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Density Figure of *Aedes aegypti* Larvae in the Laboratory Center of Universitas Nasional and Its Surrounding Residences

Nico Hartandi[1*], Hasni Ruslan[1], Tatang Mitra Setia[1]

[1] *Biology Study Program, Faculty of Biology and Agriculture, Universitas Nasional, Jakarta, Indonesia*

* Correspondence Author: nicohartandi@gmail.com

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Abstract

Dengue remains a public health problem in Indonesia, caused by dengue virus with *Aedes aegypti* as the primary vector. Vector control requires data on larval density as an indicator of transmission risk. This study aimed to calculate the larval density of *Ae. aegypti* at the Laboratory Center of Universitas Nasional (UNAS) and its surrounding residences, and to describe the location and types of water-holding containers that potentially serve as mosquito breeding sites. The study was conducted from May to August 2025 using a descriptive observational approach. A total of 100 houses (premises) and 287 water-holding containers were inspected to calculate the House Index (HI), Container Index (CI), Breteau Index (BI), Density Figure (DF), and Larvae-Free Index (ABJ). The results showed HI = 38%, CI = 21%, BI = 59, DF = 6, and ABJ = 62%, indicating high larval density and a potential risk of dengue transmission. Most positive water-holding containers were found outdoors, and the most common container type identified was bucket. These findings suggest that environmental conditions still support mosquito breeding. It is recommended that the community routinely implement mosquito breeding site eradication activities based on the 3M-Plus principle (Menguras: draining and scrubbing containers; Menutup: tightly covering containers; Mendaur ulang: reusing or recycling discarded items; plus: additional preventive measures), that larval monitoring cadres (JUMANTIK) expand the coverage of larval surveillance, and that future research broaden its scope and methodology to obtain a more comprehensive understanding.

Keywords: *Aedes aegypti*, dengue, larval density, water-holding container

INTRODUCTION

Dengue is a disease caused by the dengue virus (DENV), primarily transmitted through mosquito bites, although transmission may also occur under certain conditions such as organ donation, blood transfusion, or vertical transmission from a pregnant mother to her baby. The virus can be transmitted transovarially in mosquitoes, allowing continuous transmission throughout their life cycle (World Health Organization, 2024a). Dengue virus consists of four serotypes (DENV-1 to DENV-4); infection with one serotype provides long-term immunity only to that serotype, while subsequent infection with a different serotype may increase the risk of severe dengue (WHO, 2024b). Most cases are mild or asymptomatic, but some may progress to severe disease or death. Currently, no specific treatment is available, and vaccine use remains limited to certain conditions (WHO, 2024a).

Dengue is endemic in more than 100 countries worldwide, with widespread distribution across tropical and subtropical regions (WHO, 2024a). In 2024, about 14 million cases were reported globally, with the highest number in the Americas Region, followed by the South-East Asia and Western Pacific Regions (WHO, 2025). Within the South-East Asia Region, Indonesia is among the 30 countries with the highest dengue endemicity worldwide (WHO Regional Office for South-East Asia, 2023). In Indonesia, dengue was first reported in Surabaya in 1968, and cases have increased annually since then (Kementerian Kesehatan Republik Indonesia, 2025). In 2024, Indonesia recorded 257,271 cases, a substantial rise from the previous year (WHO, 2025). In DKI Jakarta, 13,276 cases were reported in 2024 across all administrative areas (Kementerian Kesehatan Republik Indonesia, 2025), with South Jakarta reaching 420 cases by March 2025. Within South Jakarta, Pasar Minggu Subdistrict recorded 63 cases by the end of March 2025, making it the subdistrict with the second-highest number of cases, including 7 cases contributed by Jati Padang (Pemerintah Kota Jakarta Selatan, 2025).

In Indonesia, three species have been identified as dengue vectors, with *Ae. aegypti* recognized as the primary vector, while *Ae. albopictus* together with *Ae. scutellaris* serve as secondary vectors (Direktorat Jenderal Pencegahan dan Pengendalian Penyakit, 2017). Beyond dengue transmission, *Ae. aegypti* may also cause other negative impacts, such as disturbance of comfort (annoyance) and skin irritation, and may transmit other arboviruses (Sembel, 2009). This species undergoes complete metamorphosis; eggs are laid on water-filled container walls and can survive dry conditions for years, while larvae undergo four moulting stages before becoming pupae and adults (Soedarto, 1992). Its lifespan ranges from 3–10 days, and it is typically found within 50 m of breeding sites, with an active flight range of about 100 m (Ompusunggu, 2022). Females take repeated blood meals with a preference for humans (anthropophilic); their feeding and resting activities occur predominantly indoors (endophagic and endophilic) (Direktorat Jenderal Pencegahan dan Pengendalian Penyakit, 2017; Fadilla et al., 2015). *Ae. aegypti* breeds in clean, stagnant water both indoors and outdoors, and various residential water-holding containers have been found positive for its larvae (Soedarto, 1992; Fadilla et al., 2015).

Environmental factors, such as the rainy season, temperature, humidity, wind speed, and predators, influence *Ae. aegypti* populations (Direktorat Jenderal Pencegahan dan Pengendalian Penyakit, 2017; Susanna & Sembiring, 2011). Dengue transmission is also shaped by social conditions, including population density, human mobility, and water-storage practices, which promote *Ae. aegypti* domestication and increase its vectorial capacity (WHO, 2024a; Badan Penelitian dan Pengembangan Kesehatan, 2018). Because dengue control depends largely on effective vector control, vector surveillance becomes essential (WHO, 2024a). A common method for vector surveillance is larval inspection of indoor and outdoor water-holding containers to calculate larval indices—House Index (HI), Container Index (CI),

Breteau Index (BI), and Larvae-Free Index (ABJ)—which describe *Ae. aegypti* larval density (Direktorat Jenderal Pencegahan dan Pengendalian Penyakit, 2017).
Several previous studies conducted in different regions of Indonesia have demonstrated that many areas still exhibit larval density levels indicating a substantial risk of dengue transmission. Widjajanti et al. (2020) reported HI values >30%, CI >10%, BI >40, and ABJ <70% in three districts of Central Kalimantan. Similarly, Khotafiatun et al. (2021) documented HI = 32.1%, CI = 13.7%, BI = 42.7, and ABJ = 68% in Jeruksari Village, Pekalongan. Tatawi et al. (2024) also reported HI = 44%, CI = 15.31%, BI = 68, and ABJ = 56% in Rumoong Bawah Subdistrict, South Minahasa. Although Nurhidayah et al. (2022) observed relatively lower indices in Karanganyar Gunung Subdistrict, Semarang (HI = 5.22%, CI = 2.86%, BI = 5.72, ABJ = 94.77%), larval presence was still detected despite high community participation in vector control efforts.

The Laboratory Center of Universitas Nasional (UNAS) is located in Jati Padang, Pasar Minggu, South Jakarta–an area that has reported dengue cases. The laboratory complex is surrounded by residential houses, boarding houses, and experimental garden areas that potentially provide breeding habitats for mosquitoes. Preliminary observations identified several water-holding containers positive for mosquito larvae, along with noticeable mosquito activity within the area.

Despite its epidemiological relevance, no previous study has specifically examined larval density of *Ae. aegypti* in this academic environment. Therefore, this study aimed to determine the larval density indices and describe the distribution of water-holding containers in the Laboratory Center of UNAS and its surrounding residential area.

METHOD

Study Area and Design

This study employed a descriptive observational design conducted from May to August 2025. The study area covered the Laboratory Center of UNAS and surrounding residential areas within approximately a 100-meter radius in RW 001, Jati Padang, Pasar Minggu, South Jakarta (Figure 1).

Sampling

The study population consisted of approximately 120 houses within the defined radius. A total of 100 houses (Direktorat Jenderal Pencegahan dan Pengendalian Penyakit, 2017; Ompusunggu, 2022) were selected using purposive sampling based on accessibility and residents' consent. All accessible water-holding containers containing water were inspected, both indoors and outdoors.

Larval Collection and Identification

Larval inspection was conducted using flashlights for visibility. One larva was collected from each positive container using the single larva method (Direktorat Jenderal Pengendalian Penyakit dan Penyehatan Lingkungan, 2011; Susanna & Sembiring, 2011). Collected larvae were killed in warm water and preserved in 70% alcohol. Morphological identification was performed under a binocular microscope using diagnostic characteristics including siphon structure, thoracic spines, and comb teeth morphology to confirm *Ae. aegypti* species.

Figure 1. Study Population Area (Google Earth, 2025)

Data Analysis

The following indices were calculated:

- House Index (HI): percentage of houses positive for *Ae. aegypti* larvae.
- Container Index (CI): percentage of water-holding containers positive for *Ae. aegypti* larvae.
- Breteau Index (BI): number of water-holding containers positive for *Ae. aegypti* larvae per 100 houses inspected.
- Larvae-Free Index (ABJ): percentage of houses free from *Ae. aegypti* larvae.

The Density Figure (DF) was determined based on WHO classification (Table 1). Data were analyzed descriptively and presented in frequency distribution tables.

Table 1. Density Figure (DF) Classification

DF	HI (%)	CI (%)	BI	Category
1	1–3	1–2	1–4	Low
2	4–7	3–5	5–9	Moderate
3	8–17	6–9	10–19	Moderate
4	18–28	10–14	20–34	Moderate
5	29–37	15–20	35–49	Moderate
6	38–49	21–27	50–74	High
7	50–59	28–31	75–99	High
8	60–76	32–40	100–199	High

9	⩾77	⩾41	⩾200	High

Source: Triana et al. (2021); Widjajanti et al. (2020); WHO (2003)

RESULT

A total of 100 houses and 287 water-holding containers were inspected (Table 2). Among the houses examined, 38 were positive for *Ae. aegypti* larvae (Figure 2), resulting in a HI of 38%. Of the total containers inspected, 59 were positive, producing a CI of 21%. The BI was calculated as 59, indicating 59 positive containers per 100 houses. Based on WHO density classification (Table 1), the DF was determined as 6, which falls into the high-density category. The ABJ was 62%, meaning that only 62 out of 100 houses were free from *Ae. aegypti* larvae.

Table 2. Frequency Distribution of Houses and Water-Holding Containers Based on the Presence of *Ae. aegypti* Larvae

Presence of *Ae. aegypti* Larvae	**Houses**		**Containers**	
	n	**%**	**n**	**%**
Positive	38	38	59	21
Negative	62	62	228	79
Total	100	100	287	100

Most positive containers were located outdoors (42 containers, 26%) compared to indoors (17 containers, 14%) (Table 3). Buckets were the most common container type found (126 units, 43.90%), followed by discarded items and bird drinking containers, as well as various other container types in smaller quantities (Table 4).

Table 3. Frequency Distribution of Water-Holding Container Locations Based on the Presence of *Ae. aegypti* Larvae

Container Location	**Presence of *Ae. aegypti* Larvae**				**Total**	
	Positive		**Negative**			
	n	**%**	**n**	**%**	**n**	**%**
Indoors	17	14	109	86	126	44
Outdoors	42	26	119	74	161	56
Total	59	21	228	79	287	100

In addition to *Ae. aegypti*, *Ae. albopictus* (Figure 3) and *Culex quinquefasciatus* larvae (Figure 4) were also identified in several containers.

DISCUSSION

The HI remains one of the most widely used indicators to assess *Ae. aegypti* infestation, although it does not account for container productivity (WHO Regional Office for South-East Asia, 2011). The HI value of 38% in this study greatly exceeds the 5% threshold associated with dengue transmission sensitivity, indicating substantial infestation. This finding is comparable to that of Tatawi et al. (2024), who reported an HI of 44% in South Minahasa, also categorized as high. Elevated HI values reflect widespread larval distribution and increase the probability of human–vector contact within residential settings.

Table 4. Frequency Distribution of Water-Holding Container Types Based on the Presence of *Ae. aegypti* Larvae

Container Type	Presence of *Ae. aegypti* Larvae				Total	
	Positive		Negative			
	n	%	n	%	n	%
Bucket	15	12	111	88	126	43.90
Discarded Items*	14	28	36	72	50	17.42
Bird Drinking Container	3	13	20	87	23	8.01
Plastic Tub	3	21	11	79	14	4.88
Plant Pot	1	8	11	92	12	4.18
Bathtub	1	10	9	90	10	3.48
Glass Plant Vase	0	0	10	100	10	3.48
Plant Pot Tray	4	57	3	43	7	2.44
Water Gallon	4	67	2	33	6	2.09
Basin	4	80	1	20	5	1.74
Pond	0	0	4	100	4	1.39
Barrel	2	50	2	50	4	1.39
Tarpaulin	0	0	3	100	3	1.05
Jerry Can	0	0	2	100	2	0.70
Aquarium	1	100	0	0	1	0.35
Plastic Box	1	100	0	0	1	0.35
Watering Can	1	100	0	0	1	0.35
Water Tower	0	0	1	100	1	0.35
Toilet Tank	1	100	0	0	1	0.35
Dispenser Tray	1	100	0	0	1	0.35
Bird Cage Tray	0	0	1	100	1	0.35
Dog Drinking Container	1	100	0	0	1	0.35
Cat Drinking Container	1	100	0	0	1	0.35
Earthen Jar	1	100	0	0	1	0.35
Plastic Plant Vase	0	0	1	100	1	0.35
Total	59	21	228	79	287	100

* : discarded items in this study included various types of containers, such as aquarium, plastic tub, tire, basin, plastic box, plastic bottle, bucket, gallon, drinking glass, plastic cup, material cart, flush toilet, suitcase, bowl, food container, tray, plastic dustpan, clay pot, shoe, glass jar, and thin-walled plastic food container.

The CI of 21% falls into the high category according to WHO classification and is higher than the 15.31% reported by Tatawi et al. (2024). Although CI does not reflect container productivity (WHO Regional Office for South-East Asia, 2011), it indicates widespread breeding sites in domestic environments.

Most positive containers were located outdoors. This pattern may be influenced by limited access to indoor areas and by seasonal rainfall during the study period, which allowed outdoor containers to accumulate rainwater. Similar findings were reported by Tirana et al. (2025), who observed higher larval positivity in outdoor containers due to rainwater exposure. These results emphasize the importance of outdoor container management.

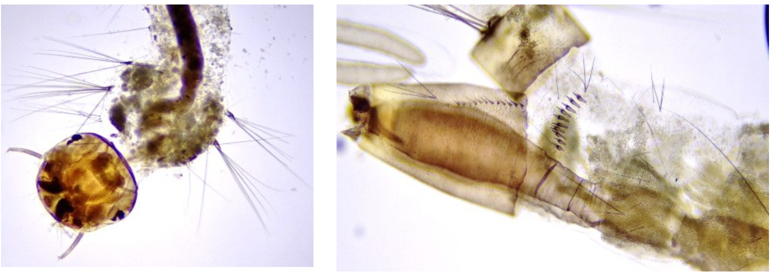

Figure 2. Documentation of *Ae. aegypti* Larvae

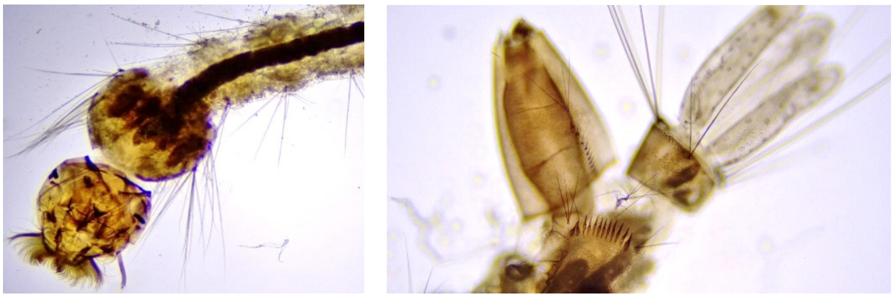

Figure 3. Documentation of *Ae. albopictus* Larvae

Figure 4. Documentation of *Cx. quinquefasciatus* Larvae

Buckets were the most common container type, with 12% found positive. This reflects common water storage practices and aligns with findings by Tirana et al. (2025), who identified buckets as key breeding containers. Additionally, several less frequent container types showed 100% positivity within their categories, indicating that even small or infrequently used containers may act as productive breeding habitats if not properly maintained.

The BI reached 59, exceeding the sensitivity threshold of 20 (WHO Regional Office for South-East Asia, 2011) and comparable to the BI of 68 reported by Tatawi et al. (2024). As BI represents

the number of positive containers per 100 houses, this high value indicates dense larval distribution and reinforces the substantial transmission potential within the study area.
The DF score of 6 further confirms high larval density according to WHO classification. This elevated DF value is consistent with field observations showing widespread use of artificial water-holding containers and the presence of discarded items capable of collecting rainwater without proper management. Such environmental conditions sustain mosquito breeding and contribute to persistent infestation levels.

The ABJ in this study was 62%, markedly below the national environmental health standard of ⩾95% for *Ae. aegypti* larvae (Kementerian Kesehatan Republik Indonesia, 2023). This low value indicates that many households remain positive for larvae, reflecting elevated dengue transmission risk. Although slightly higher than the 56% reported by Tatawi et al. (2024), both findings demonstrate that environmental health standards have not been achieved.

The detection of *Ae. aegypti*, *Ae. albopictus*, and *Cx. quinquefasciatus* indicates the coexistence of two mosquito genera within the study area. The predominance of *Ae. aegypti* is consistent with findings in other urban regions of Indonesia (Budiyanto, 2012; Tirana et al., 2025) and reflects its adaptation to densely populated environments dominated by artificial containers. The coexistence of multiple species suggests overlapping ecological niches, potentially increasing the risk of multiple mosquito-borne diseases.

Collectively, the consistently elevated larval indices and low ABJ value indicate that the study area falls into a high-risk category for dengue transmission. Strengthened source reduction practices, improved community awareness in managing artificial containers, routine entomological surveillance, and implementation of integrated vector management strategies are essential to reduce larval density and mitigate transmission risk.

CONCLUSION

The study indicates high larval density of *Ae. aegypti* in the Laboratory Center of UNAS and its surrounding residential area, as reflected by HI (38%), CI (21%), BI (59), DF score of 6, and ABJ (62%), all of which categorize the area as high risk for dengue transmission. Most positive containers were located outdoors, and buckets were identified as the dominant breeding container type. These findings highlight the important role of artificial water-holding containers in sustaining mosquito breeding. Strengthening community-based source reduction, improving management of outdoor containers, and implementing regular entomological surveillance are essential to reduce larval density and minimize dengue transmission risk in this urban academic environment.

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