

RELATIONSHIP OF WATER MEDIA CHARACTERISTICS (pH, Temperature, TDS) TO DENSITY OF AEDES SP MOSQUITO FLARS. IN KARANGGENENG VILLAGE, LAMONGAN DISTRICT

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ABSTRACT

Relationship of Water Media Characteristics (pH, Temperature, TDS) to Density of Aedes sp Mosquito Flars in Karanggeneng Village, Lamongan District. DHF (Dengue hemorrhagic fever) is a tropical endemic disease in Indonesia with a fluctuating trend in Lamongan. The main factor under control is the larval breeding habitat. This study aimed to determine the relationship between the characteristics of the water medium and the density of Aedes sp. mosquito larvae in Karanggeneng Village, Lamongan Regency. We conducted this quantitative study using a cross-sectional observational method on a sample of 80 houses in Karanggeneng Village, employing a straightforward random sampling technique. We recorded the data collection in the observation sheet and analyzed it with a chi-square test. The results showed that 37 houses were positive for Aedes sp. larvae based on HI (DF = 6), CI (DF = 6), and BI (DF = 7), so Karanggeneng Village has a high mosquito larval density. There is a significant relationship between water media and the presence of Aedes sp. mosquito larvae. The relationship between pH (p-value = 0.000), temperature (p-value = 0.000), and TDS (p-value = 0.000) is significant. We recommend regularly draining the water container weekly to prevent mosquito larvae from using it as a habitat.

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INTRODUCTION

The Aedes sp. mosquito carries the dengue virus, which causes dengue hemorrhagic fever (DHF). In this case, the sufferer will experience fever symptoms for 2–7 days, feeling weak and tired, sometimes followed by other symptoms. Indonesia has a tropical climate that mosquitoes enjoy breeding in. Mosquitoes, a type of arthropod, pose a significant threat to human health due to their role as disease vectors, spreading disease throughout tropical regions every decade ⁽¹⁾. The rapid spread of the dengue virus and its transmission through mosquito bites puts Indonesian people at risk of contracting dengue hemorrhagic fever (DHF). The mosquito species Aedes aegypti and Aedes albopictus transmit dengue fever. Mosquitoes use undrained water reservoirs as breeding grounds. The presence of mosquitoes in an area is an indicator that the area contains Aedes sp. mosquito breeding. Improving

sanitation, health, and movement (PSN) to eradicate mosquito nests can reduce dengue virus transmission to the lowest possible level ⁽²⁾.

Cases of dengue hemorrhagic fever (DHF) in Lamongan Regency in the last 3 years (2019-2021) have fluctuated. In 2019, there were 387 cases of dengue fever recorded, in 2020 there were 112 cases, and in 2021 there was an increase of 219 cases. Numerous factors contribute to the rise in dengue fever, including population density, the presence of mosquito breeding sites, unclean surroundings around homes, and individuals' reluctance to regularly drain water reservoirs. Apart from that, breeding places or other names for containers can impact by increasing cases of dengue hemorrhagic fever. More containers equate to an increase in mosquito breeding sites. This is the reason for the increase in the number of dengue fever cases ⁽³⁾.

Significant risk factors for dengue fever include the type, material, and color of the water reservoir or container, the water source, the presence of larvae-eating fish, and the use of larvicide. Types of containers that are positive for larvae are generally bathtubs, toilet bowls, drums, rockers, and buckets. Meanwhile, plastic is the most commonly used material for containers, followed by cement or cast. The color of the container plays a significant role when mosquitoes are present. Meanwhile, rainwater and pump wells are the most common water sources for containers. Additionally, containers that are conducive to larvae growth are those that lack larvae-eating fish and do not receive regular larvicide spraying ⁽⁴⁾.

Residential containers both inside and outside the house often serve as a habitat for the development of *Aedes* sp. mosquito larvae. In addition, we can categorize the habitat for *Aedes* sp. larvae, whether natural or artificial, as stable, meaning it can be either temporary, permanent, or semi-permanent. Mosquito breeding sites with stagnant water are suitable for mosquito reproduction and larval development ⁽⁵⁾. The *Aedes* sp. mosquito naturally uses containers with clear water, a humid atmosphere, and protection from sunlight as a breeding place. Water from various sources, such as well water, rainwater, and river water, can serve as a breeding ground. Each of these waters has different characteristics. Apart from that, the type of container, location, cover, base material, color, water source, and environmental conditions are also the main reasons for mosquitoes to breed ⁽⁶⁾.

The physiochemical properties of the water carried, such as pH, temperature, and TDS, will influence the growth and development of *Aedes* sp. Environmental conditions with a water temperature between 25°C and 35°C are the ideal temperature for mosquitoes to breed. Apart from that, a pH between 6.5 and 7 is the normal pH for mosquitoes to survive in water. Mosquitoes prefer clear water for breeding, as they cannot survive in turbid conditions or when Total Dissolved Solids (TDS) levels exceed 1000 mg/l ⁽⁷⁾. The Larval Free Rate (ABJ) program is the appropriate control of *Aedes* sp. mosquito larvae. According to WHO, efforts to transmit dengue fever require an HI (house index) of 5% or a larvae-free rate of 95% ⁽⁸⁾. In Karanggeneng Village, Lamongan Regency, this study aims to determine the relationship between water media characteristics and the density of *Aedes* sp. mosquito larvae.

MATERIALS AND RESEARCH METHODS

We conducted this research in Karanggeneng Village, Karanggeneng District, Lamongan Regency from January to February 2023. We conducted the research descriptively and quantitatively using a cross-sectional approach to determine the density of larvae. We calculated this density using the house index (HI), which indicates the percentage of buildings containing *Aedes* sp. mosquito larvae, the container index (CI), which indicates the percentage of containers containing *Aedes* sp. mosquito larvae, and the Breteau index (BI), which represents the percentage of containers positive for mosquito larvae relative to the number of buildings inspected. This research also examines the correlation between the characteristics of water media and the density of *Aedes* sp. mosquito larvae in Karanggeneng Village. In this case, the characteristics of the water medium measured are pH, temperature, and TDS of the water.

The residents of Karanggeneng Village, with a total of 600 houses, were the population in this study. The samples in this study were water reservoirs (containers) located inside and outside 80 residents' houses in Karanggeneng Village, Lamongan Regency. The sampling method is simple random sampling. The instruments used in this research were a questionnaire, an observation sheet, and a flashlight were used in this study to observe the presence of Aedes sp. mosquito larvae. We conducted observations to identify the existence of Aedes sp. mosquito larvae in every container within individuals' residences. We obtained data on the degree of acidity (pH), water temperature, and TDS of water through direct measurements using a pH test unit and TDS meter, which we then recorded in an observation sheet. The independent variables of this research are pH, temperature, and water TDS, while the dependent variable is the presence of Aedes sp. mosquito larvae. In SPSS IBM 21, bivariate analysis with the chi-square test was used to determine the relationship between water media characteristics and the presence of Aedes sp. mosquito larvae, with a p-value of 0.05. We calculate larval survey data using the following formula and adjust mosquito larvae density levels to Table 1.

$$\text{House Index} : HI = \frac{\text{Jumlah Rumah Yang Terdapat Jentik}}{\text{Jumlah Rumah Yang Diperiksa}} \times 100\%$$

$$\text{ContainerIndex: } CI = \frac{\text{Jumlah Kontainer Yang Terdapat Jentik}}{\text{Jumlah Container Yang Diperiksa}} \times 100 \%$$

$$\text{Breteau Index: } BI = \frac{\text{Jumlah Kontainer Yang Terdapat Jentik} \times 100 \text{ Rumah}}{\text{Jumlah Rumah Yang Diperiksa}}$$

Table1. Aedes sp. Mosquito Larvae Density Index.

Density Figures		House Index	ContainerIndex	Breteau Index
Low	1	1-3	1-2	1-4
Currently	2	4-7	3-5	5-9
	3	8-17	6-9	10-19
	4	18-28	10-14	20-34
	5	29-37	15-20	35-49
Tall	6	38-49	21-27	50-74
	7	50-59	28-31	75-99
	8	60-76	32-40	100-199
	9	>77	>41	>200

RESEARCH RESULTS AND DISCUSSION

Density of Aedes sp mosquito larvae.

Based on the results of a survey conducted on 80 houses in Karanggeneng Village, houses were found to be positive for Aedes sp. mosquito larvae. As many as 37 (46% of houses) did not find Aedes sp. mosquito larvae. as many as 48 houses (60%) The survey results for the containers examined revealed that 62 (27%) containers were positive for Aedes sp. mosquito larva We found no Aedes sp. mosquito larvae in 167 (73%) of the containers. d. The results of the analysis of the HI, CI, and BI values were 46.3% (DF = 6), 27.1% (DF = 6), and 77.5% (DF = 7), as shown in Table 2.

Table2. Density Level of Aedes sp. Mosquito Larvae. in Karanggeneng Village

Checked	The presence of Aedes sp. Mosquito larvae.					HI	DF	CI	DF	BI	DF
	Positive	%	Negative	%	Amount						
House	37	46%	48	60%	80	46.3%	6	27.1%	6	77.5%	7
Container	62	27%	167	73%	229						

Note: House Index (HI), Container Index (CI), Breteau Index (BI)

The relationship between water media characteristics and the presence of *Aedes* sp mosquito larvae.

The observations conducted in 80 houses in Karanggeneng Village revealed a pH range of 6.5–8, a temperature range of 25°C to 35°C, and a TDS value of 175–235 mg/l in each container. The results of statistical tests show that there is a relationship between the presence of *Aedes* sp. mosquito larvae and a significant p-value of 0.000 based on differences in pH, temperature, and TDS, as shown in Table 3.

Table3. The Relationship between Water Media and the Presence of *Aedes* sp. Mosquito Larvae. in Karanggeneng Village

Water Media	The presence of <i>Aedes</i> sp. Mosquito larvae.				Total		p-value
	Positive		Negative		F	%	
	F	%	F	%	F	%	
pH							
6.5 – 8	37	100.0%	0	0.0%	37	100.0%	0,000
<6.5 - >8	0	0.0%	43	100.0%	43	100.0%	
Temperature							
25°C -35°C	37	100.0%	0	0.0%	37	100.0%	0,000
<25°C - >35°C	0	0.0%	43	100.0%	43	100.0%	
TDS							
175 – 235 mg/l	37	100.0%	0	0.0%	37	100.0%	0,000
<175 - >235 mg/l	0	0.0%	43	100.0%	43	100.0%	

Vector control to determine the density of mosquito larvae in an area can be carried out We conduct larval surveys in each container and housWe measure larval density by computing index values, including the Houseouse Index (HI), Container Index (CI), Breteau Index (BI), and Density Figure (DF). ensity Figure (DF). HI describes the number of houses where mosquito larvae were found, CI is the number of containers where mosquito larvae were found, and BI is the value of containers where mosquito larvae were found in tlf the HI and CI values surpass 5%, they are considered high-risk, while the BI value surpasses 50%. The risk of dengue fever transmission will increase as the index value increases fever transmission ⁽⁹⁾.

Observations on 80 houses in Karanggeneng Village revealed 37 to be positive for larvae and 48 to be negative. Given the HI value of 46.3% and the provisions, we can conclude that Karanggeneng village falls into the high category, indicating a high risk of dengue hemorrhagic fever transmission. The total number of containers found in 80 houses was 229. Containers that were positive for larvae were 62 (27%) while the ones that were negative for larvae were 167 (73%). According to WHO guidelines, Karanggeneng Village's container index falls into the high category with a CI index of 27.1%. The BI value shows 77.5%. This value also exceeds WHO regulations. According to the values of DF = 7, HI > 5%, CI > 5%, and BI > 50%, Karanggeneng Village has a fairly high risk of dengue fever transmission ⁽¹⁰⁾. Another study examines the density of *Aedes* species. In several elementary schools in dengue-endemic areas in Palembang City, they received a score of DF = 8, which is also in the high category ⁽¹¹⁾. Similar research in West Ranomeeto District, Southeast Sulawesi Province, showed that the density of mosquito larvae was quite high, with a DF value of 6 ⁽¹²⁾. In Gambesi Village, South Ternate District, the results of a larval survey in 150 houses showed a high level of larval density, namely DF = 8. This condition has the potential to cause rapid transmission of the dengue hemorrhagic fever virus, which occurred in Gambesi Village due to poorly maintained and densely populated environmental factors ⁽¹³⁾.

This study found that the bathtub was the type of container with the highest percentage of positive larvae. Bathtubs have the capacity to hold a lot of water, so the water volume is high, and generally there is no cover. Bathtubs are containers that people use for daily needs with a large capacity so that individuals pay less attention to regular draining and prefer to fill them with new water. This makes it easier for mosquitoes to breed. The type of water container certainly influences the presence of mosquito larvae because each water container

has a different availability of microorganisms ⁽¹⁴⁾. When you drain containers once a week, you reduce the risk of contracting dengue fever compared to homes that do not drain bathtubs regularly ⁽¹⁵⁾.

Using chi-square tests, we found that the pH (p-value = 0.000), temperature (p-value = 0.000), and total dissolved solids (p-value = 0.000) of the water have a significant effect on the number of *Aedes sp.* mosquito larvae in Karanggeneng Village. A total of 37 containers that tested positive for larvae had a pH between 6.5-8. This condition is in accordance with the nature of the *Aedes sp.* mosquito larvae, which cannot survive at pH 3 and pH > 12. ⁽¹⁶⁾. The degree of water acidity, or pH, is a factor that really determines the growth of *Aedes sp.* mosquito larvae. Acidic water has higher dissolved oxygen, whereas alkaline water has lower dissolved oxygen. This situation will cause mosquito larvae to not be able to survive in an acidic or alkaline pH because it will inhibit the cytochrome oxidase enzyme in the larva's body, which functions in the metabolic process. ⁽¹⁷⁾. The acidity level (pH) in water is an important variable in the survival and development of *Aedes sp.* mosquito larvae, because conditions that are too acidic or alkaline result in mosquitoes not being able to survive. ⁽¹⁸⁾. The urban and suburban areas of Kinshasa, Congo, yielded similar results, with the positive pH for larvae falling within the range of 6.7. *Aedes sp.* mosquitoes. The physiochemical properties of water and the chosen water source influence egg laying, and the degree of acidity (pH) significantly influences the reproduction of *Aedes sp.* mosquito larvae ⁽¹⁹⁾. Previous research stated that a pH between 7-8 (normal) is the habitat most often found by *Aedes sp.* mosquitoes. If the pH is too alkaline or acidic, it will also inhibit the growth of plankton in the water, which functions as food for the larvae ⁽²⁰⁾.

The water temperature in containers found in Karanggeneng Village ranges from 25°C to 35°C. The optimal temperature for the life of mosquito larvae is around 25–30 °C ⁽²¹⁾. Water temperature greatly influences larval development because mosquitoes prefer tropical climates and warm temperatures. The hatching of mosquito eggs is dependent on the water temperature. If the water medium used by mosquitoes to lay eggs is suitable, the eggs will more easily become instars. Larvae can adapt to low or high temperatures, but this will affect the quality of their growth. Larval metabolism halts at temperatures ranging from 10°C to over 40°C, as fluctuations in temperature can alter the levels of CO₂ and O₂ in the water medium, thereby hindering the larvae's ability to meet their metabolic needs. Similar to other research, there is a correlation between water temperature and the presence of *Aedes sp.* mosquito larvae. Environmental factors influence the moisture activity and metabolism of mosquito larvae. *Aedes sp.* mosquitoes require an average rainfall of 500 mm and temperatures between 25°C and 35°C ⁽²²⁾. Similar conditions in Brazil also show *Aedes sp.* live at 30 °C. Female mosquitoes prefer warm temperatures to lay their eggs. Temperatures that are too hot or cold make the larvae unable to survive ⁽²³⁾.

Total dissolved solids (TDS) are solids that dissolve in water. A high TDS content can decrease sunlight penetration into water and inhibit oxygen regeneration and photosynthesis in living things. Under normal conditions, the TDS value, namely 500 ppm, is still optimal for larvae to survive ⁽²⁴⁾. We found that larva-positive containers in Karanggeneng Village had a TDS value of approximately 175 mg/l. Despite meeting the quality standards for clean water with a maximum content of 1000 mg/l, we found mosquito breeding. ⁽²⁵⁾. The *Aedes sp.* mosquito naturally prefers clean water for breeding. The presence of TDS indicates the presence of dissolved minerals, salts, and metals, not just mud. If the TDS level is high, it will disrupt the growth and survival of *Aedes sp.* mosquito larvae. Similar research also shows that the *Aedes sp.* prefers to lay eggs in clean water because TDS refers not only to water molecules but to all the minerals dissolved in it ⁽¹⁹⁾. *Aedes sp.* uses water with a TDS level of 889 ppm for maximum life. The TDS value in water causes dense ion content and increased electrical conductivity, making it difficult for mosquito larvae to survive ⁽²⁶⁾.

CONCLUSIONS AND RECOMMENDATIONS

The increase in water hyacinth cover during 2021 is around 128.1 ha per month. In the Jatiluhur Reservoir, the distribution of water hyacinth tends to follow the flow of water from the inlet to the outlet. The presence of water hyacinth covering parts of the reservoir waters has a negative impact on the functions and business activities in the Jatiluhur Reservoir. Efforts to control water hyacinth in the Jatiluhur Reservoir are carried out using physical methods by taking the water hyacinth in the waters. We recommend conducting routine and sustainable control efforts. This may involve periodically scheduling the physical removal of aquatic plants each month to prevent excessive accumulation. Physical efforts to control water hyacinth must consider the rate of growth in the water hyacinth's own area. In addition to physical methods, consider using biological control methods, such as the introduction of natural control insects, such as the beetle *Neochetina Eichhornia*, which has proven effective in controlling water hyacinth populations in some areas.

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