other non-fig trees were very limited, making the fig trees the highly dominant trees. Meanwhile, along both wide sides of the MH Thamrin Boulevard, many other trees were also planted as street trees. Thus, although the percentage of fig trees was also high in this area, the fig trees did not dominate the tree community.
Table 4. *Ficus* species based on stage and fruiting stage in the study site.

| No | Species                          | Growth Stage | Fruiting Stage |
|----|----------------------------------|--------------|----------------|
|    |                                  | Tree | Poles | Sapling | None | Early | Full | Late |
| 1  | *Ficus benjamina* L.              | 238  | 58   | 0      | 246  | 5     | 1    | 7    |
| 2  | *Ficus binnendykkii* (Miq.) Miq. | 5    | 0    | 0      | 4    | 0     | 0    | 0    |
| 3  | *Ficus caulocarpa* (Miq.) Miq.   | 1    | 0    | 0      | 0    | 1     | 0    | 0    |
| 4  | *Ficus elastica* Roxb. ex Hornem | 6    | 4    | 0      | 7    | 0     | 0    | 0    |
| 5  | *Ficus kurzii* King              | 47   | 30   | 0      | 8    | 0     | 1    | 3    |
| 6  | *Ficus lyrata* Warb              | 32   | 11   | 0      | 0    | 0     | 17   | 0    |
| 7  | *Ficus macellandii* King         | 3    | 0    | 0      | 3    | 0     | 0    | 0    |
| 8  | *Ficus microcarpa* L.f.          | 8    | 7    | 0      | 3    | 0     | 0    | 0    |
| 9  | *Ficus septica* Burm.f.          | 0    | 0    | 19     | 1    | 17    | 0    | 0    |
| 10 | *Ficus variegata* Blume          | 0    | 1    | 0      | 0    | 0     | 1    | 0    |
|    | Total                            | 340  | 111  | 19     | 272  | 23    | 20   | 10   |
|    | Percentage (%)                   | 72.34| 23.62| 4.04   | 83.69| 7.08  | 6.15 | 3.08 |

Table 5. Number of *Ficus* based on residential clusters in the study site.

| No | Species                  | Residential Cluster | MH Thamrin Boulevard | Total |
|----|--------------------------|---------------------|----------------------|-------|
| 1  | *F. benjamina* L.        | Victoria            | Mediterania 2        | Bukit Golf Hijau | 167   |
|    |                          | 128                 | 21                   | 1     | 98    | 248   |
| 2  | *F. binnendykkii* (Miq.) Miq. | 0               | 0                   | 0     | 4     | 4     |
| 3  | *F. caulocarpa* (Miq.) Miq. | 1               | 0                   | 0     | 0     | 1     |
| 4  | *F. elastica* Roxb. ex Hornem | 2               | 0                   | 5     | 0     | 7     |
| 5  | *F. kurzii* King         | 49                  | 0                   | 0     | 7     | 56    |
| 6  | *F. lyrata* Warb         | 0                   | 0                   | 0     | 37    | 37    |
| 7  | *F. macellandii* King    | 0                   | 3                   | 0     | 0     | 3     |
| 8  | *F. microcarpa* L.f.     | 10                  | 0                   | 0     | 3     | 13    |
| 9  | *F. septica* Burm.f.     | 1                   | 0                   | 0     | 18    | 19    |
| 10 | *F. variegata* Blume     | 1                   | 0                   | 0     | 0     | 1     |
|    | Total                    | 192                 | 24                   | 6     | 167   | 389   |
|    | Percentage (%)           |                     |                     |       |       |       |

4. Discussion

The condition of fig trees in the study site varied according to maintenance. The maintenance by the Sentul City management is limited to trimming, pruning, cutting, and watering. There was no fertilizer applied for the fig trees. Based on [1], the average height of fig species found in the study site ranging from 10 m (for *F. binnendykkii*) to 40 m (for *F. variegata*). The tallest tree found in the study site was *F. elastica* that did not receive cutting or pruning.

Unfortunately, information on the diversity of fig trees in urban areas, specifically in a residential complex, was very limited, apart from a study in Bogor Botanical Garden [6] that reported a higher number of species. Compared to the number of fig species in Bogor Botanical Garden, the study area has a lower diversity. In 2017 [6], at least 97 fig species grew in Bogor Botanical Garden, consisting of 56 identified species and 41 unidentified species. The collection of figs in Bogor Botanical Garden was
184 individuals [6]. However, since Sentul City is a human-made environment, 389 fig trees consisted of 10 species within 270 ha (density 1.42 trees/ha on average, 9.80 trees/ha in Victoria Cluster) was considered a high number.

Several studies on vegetation diversity in urban areas in Indonesia revealed that only a few Ficus species were found [19, 20, 21]. For example, only two species of figs were found out of 58 shading trees in the city parks of Kediri, and those were F. benjamina and F. elastica [19]. In the urban forest of Bandar Lampung, only one fig species was listed in [20], and in Yogyakarta, the only fig species recorded along the main road was F. elastica [21]. However, a study in several habitat types in an urban area of Yogyakarta reported a total of six species of figs, with F. benjamina distributed in 8 of 10 study sites [22]. On the other hand, study abroad, such as in Singapore (637.5 km² or 637,500 ha), an urban city/country in tropical South-East Asia similar to the study site, has 46 fig species [2]. While Hong Kong, located in subtropics, having a size of 1,100 km² (equal to 110,000 ha), was reported to harbor 14 Ficus species [13].

The need for green open spaces or vegetation cover in residential areas is important; it provides an environmental and social advantage for the urban inhabitants [23]. The diversity and abundance of fig in urban areas will increase the biodiversity of the residential area, which in turn increase the value of the area. Fruiting figs are recognized as food sources for wildlife, especially frugivores, mainly birds such as Pink-necked Pigeon, Treron vernans, and mammals, such as Long-tailed Monkey Macaca fascicularis. However, fig trees also provide food sources for many insectivorous birds [24]. Among 43 bird species reported in the Sentul City area and might take advantage of fig trees, mostly are insectivores, while only two species (4.75%) are frugivores [25]. Additionally, Ficus gives shades and is good in regulating temperature in the cities due to their dense crown [26]. However, because this study was not aimed at examining the effect of trees on temperature, no measurement was taken. Other studies, such as [27], revealed that F. microcarpa ‘Golden Leaves’ has a good cooling effect that can reduce temperature to 10.0 ± 1.6 °C. Ficus benjamina L. in Bogor Botanical Garden was reported to have a very high capacity in absorbing CO₂ [28], thus highly effective in regulating microclimate.

The selection of plant species to be planted or kept in residential areas must consider the interest of the people’s daily life in the residential area. Species diversity of urban vegetation in residential areas correlated with several factors such as housing prices and other human factors, including preferences [29]. In this study, the Developer used Ficus as one of the cluster themes and consequently planted a relatively high number of figs in that cluster. In another cluster, such as in Mediterrania II, the developer planted bintaro (Cerbera manghas). Unfortunately, no information was available on the reason for species preference or theme by the developer. Although most of the fig plants in the area were planted by the developer, some seemed to grow naturally. Those that grow naturally are observed at the border of settlement. According to [6], figs might regenerate with the help of animal agents that spread the seeds, and then it will grow at the host tree as hemi-epiphyte.

Ficus grow well in tropical areas, predominately in wet areas, although they grow in drier places [1]. Maintenance of fig trees in residential areas is essential, especially because of the capability of figs to adapt to severe environmental conditions The stranglers with their strong roots, such as F. benjamina and F. macrocarpa [1] are potentially grip human-made structures such as buildings [7, 26], this might be the reason why maintenance in housing complex is essential to avoid conflict between nature and human interest

5. Conclusion

There were 10 fig species in the study site, consisted of eight native species (dominated by F. benjamina) and two non-native species to Indonesia. Although no information on the reason for tree species selection planted by the Developer in Sentul City, this study showed that residential areas such as Sentul City are potential habitats for Ficus species in an urban environment. The occurrence of figs in the residential area improves the quality of human settlement by providing shades, greenery, and habitats for wildlife. However, maintenance is necessary to keep the balance between fig growth and safety of the buildings and infrastructures.
6. References

[1] Berg C C and Corner E J H 2005 Moraceae: Ficeae *Flora Malesiana Series I* 17(2) 702

[2] Lok A F S L, Ang W F, Ng B Y Q, Leong T M, Yeo C K and Tan H T W 2013 *Native Fig Species as a Keystone Resource for the Singapore Urban Environment* (Singapore :Raffles Museum of Biodiversity Research, National University of Singapore)

[3] Lambert F R and Marshall A G 1991 Keystone characteristics of bird-dispersed *Ficus* in a Malaysian Lowland Rainforest *J. of Ecology* 79(3) 793-809

[4] Shanahan M, So S, Gompton S G and Gorlet R 2001 Fig-eating by vertebrate frugivores: a global review *Biol. Rev. Camb. Philos. Soc.* 76 529-72

[5] Yusuf R 2011 Sebaran ekologi dan keanekaragaman *Ficus* spp di Indonesia *Berk. Penel. Hayati*. Edisi khusus 5A 83-91 [in Indonesia]

[6] Peniwidiyanti 2017 *Hemiepifit Ficus* spp di Kebun Raya Bogor *Warta Kebun Raya* 15(1) 25-31

[7] Jim C Y 2013 Ecology and conservation of strangler figs in urban wall habitats *Urban Ecosyst* 17 405–26

[8] Wijaya I K M 2017 Ruang Sakala dan Niskala di sekitar pohon beringin di Denpasar *Prosiding Seminar Nasional SPACE 3* Program Studi Perencanaan Wilayah dan Kota Fakultas Teknik, Universitas Hindu Indonesia Jalan Sangalangit, Tembawun-Penatih, Denpasar Bali ISBN 978-602-73308-1-8

[9] Sukmawati J G 2019 Keanekaragaman dan distribusi ekologis *Ficus* spp di Kalimantan *Buletin Kebun Raya* 22(2) 85-94 [in Indonesia]

[10] Dominy N J, Yeakel J, Bhat U, Ramsden L, Wrangham R W and Lucas P W 2016 How chimpanzees integrate sensory information to select figs *Interface Focus* 6 20160001

[11] Kinnaird M, O’Brien T G and Suryadi S 1999 The importance of figs to Sulawesi’s imperilled wildlife *Tropical Biodiversity* 6(1&2) 5-18

[12] Wendein M C, Runkie J R and Kalko E K V 2000 Nutritional values of 14 fig species and bat feeding preferences in Panama *Biotropica* 32(3) 489-501

[13] Corlett R 2006 Figs (*Ficus*, Moraceae) in urban Hongkong, South China *Biotropica* 38 116-21

[14] Caughlin T T, Ganesh T and Lowman M D 2012 Sacred fig trees promote frugivore visitation and tree seedling abundance in South India *Current Science* 102 918-922

[15] Walther B A, Geier J, Chou L and Bain A 2018 The figs of winter: seasonal importance of fruiting fig trees for urban birds *Acta Oecologia* 90 28-34

[16] Suheri A, Kusmana C, Yanuar M, Purwato J and Setiawan Y 2019 Model prediksi kebutuhan air bersih di kawasan perkotaan Sentul City *JSIL* 04 207-208

[17] Syafriana A and Arifin HS 2020 Rain garden model for storm water management in Sentul City, Bogor, Indonesia *Proc IOP Conf Ser Earth Environ Sci* 477 012031

[18] Badan Pusat Statistik Kabupaten Bogor 2020 *Kecamatan Babakan Madang dalam Angka* (Bogor: BPS)

[19] Sulistyawati T I and Yunita 2019 Jenis-jenis pohon peneduh di taman kota Kediri *Jurnal Biologi dan Pembelajarannya* 6(1) 13-7

[20] Setiawan A, Alikodra H S, Gunawan A and Darnaedi D 2018 Keanekaragaman jenis pohon dan burung di beberapa area hutan kota Bandar Lampung 2006 *JMHT* 12(1) 1-13

[21] Syahbudin A, Adiirianti D T, Mulyana B, Meinata A, Phenomenon S P, Hanindita A S H, Syauffiana R L, Yudhistira R, Arifiriana R, Makkarenu, Osozawa K and Ninomiya I 2018 Urban trees in the cities of Matsuyama (Japan) and Yogyakarta (Indonesia): tree species diversity, design, and culture *Proc IOP Conf Ser Earth Environ Sci* 203 012013

[22] Mukhlis 2013 Pemilihan jenis pohon untuk pengembangan hutan kota di kawasan perkotaan Yogyakarta *Jurnal Ilmu Kehutanan* 7(1) 37-47 [in Indonesia]

[23] Dwyer J F, McPherson E G, Schroeder H W and Rowntree R A 1992 Assessing the benefits and costs of the urban forests *J of Arboriculture* 18(5) 227-34
[24] MacKay K D, Gross C L and Rosetto M 2018 Small populations of fig trees offer a keystone food resource and conservation benefits for declining insectivorous birds *Global Ecology and Conservation* **14** e00403

[25] Mardiastuti A, Mulyani Y A, Asmoro A T and Putra M S K 2017 Bird community in urban residential area: Which species sustain after five elapse years? *Proc IOP Conf Ser Earth Environ Sci* **179** 010240

[26] Vargas-Garzón B and Molina-Prieto L F 2012 *Ficus benjamina* L. in the cities: high number of individuals, severe damages to infrastructure and expensive economic losses *Revista nodo* **7**(13) 93-101

[27] Zhang R 2020 Cooling effect and control factors of common shrubs on the urban heat island effect in a southern city in China *Scientific Reports* **10**

[28] Dahlan E 2008 Jumlah emisi gas CO2 dan pemilihan jenis tanaman berdaya rosot sangat tinggi: Studi kasus di Kota Bogor *Media Konservasi* **13**(2) 85-9 [in Indonesia]

[29] Guo P, Su Y, W W, L W, Zhang H, Sun X, Ouyang Z and Wang X 2018 Urban plant diversity in relation to land use types in built-up areas of Beijing *Chin. Geogr. Sci.* **28**(1) 100-10

**Acknowledgment.**

This study was part of long-term ecological research on Biodiversity of Tropical Rain Forest of South-East Asia under the collaboration between the Faculty of Forestry and Environment IPB University and National Institute of Ecology (NIE), Korea. The authors thank the management of Sentul City for having provided access to research their area. The authors also thank Rahayu Octaviani, many field assistants and volunteers who helped to collect data, and Ramdani Manurung for digitizing the map.