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Diversity of *Ficus* (Moraceae) along the riparian zone of Samin River, Central Java, Indonesia

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Abstract. *Kusuma AN, Zaky FA, Pribady TR, Agustin YS, Nugroho GD, Dewangga A, Setyawan AD. 2024. Diversity of* Ficus *(Moraceae) along the riparian zone of Samin River, Central Java, Indonesia. Intl J Bonorowo Wetlands 14: 96-104.* Riparian vegetation plays an immense role in maintaining the hydrological and ecological functions of a river. One eminent vegetation species with great importance in riparian zone is the group of *Ficus* or figs. Many *Ficus* species occur in riparian ecosystems including in the Samin River, which stretches from Karanganyar to Sukoharjo Districts, Central Java, Indonesia and empties into the Bengawan Solo River. This study aimed to determine the diversity of *Ficus* along the riparian zone of Samin River from the upstream to the downstream. Data collection used a survey method at six stations by cruising a path with length of 1 km at each station and observing the right and left side of the river with a radius of 5-10 meters. All *Ficus* species, abiotic factors, altitude, and coordinates of the location point were recorded. Data was analysed to calculate Shannon-Weiner diversity index (H'), Evenness index (E) and Margalef species richness index (R). The results of the study documented 7 *Ficus* species, namely *F. racemosa* (34 individuals), *F. septica* (32 individuals), *F. fistulosa* (22 individuals), *F. benjamina* (11 individuals), *F. elastica* (1 individual), *F. microcarpa* (1 individual) and *F. virens* (1 individual). Species diversity index, evenness index and richness index at the upstream, middlestream and downstream sections ranged 0.54-0.88 (low diversity), 0.41-0.80 (uneven-almost even), and 0.52-0.61 (low richness), respectively. *Ficus* in the Samin River occurred in the habitat with air temperature of 21-38.4°C, humidity of 73-97%, and soil pH of 7-7.2. The findings of this study imply that riparian zone along the Samin River comprises a considerable diversity of *Ficus* which can maintain river sustainability.

Keywords: Biodiversity, *Ficus*, riparian zone, Samin River

INTRODUCTION

Biodiversity is the variety of living beings that includes plants, animals, and the various genetic materials contained in them, as well as the ecological factors that affect them (Hardiwinoto et al. 2024). According to Lewinsohn and Jorge (2024), species diversity is the basic component of biodiversity. Assessments on biodiversity are commonly carried out by focusing on specific taxonomic groups, taking into account the number and relative abundance of species. It is important to evaluate species diversity at different spatial scales to identify which patterns are visible at each scale and what factors may determine them. Other aspects, such as phylogenetic, functional, and interactional diversity, contribute to improved assessments of the dynamics in species diversity due to environmental change and their consequences for ecosystem services that are important for human subsistence and well-being.

Rivers are aquatic ecosystems that have important roles for humans and other organisms. Riparian areas deliver various ecological functions, including protection for regional biodiversity, climate regulation, water protection, and nutrient filtration. These ecological functions are directly related to the vital ecosystem services provided to society. Many of these functions have direct economic relevance, including support for agriculture, forestry, industry, and recreation such as waterfalls, hiking, canoeing, and fishing (González et al. 2017). In providing such ecological services, there are several biotic and abiotic factors that should present in riparian zone, one of which vegetation diversity. Riparian area with large proportion of vegetation cover combined with great number of species diversity will maintain the ecological functions of the river. According to Zeng et al. (2019), riparian plant diversity is influenced by groundwater depth, distance from the river, soil moisture content, and soil salinity.

One of the riparian biodiversity in the form of trees that is important to support the hydrological function of rivers is plants of the genus of *Ficus* or figs group (Izzati and Hasibuan 2019). In term of ecological aspect, *Ficus* provides twice as many benefits as other vegetation, indicating that conserving and using *Ficus* to restore degraded ecosystems is more effective than other species (Hendrayana et al. 2022). *Ficus* species can initiate and facilitate the regeneration of plant communities in a landscape that not only supports the spread of fruiting

plants but can also develop new compositional structures (Dewi et al. 2023). Many species from the genus of *Ficus* have the habitat in riparian ecosystems with widespread distribution throughout Indonesia, one of which is Samin River, which stretches from Karanganyar District to Sukoharjo District and empties into the Bengawan Solo River, Central Java, Indonesia. Bengawan Solo has 28 sub-watersheds, including the Samin River.

Bengawan Solo watershed has experienced a decline in many of its ecological functions caused by several factors, including changes in land use and low public environmental awareness (Fatimah et al. 2023). Samin River has high biodiversity, especially in the upstream part on Mount Lawu slope which has distinctive flora and fauna. However, the great economic potential in the upper Samin River causes tremendous pressures on land use. There are increasing trends of forest encroachment for agricultural activities, construction of houses on steep slopes, and changes in land use from natural landscape into built-up area to harness tourism opportunities by developing hotel facilities, villas, homestays, and coffee shops. The middle part of the Samin River located in Karanganyar District is characterized with the presence of agricultural land and semi-urban area with the diversity is relatively maintained. The downstream area of Samin River, which is the meeting point with Bengawan Solo River in Sukoharjo District, is dominated by urban residentials, reducing the ecosystem quality compared to the upstream.

The variation of biodiversity that exists in the Samin River, starting from the upstream, middle, and downstream with differences and factors that influence it, has not been widely studied, especially for taxonomic group which has great ecological importance such as *Ficus* or figs. Therefore, this research is aimed to identify the diversity of *Ficus* along the banks of the Samin River. We expected the results of this study are useful for understanding the ecology, distribution, and diversity of *Ficus* in Samin River which might serve as baseline information for river management and biodiversity conservation.

MATERIALS AND METHODS

Study area

The research was conducted in March 2024 in several areas of the Samin River, Samin River, Central Java, Indonesia. Samin River is geographically located between the coordinates of 110°46′35″ E - 111°10′42″ E and 7°26′43″S - 7°43′00″ S. Samin River has an area of about 63,494.85 ha with a river length of 53.8 Km. Data collection was conducted in three stations, divided into 6 villages, from the upstream to the downstream before it empties into the Bengawan Solo River. In the upstream part of the river, we selected the river section in Blumbang and Tlogo Dringo Villages, Karanganyar District, then for the middlestream, Plosorejo and Girilayu Villages were choosen, Karanganyar District and in the downstream was in Kadokan and Mojolaban Villages, Sukoharjo District (Table 1, Figure 1).

Samin River meanders through various types of land, ranging from dense tropical rainforests to cultivated farmland. The area surrounding the Samin River showcases diverse habitats, including primary forests, secondary forests, agricultural land, and urban areas. Its geographical conditions and tropical climate make it a suitable environment for the growth and development of various plant species, including members of the Moraceae family, such as the genus *Ficus* (Noviyanti et al. 2021).

Data collection

Data collection used a survey method along the river with length of 1 km at each station by exploring and observing the right and left of the river at a radius of 5-10 meters from the cruising path. During the exploration, each *Ficus* species was recorded along with the number of individuals, and abiotic factors such as air temperature, humidity, soil pH, altitude and coordinates. Identification of each type of *Ficus* species was based on the morphological characteristics, referring to available literature, such as journals and books, as well as taxonomical databases, such as Berg and Corner (2005) and Global Biodiversity Information Facility (GBIF).

Data analysis

Data analysis was carried out descriptively regarding the information of the species, its ecological functions in riparian areas, abiotic factors, and the ecological index of *Ficus* found. We also calculated ecological indices to describe the diversity and distribution of organisms within an ecosystem to provide an overview of the health and stability of an ecosystem and to monitor changes in biodiversity over time. The ecological indices were analyzed based on the diversity index of the Shannon-Wiener index (H'), Evenness index (E) and Margalef species richness index (R).

Table 1. Research location and coordinates in Samin River, Central Java, Indonesia

Location		Station	Coordinate
Upstream	Blumbang Village, Karanganyar District	1	7° 39' 3.2076" S, 111° 9' 31.158" E
	Tlogo Dringo Village, Karanganyar District	2	7° 40' 23.4732" S, 111° 11' 21.0768" E
Middlestream	Girilayu Village, Karanganyar District	3	7° 39' 17.892" S, 111° 4' 55.6104" E
	Plosorejo Village, Karanganyar District	4	7° 38' 39.9732" S, 111° 2' 59.0244" E
Downstream	Kadokan Village, Sukoharjo District	5	7° 35' 58.4448" S, 110° 49' 59.4876" E
	Mojolaban Village, Sukoharjo District	6	7° 35' 57.768" S, 110° 50' 0.8052" E

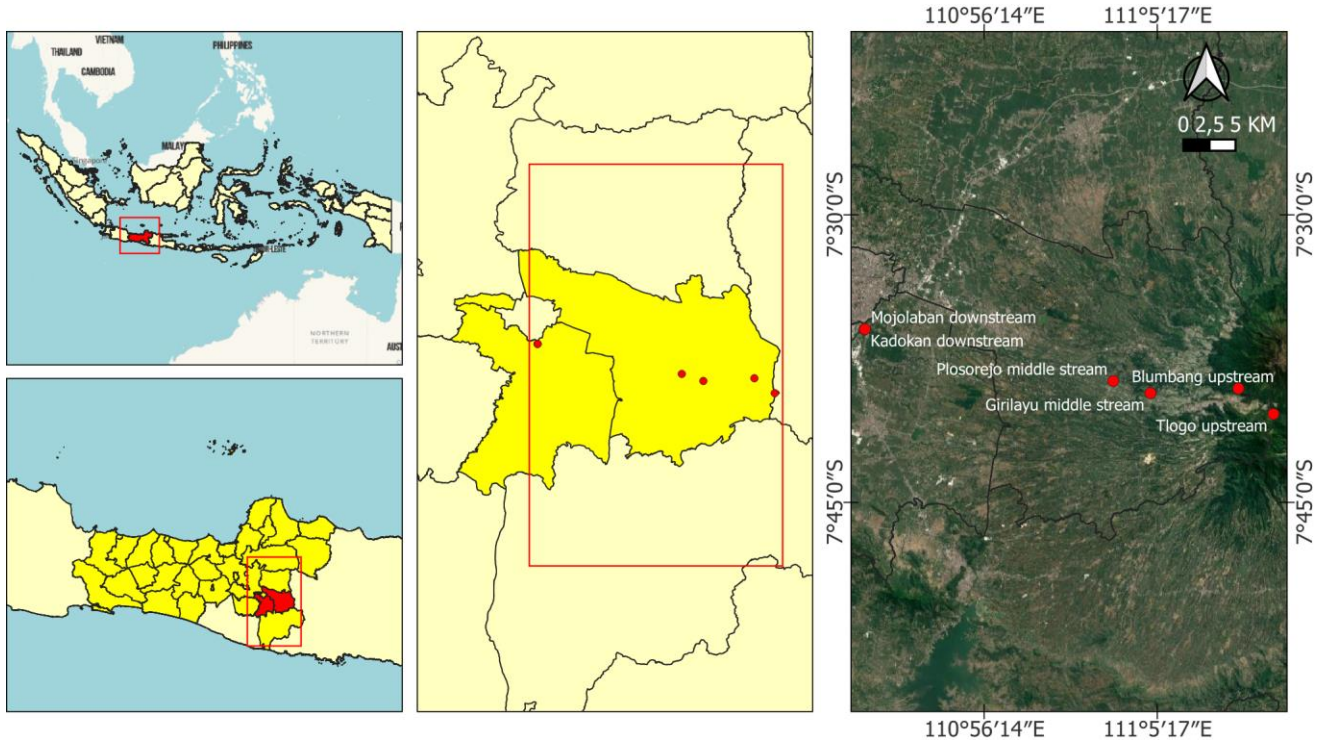

Figure 1. Map of research locations along the Samin River in Karanganyar (A; B; C; D) and Sukoharjo Districts (E; F), Central Java, Indonesia. The photograph shows each station at: A. Blumbang Village; B. Tlogo Dringo Village; C. Girilayu Village; D. Plosorejo Village; E) Kadokan Village; F. Mojolaban Village

Shannon-Wiener index (H') was calculated using formula below (Kim et al. 2017)

$$H' = -\sum(Pi \ln Pi)$$

Where: H': Shannon Wiener Diversity index (H'); ni: The number of individuals or important values of type I; S: The total number of species found; N: Individual total or total importance of all types

The range of Diversity index (H') was classified as:

H >3: High diversity; 1 ≤ H ≤ 3: Medium diversity; H < 1: Low diversity

Evenness index (E) was calculated based on Strong (2016) as follow:

$$E = \frac{H'}{lnS}$$

Where: E: Evenness index; H': Shannon Wiener Diversity index (H'); S: Total number of species discovered

Evenness index was categorized as:

0.00-0.25: Uneven; 0.26-0.50: Not evenly distributed; 0.51-0.75: Fairly even; 0.76-0.95: Almost even; 0.96-1.00: Equally

Margalef Species Richness index (R) was calculated using the formula based on Lemos et al. (2023):

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

Where: R: Richness index; S: Total number of species discovered; N: Total number of individuals found

Margalef species richness index was classified as:

R < 3.5: Low species richness; 3.5 ≤ R ≤ 5: Moderate Species Richness; R > 5: High Species Richness

RESULTS AND DISCUSSION

Diversity of *Ficus* along the Samin River

The observation results are presented in Table 2, revealing the identification of 7 *Ficus* species (Figure 2), namely *Ficus fistulosa* Reinw. ex Blume (22 individuals), *Ficus benjamina* L. (11 individuals), *Ficus racemosa* L. (34 individuals), *Ficus virens* Aiton (1 individual), *Ficus septica* Burm.fil. (32 individuals), *Ficus microcarpa* L.fil. (1 individual), and *Ficus elastica* Roxb (1 individual). *Ficus* in the Samin River was assessed across three segments: upstream, midstream, and downstream. In the upstream segment, three species were identified: *F. fistulosa* (22 individuals), *F. benjamina* (2 individuals), and *F. racemosa* (2 individuals). The midstream segment hosted three species: *F. benjamina* (8 individuals), *F. racemosa* (8 individuals), and *F. septica* (31 individuals). Lastly, the downstream segment exhibited six species: *F. benjamina* (1 individual), *F. racemosa* (24 individuals), *F. septica* (1 individual), *F. microcarpa* (1 individual), *F. virens* (1 individual), and *F. elastica* (1 individual).

Ficus benjamina was found at elevations ranging from 90 to 1554 meters above sea level (masl), while *F. fistulosa* was discovered in the upper part of the river, at elevations ranging from 1404 to 1490 masl. In the middle part of the Samin River, at elevations ranging from 85 to 624 masl, *F. septica* was found. Meanwhile, in the lower section of the Samin River, in Kadokan Village, *F. elastica* was located at 90 masl. Additionally, *F. microcarpa* was found in the lower part of the river at 83 m asl. *F. racemosa* was distributed across all stations with elevations ranging from 85 to 1758 masl. Based on this research, *F. racemosa* and *F. benjamina* can live from lowlands to highlands (above 1,500 masl), which is different with *F. fistulosa*, which can only be found in highlands. In contrast, *F. elastica*, *F. microcarpa* and *F. virens* can only found in the lowlands below 100 meters above sea level (Table 2). In the upstream section of the Samin River at Station 1 and Station 2, there were fewer *Ficus* species than in the middle and downstream sections of the river. It is in line with the research of Pothasin et al. (2014), which revealed differences in species richness, density and diversity. There are a greater number of *Ficus* species at elevations between 400-600 m above sea level. The distribution of species richness along altitudinal gradients is regulated by biological and climatic factors. Other factors, such as soil fertility, vegetation and topography, can also influence species richness patterns (Isnaini and Sukarsono 2015; Kadir 2015). Based this research, *Ficus* in the Samin River riparian area were mostly found at Stations 4, 5 and 6, which are the middle and lower reaches of the Samin River with elevation 400-1000 m above sea level.

Table 2. *Ficus* species found along the Samin River, Central Java, Indonesia

Species	Upstream		Middle		Downstream		Elevation	Habitat		Number of
	B	TD	G	P	K	M	(m asl.)	T	E	Individuals
Ficus benjamina L	✓	-	✓	✓	-	✓	90-1,554	✓	-	11
Ficus elastica Roxb	-	-	-	-	✓	-	90	✓	-	1
Ficus fistulosa Reinw. ex Blume	✓	✓	-	-	-	-	1,404-1,490	✓	-	22
Ficus microcarpa L.fil.	-	-	-	-	-	✓	83	✓	-	1
Ficus racemosa L.	-	✓	✓	✓	✓	✓	85-1,758	✓	-	34
Ficus septica Burm.fil..	-	-	✓	✓	-	-	85-624	✓	-	32
Ficus virens Aiton	-	-	-	-	✓	-	85	-	✓	1

Note: B: Blumbang Village; TD: Tlogo Dringo Village; G: Girilayu Village; P: Plosorejo Village; K: Kadokan Village; M: Mojolaban Village; T: Terestrial; E: Epifit

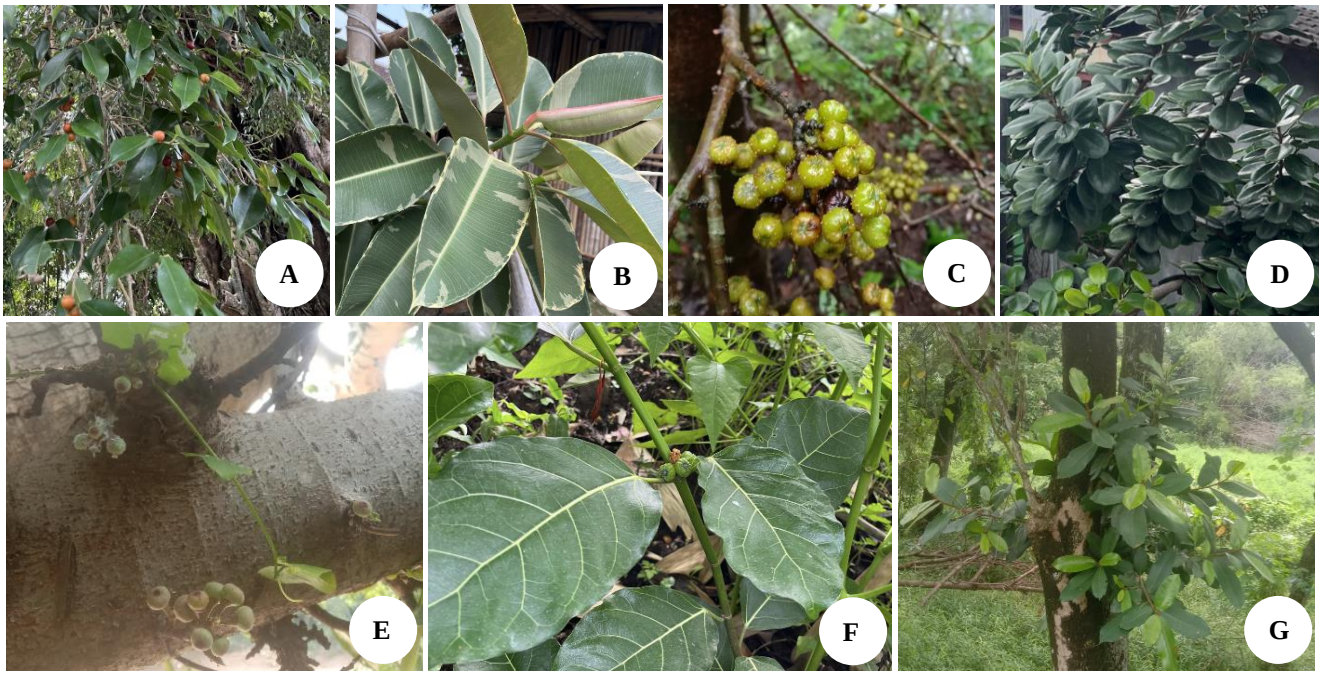

Figure 2. *Ficus* species found along the Samin River, Central Java, Indonesia: A. *Ficus benjamina*; B. *Ficus elastica*; C. *Ficus fistulosa*; D. *Ficus microcarpa*; E. *Ficus racemosa*; F. *Ficus septica*; G. *Ficus virens*

A study Fikriyya et al. (2023) located in the Banjaran River, Banyumas District, Indonesia showed that *F. septica* was found in disturbed areas, suggesting the high adaptability of this species across various habitat conditions including those disturbed by anthropogenic activities. This species can also reduce heavy metals in the soil (Mariwy et al. 2020). This is in line with the finding of this study where *F. septica* were found in the middle section of the Samin River which is located in residential areas where river condition is disturbed by water discharge. A research by Ayu et al. (2023) showed that *F. racemosa* can live in various habitats, which is similar with the finding of this study where *F. racemosa* in the Samin River can be found in the upstream, middle and downstream. Meanwhile, *F. fistulosa* grows in upstream areas because of its strong and extensive root system morphology. This is supported by Ridwan and Pamungkas (2015) and Ayu et al. (2023) which stated that in the spring area the vegetation that grows is primarily *Ficus* with roots that can reach the aquifer which can facilitate the ground flow to become springs.

Description of *Ficus* species

Ficus benjamina *L.*

From the observations and according by Hadi et al. (2019), the trunk is round and upright, and the surface is rough and blackish brown (Figure 2.A). The leaves are plain green and oval. The tops of the leaves are covered with two large scales. It has single flowers that come out and grow from the leaf axils. The petals are shaped like a funnel. They are slightly greenish-yellow in color and small in size. The fruit is small, round, 0.5-1 cm long, green when young and reddish when ripe.

Ficus elastica *Roxb*

Ficus elastica is commonly used as ornamental plant that attract attention with their large, glossy leaves (Figure 2.B). This species is native to the tropics of East Asia, although it is now spread throughout the world (Munir 2023). The plant has broad, dark green, glossy leaves. The leaf midrib contrasts with the white color. This species can grow quite large indoors if well cared for. This tree has slender, drooping branches, giving it an elegant appearance. *F. elastica* can grow well in tropical and subtropical regions, usually in lowland forests. The plant is known for its latex-containing sap that can be extracted for industrial use, especially in the production of synthetic rubber. *F. elastica* has a variety of benefits, including environmental uses, medicinal uses, and as a source of fuel and food (Dewi et al. 2023)

Ficus fistulosa *Reinw. ex Blume*

This plant grows in several tropical countries, including Indonesia (Figure 2.C). The unripe fruits are green, with a thumbnail size and spherical shape, with some flattening on top and bottom (Ditthawutthikul et al. 2021). *F. fistulosa* is tree up to 20 meters high, has branch with grey-brown trunk and white gummy, leaves are egg-shaped to oval or elliptical to lanceolate. The location of the leaves is on the stem, alternating or sitting opposite; meanwhile, young leaves of the *F. fistulosa* could be processed as vegetables or used as a forage plant for ruminants (Wijaya and Defiani 2021).

Ficus microcarpa *L.fil.*

Ficus microcarpa, commonly known as Chinese or Malay banyan or fig, is considered one of the most

common urban trees in warm climates around the world (Figure 2.D). It is known as an invader species due to its ability to grow in inhospitable places, large number of fruit production, and fast spreading growth (Fiorenza et al. 2022). Traditionally, *F. microcarpa* has been used in folk medicine to treat various diseases, such as in China, *F. microcarpa* is referred to as "rong shu", used to treat flu, malaria, acute colitis, tonsillitis, bronchitis, and rheumatism, as it has pharmacological properties, including antioxidant, antibacterial, anticancer, antidiabetic, anti-diarrheal, anti-inflammatory, anti-asthmatic, hepatoprotective, and hypolipidemic activities (Kalaskar et al. 2023). *F. microcarpa* is also a riparian tree species that indicates the water quality of springs and waterways (Rambey et al. 2021).

Ficus racemosa *L.*

Ficus racemosa, which generally grows around rivers, can be used an environmental indicator of land use change (Figure 2.E) (Peniwidiyanti et al. 2022). This plant is distributed in India, Bangladesh, Myanmar, Thailand, Indonesia, Vietnam, Australia, etc. In Bangladesh, it grows in the plains and lower areas, up to 1,000 meters above sea level and well-known as medicinal plant, commonly known as *dumor* in Bengali. This plant is also known as *audumbar*, bunch fig tree, Indian fig tree or *goolar*, and has antibacterial, antitussive, anthelmintic, anti-diarrheal, anticancer, and anti-inflammatory properties (Pingale et al. 2019).

Ficus septica *Burm.fil.*

Ficus septica, also known as *awar-awar* in Indonesian, is a tree that can grow to 3-25 meters tall with a pale brown to yellowish brown trunk (Figure 2.F). The leaves are oval-ovate with a rounded base, a fairly blunt tapering tip, and a flat edge. *Awar-awar* has an important role in the ecological and hydrological functions in the riparian zone because it can grow on various soil types and is often found in secondary rainforests, bushes, roadsides, and riverbanks. This species is also pollinated by agonid wasps of the genus *Ceratosolen*, which play an important role in dispersing its seeds (Soliman et al. 2021). In addition, *awar-awar* leaves have ecological benefits as a medicine for various diseases, including skin diseases, appendicitis, boils, venomous snake bites, and shortness of breath, and the roots are used as an antidote for fish poison and asthma control (Alaman et al. 2020).

Ficus virens *Aiton*

Ficus virens is a tree that can grow to 24-27 meters in dry areas and as high as 32 meters in more humid areas (Figure 2.G) (Nair et al. 2021). This tree has a wide canopy and hanging aerial roots, which provide protection for humans and symbolize harmony between humans and nature. This species are often planted in locations that are considered sacred or holy, such as squares, springs and cemeteries, because of their deep philosophical meaning. It is a fig tree belonging to a group of trees known as strangler figs, because the seeds can germinate on other trees and grow to strangle them, eventually killing the host tree.

One of the morphological characteristics of *Ficus* is that it has an extensive root system that grows strongly into the ground and reaches the ground widely, which can play a role in soil conservation by preventing soil erosion around river flows. It also stabilises the groundwater cycle and filters groundwater to support water quality around the *Ficus* growing area (Ulfah et al. 2015). The large stature of plants and roots that can reach water areas benefit other organisms, such as aquatic animals, insects and microbial organisms maintain biodiversity in riparian areas (Vargas et al. 2023). *Ficus* produces dense fruit, which can be a source of food for several animals. Fruits that fall and rot will become a source of nutrients for the surrounding soil and the surrounding water ecosystem. The dense leaves and branches that grow thickly around river flow function as vegetation cover, which can maintain the temperature of the water and soil as well as the organisms that live in the ecosystem (Zotz et al. 2021). *Ficus* are particularly attractive to seed dispersers because they produce large and highly nutritious fruits. The effectiveness of *Ficus* trees in promoting vegetation recovery is higher than other common trees. Therefore, the conservation of *Ficus* trees should be prioritized (Cottee-Jones et al. 2016). Several *Ficus* species are also used as a traditional medicine for diarrhea, oligogalactia, and diabetes (Shi et al. 2018). *Ficus* and its species-specific pollinator wasps (Agaonidae) greatly influence community ecology by forming a remarkable plant-insect obligate mutualism (Aribal et al. 2016). *Ficus* is essential for the sustainable management of river ecosystems by increasing carrying capacity, cleaning water and stabilizing riverbanks (Raphael and Laika 2022).

Ecological indices

Shannon-Wienner (H') diversity index

The Shannon-Wiener Diversity index (H') is a measure of biodiversity that evaluates species richness (number of species) and evenness (distribution of individuals among species) (Odum 1993). When applied to *Ficus* species, the index helps assess their ecological importance and diversity within a particular habitat. Based on the Shannon-Wiener Diversity index (H') (Table 3), the highest diversity index was in the middlestream area with H' of 0.88. This value is higher than the average *Ficus* diversity found by Purba et al. (2015) with H' of 0.6. A low Shannon-Wiener Diversity index indicates low biodiversity in a given ecosystem, meaning the ecosystem either has few species (low richness) and the number of individuals was almost uniform (Rohman et al. 2023). Diversity includes two main dimensions, the variation in the number of species and the number of individuals of each type in an area. At each location, the abundance of each species varies quantitatively because some species are much more important than others, resulting in high and low diversity of ecosystems (Hasan et al. 2020).

Evenness index

The evenness index measures the degree of evenness of individual species abundance within a community. Evenness indicates the balance and stability of community (Adelina et al. 2016). Based on Table 4, the evenness index

in the Samin River upstream is E = 0.49, indicating that *Ficus* species were not evenly distributed. Similarly, in the downstream area, with a value of E = 0.41, the distribution was not even because only two species were found in both areas. It contrasts, in the middle part of the Samin River had E value of 0.80, suggesting that *Ficus* were almost evenly distributed due to the presence of several species. *Ficus* species with effective seed dispersal agents, such as birds and bats, may dominate in numbers. Inefficient dispersal systems can limit the abundance of certain species, lowering evenness (Nakabayashi et al. 2019). Low evenness often reflects ecological imbalance or dominance by a few species well-adapted to the environment (Rohman et al. 2023).

Richness index

According to Baderan et al. (2021), the greater number of species found in a community the greater the richness index. However, the richness index indicates that the increase in the number of species is inversely proportional to the number of individuals. Table 5 shows that the *Ficus* richness index at the upstream station is 0.61, falling into the low category and indicating that the number of *Ficus* species was relatively few. Similarly, the *Ficus* richness index at the midstream and downstream stations are 0.52 and 0.59, respectively, falling into the low category. These results suggest that the Samin River has a relatively low number of *Ficus* species and an uneven distribution. It may be due to various factors, including climatic conditions, topography, and interactions with other vegetation (Isnaini and Sukarsono 2015). Similar studies conducted in other areas, such as in the Satui Sub-watershed, South Kalimantan, Indonesia (Kadir 2015), have shown that vegetation composition and structure also influence the potential of vegetation as a parameter for hydrology and soil erosion.

Abiotic factor of Samin River

Based on the observations, the abiotic factors in the *Ficus* habitat along the Samin River vary across stations (Table 6). In the upper section at Blumbang Village, the air temperature was 21-23.8°C with 89% humidity and a soil pH of 7 while at Tlogo Dringo, it was 22-23°C, 97% humidity, and soil pH of 7. In the middle section at Girilayu Village, the temperature increased to 25-28°C with 87% humidity and a soil pH of 7, while at Plosorejo Village was at 28-29°C with 79% humidity and a soil pH of 7.2. In the lower section at Kadokan Village, the temperature increased to 30-38.4°C with 73% humidity and a soil pH of 7, while at Mojolaban Village, it was 30-38°C with 73% humidity and a soil pH of 7. The lower section generally exhibited higher air temperatures than the upper and middle segments.

Abiotic parameters (air temperature, soil pH, air humidity) are very important factors that influence the distribution of *Ficus* in the Samin River. The measurement of abiotic parameters aims to determine the physical conditions of aquatic ecosystems that support *Ficus* diversity. The temperature in this study, which ranged from 23-30°C, is in line with Yuan et al. (2024), who stated that in the native habitat, many *Ficus* species are found in warm regions, but they can also withstand short periods of cooler temperatures, especially when dormant. Low humidity levels lead to increased transpiration (water loss through the leaves), which can stress the plant. This can result in dried tips or edges on the leaves and overall reduced plant vitality. *Ficus* may exhibit leaf drop in response to prolonged dry air, as a survival mechanism to reduce water loss (Yuan et al. 2024), so a high humidity is an ideal for their health.

Table 3. Shannon-Wienner Diversity index (H') of *Ficus* in Samin River, Central Java, Indonesia

Stations	H'	Category
Upstream	0.54	Low
Middlestream	0.88	Low
Downstream	0.74	Low

Table 4. Evenness index of *Ficus* in Samin River, Central Java, Indonesia

Stations	Evenness index	Category
Upstream	0.49	Not evenly
Middlestream	0.80	Almost even
Downstream	0.41	Not evenly

Table 5. Richness index of *Ficus* in Samin River, Central Java, Indonesia

Stations	Richness index	Category
Upstream	0.61	Low
Middlestream	0.52	Low
Downstream	0.59	Low

Table 6. Abiotic factors in the habitat of *Ficus* in the Samin River, Central Java, Indonesia

Station		Air Temperature (°C)	Air Humidity (%)	Soil pH
Upstream	Blumbang Village (1)	21-23.8°C	89%	7
	Tlogo Dringo (2)	22-23°C	97%	7
Middlestream	Girilayu Village (3)	25-28°C	87%	7
	Plosorejo Village (4)	28-29°C	79%	7.2
Downstream	Kadokan Village (5)	30-38.4°C	73%	7
	Mojolaban Village (6)	30-38°C	73%	7

In riparian zones, where *Ficus* are often found, soil pH is influenced by the presence of river water and organic matter. In these areas, *Ficus* species contribute to soil stabilization and the provision of organic matter, but changes in pH due to erosion or human activity can disrupt their distribution locally (e.g., in the forests of Thailand and Borneo) (Pothasin et al. 2014; Nakabayashi et al. 2019). The pH results in this study were within the optimal range, i.e. from 7 to 7.2. *Ficus* also exhibit tolerance to varying soil pH, depending on the specific needs of the species. Some *Ficus* species, such as *F. benjamina* and *F. elastica*, are more commonly found in environments with neutral to slightly acidic soil pH because this pH match supports microbial activity that aids in decomposition and nutrient release (Nakabayashi et al. 2019; Gaur et al. 2024).

In conclusion, the study documented 7 *Ficus* species along the Samin River, namely *F. fistulosa* (22 individuals), *F. benjamina* (11 individuals), *F. racemosa* (34 individuals), *F. virens* (1 individual), *F. septica* (32 individuals), *F. microcarpa* (1 individual), and *F. elastica* (1 individual). The species diversity index, the species evenness index and the species richness index obtained in the entire Samin River (upstream, middlestream and downstream) are 0.54-0.88 (low), 0.41-0.80 (uneven-almost even), and 0.52-0.61 (low), respectively. The *Ficus* recorded in this study occurred in habitat with air temperature of 21-38.4°C, humidity of 73-97%, and soil pH of 7-7.2. The study suggests that knowledge of *Ficus* ecology, distribution, and diversity is crucial for managing rivers and preserving biodiversity in general. Knowing this allows for the implementation of suitable measures to safeguard the river environment and guarantee its sustainability.

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