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RESEARCH ARTICLE

Community Participation and Mosquito Breeding Sites in Cimahi City: Current Conditions and Challenges in Dengue Fever Control

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Abstract

In 2021, Cimahi City recorded the 5th highest dengue fever (DF) cases among 27 districts/cities in West Java. Efforts to control DF have been going on for several decades, with one strategy being to involve community participation in eliminating mosquito breeding sites. This research evaluated community participation in Cimahi city by identifying mosquito breeding locations inside and outside the home. Samples were taken from 15 sub-districts in Cimahi city. The research population involved houses in 15 sub-districts, with a total sample of 1,560 houses representing each sub-district. Larval sampling was carried out in various water reservoirs, both natural and artificial, around residential areas. The successfully taken larvae were then identified and counted in the laboratory. The research showed that the most dominant mosquito breeding place was in bucket-type containers, namely 130 units (3.2%). Entomological data produced a free larva index (FLI) of 79.23%, a house index (HI) of 20.7%, a container index (CI) of 8.07%, and a Breteau index (BI) of 20.5%. This finding indicated a lack of community involvement in preventing vector-borne diseases by eliminating breeding sites. Cimahi city still had the potential to spread vector-borne diseases.

Keywords: *Aedes aegypti*, dengue, breeding sites, Cimahi, community participation

Introduction

This research was conducted to respond to the increase in dengue hemorrhagic fever (DHF) cases in Bandung city, which reached the highest level in West Java province in 2021.[1] As a region with significant incidence and mortality rates of vector-borne diseases, West Java province was the focus of analysis in this context. Cimahi city, as an integral part of this province, has experienced a growth in dengue fever cases in the last two years, especially in the teenage age group and males.[1] This increase recorded Cimahi as one of the cities with the highest dengue morbidity and mortality rates in West Java in 2021.[2] Although human resources, funding, and activity facilities are adequate, expanding the surveillance system and increasing community participation was crucial for controlling this disease.[3–5]

The breeding environment for the *Aedes aegypti* mosquito, which carries the dengue virus, had significant diversity inside and outside the home.[4,5] Research from various countries shows that environmental management, especially related to water storage containers, directly impacts mosquito population growth.[6–8] In Cimahi city, previous research had not evaluated *Aedes aegypti* breeding sites.[1] The main sampling area is located in an urban area where the population is busy and requires a relatively high supply of clean water. Hence, residents rarely clean it for fear of a lack of water supply.[8]

Therefore, this study aims to identify variations in mosquito breeding sites and evaluate community participation in Cimahi city. The information obtained from this research

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was hoped to help the government develop more effective control strategies. Likewise, entomological aspects became the focus of additional research to gain a deeper understanding of the effectiveness of entomological surveillance in Cimahi city.

This data would provide an overview of the mosquito's entomological index and highlight the challenges that might be faced in controlling dengue vectors. Thus, this research positively impacted improving dengue prevention and control strategies in Cimahi city.

Methods

This research was an observational study with an entomological survey conducted in Cimahi city, involving around 100 households taken randomly at each sampling location. Based on the law of large numbers, which states that the larger the sample size, the closer the sample results are to the actual population characteristics. By selecting 100 samples, even though it is not a total sample of the population, the results will be close enough to the average value of the population.[9] Sample collection was carried out over three months, from October to December 2023, in 15 sub-districts. A total of 1,500 houses were the focus of the research as a representation of each selected subdistrict, as listed in Table 1. Larval sampling was conducted inside and outside the house in various water reservoirs.[10,11]

The sampling procedure for mosquito larvae in containers, according to WHO, involves several main steps that must be followed to ensure accurate and representative results in surveys of *Aedes aegypti* mosquito larvae or other species that are vectors of diseases such as dengue fever.[12]

The procedure is as follows: (1) Equipment preparation: the primary tool used is a pipette or larval dipper, and sample containers and larvae collection bottles must also be prepared to store the larvae found. (2) Container inspection: all containers that can become breeding grounds for mosquitoes, such as buckets, drums, flower pots, and water reservoirs, should be thoroughly inspected, and the water surface and the area around the container to detect larvae. (3) Swoop technique: a mosquito scoop or pipette is used to scoop water from the surface of the container, especially in shaded areas and close to the walls of the container, as mosquitoes tend to lay their eggs in these places; and the water is stirred slowly to make the larvae appear on the surface, then the larvae are scooped out carefully. (4) Perform a sweep in several parts of the container if it is large. (5) Collection and identification:the scooped larvae were put into collection containers and taken to the laboratory for identification, and this process was repeated on all containers in the survey area to obtain representative data. (6) Recording: record the number and type of containers checked, the number of larvae found, and the identification of the type of mosquito.

Table 1 Sampling Locations

No	District	Sub-district	Area (km^2)
1	Cimahi Utara	Cibabat	16.92
2		Cipageran	
3		Citereup	
4		Pasir Kaliki	
5	Cimahi Tengah	Baros	10.00
6		Cigugur	
7		Tengah	
8		Cimahi	
9		Karang Mekar	
10		Padasuka	
		Setiamanah	
11	Cimahi Selatan	Cibereum	13.31
12		Cibeber	
13		Leuwigajah	
14		Melong	
15		Utama	

The identified larvae were taken using a plastic pipette and sent to the Parasitology Laboratory at the Faculty of Medicine, Universitas Padjadjaran. The sample included residential homes with and without water reservoirs that met the inclusion criteria.[5,13] Environmental conditions, such as temperature and humidity, were measured simultaneously in each container during larval observations.[14] The collected data was analyzed using Microsoft Excel 2010. This research received approval from the community health center in each related sub-district. This research was also approved with Registration Number 954/UN6. KEP/EC/2023 by the Faculty of Medicine Ethics Committee, Universitas Padjadjaran.

Mosquito larvae surveys were conducted to collect entomological data. Data calculations use larval indices, such as the house index (HI), container index (CI), and Breteau index (BI). The formula for calculating the mosquito population density value is to combine HI, CI, and BI.[4,15]

$$HI = \frac{\text{Number of houses positive for larvae}}{\text{Number of houses inspected}} \times 100$$

$$CI = \frac{\text{Number of positive containers}}{\text{Number of containers inspected}} \times 100$$

$$BI = \frac{\text{Number of positive containers}}{\text{Number of houses inspected}} \times 100$$

$$FLI = \frac{\text{Number of negative containers}}{\text{Number of containers inspected}} \times 100$$

The density figure results are interpreted as follows: a value <1 indicates a low risk of transmission, 1–5 indicates a moderate risk, and >5 indicates a high risk of transmission.[4]

Results

Figure shows the results of observations of mosquito breeding locations. Of the 3,963 containers examined, 320 (8.07%) were identified as containing mosquito larvae with the following details: buckets 130 units (3.2%), bathtubs 83 units (2%), drums 31 units (0.7%), the dispenser 36 units (0.9%), pot five units (0.12%), pool eight units (0.2%), jar three units (0.10%), water gutter four units (0 .10%), bird cage three units (0.10%), tires two units (0.05%), refrigerator four units (0.10%), aquarium one unit (0.02%), cans three units (0.10%), four units of glass/bottle (0.10%), two units of jar (0.05%), one unit of gallon (0.02%), and one unit of trash can (0.02%).

The environmental measurements revealed that the average water temperature in the containers examined was 26.2°C, while the air humidity was 58.7% (Table 2). The larval survey produced an FLI of 79.23%, HI 20.7%, CI 8.07%, and BI 20.5% (Table 3).

Table 2 Environmental Conditions in Cimahi City

District	Temperature (°C)	Humidity (%)
Cibabat	25.66	55.25
Cipageran	25.96	61.72
Citereup	24.53	71.82
Pasir Kaliki	27.48	67.91
Baros	26.44	49
Cigugur Tengah	26.94	47.83
Cimahi	27.95	51.24
Karang Mekar	28	48.03
Padasuka	26.28	69.75
Setiamanah	27.14	66.14
Cibereum	26.4	57.87
Cibeber	26	65.4
Leuwigajah	25	62.28
Melong	25.35	56.03
Utama	25.21	69.29

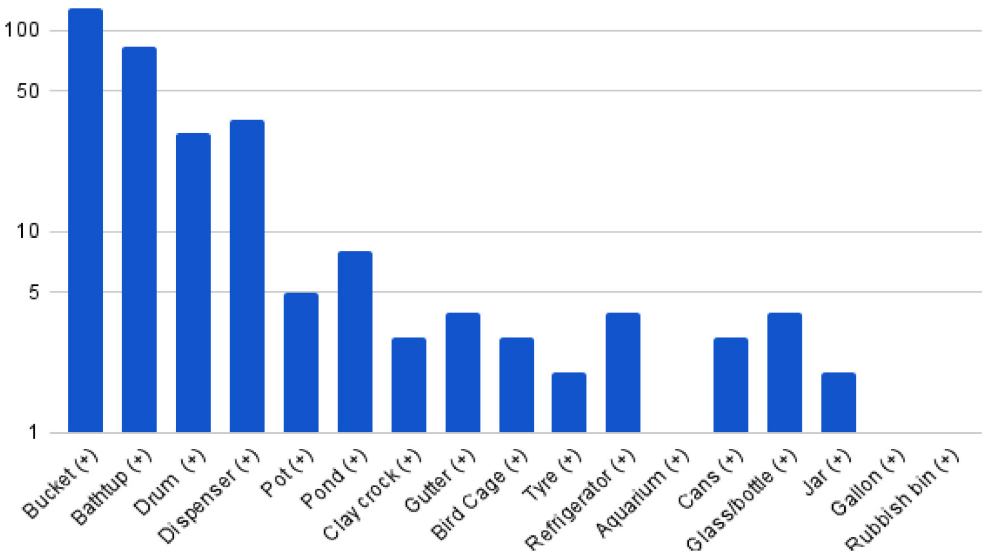

Figure Distribution of Larvae Based on Type of Container Found

Table 3 Larva Index

Object	Quantity			Larva Index (%)			
	Checked	Positive Larva	Negative Larva	FLI	HI	CI	BI
House	1,560	324	1,236	79.23	20.7		
Containers	3,963	320	3,643			8.07	20.5

Discussion

Research conducted in Cimahi city showed that most mosquito larvae were found in buckets and bathtubs.[1,5] This is caused by bathing using a dipper, which is more common than showering among the people of Cimahi city. The bathtub also functions as a place to store water for daily needs, so it has a large capacity and can store water for an extended period.[16,17] The main sampling area is located in an urban area where the population is busy and requires a relatively high supply of clean water. Hence, residents rarely clean it for fear of a lack of water supply.[8] The main places for *Aedes aegypti* mosquitoes to breed in the house include bathtubs, toilet bowls, drinking water reservoirs, jars, clay barrels, plastic barrels, buckets, drums, and ornamental plant vases, which are often neglected to keep clean.[7,8] In contrast to the findings in Cimahi city, research by Dom et al.[18] shows that the breeding places for the *Aedes aegypti* mosquito are more often found outside the house, and the most dominant places are barrels, plastic drums, and jerry cans. In the case of Dom et al.,[18] residents rely on rainwater for their daily water needs, so residents often use the three water reservoirs to meet their water needs.

The results of the larval survey from 1,560 houses showed FLI of 79.23%, HI 20.7%, CI 8.07%, and BI 20.5%. HI and CI calculations produce larval density with density figures. In contrast, BI calculations produce density figure 5, which indicates that Cimahi city had a moderate risk of disease transmission caused by mosquito vectors.[1,5] This confirms that community participation in preventing vector-borne diseases by eliminating vector breeding sites is still very lacking, and Cimahi city has the potential to experience the spread of vector-borne diseases.

Water temperature and humidity are environmental factors that influence mosquito larvae growth.[4,5] The optimum temperature for mosquito growth is 20°C to 25°C.[4,5] Based on the measurement results, the average water temperature in the containers examined was 26.2°C, indicating that Cimahi city had a temperature that supports mosquito breeding.[1,5] Another factor that influences the growth of mosquito larvae is humidity.[4,5] The optimal humidity level for mosquito growth ranges from 81.6% to 89.5%.[4,5] Cimahi city has a humidity level of 58.7%, which is lower than the optimal humidity level for larval growth. This finding aligns with research by Ridha et al.[19] in Banjarbaru and Mading and Kazwaini[20] in Central Lombok, who found larvae at 67.3% and 65% humidity. This shows that humidity levels in the 65–67% range are still sufficient for eggs to develop into larvae well. In conclusion, even though the humidity level is lower than optimal (81.6–89.5%), Cimahi city can still support the growth of mosquito larvae well.

Conclusions

Despite being a small city, the research findings indicate that the success rate of mosquito control programs in Cimahi remains suboptimal, with a relatively high FLI. Although the government has implemented various programs to reduce the risk of vector-borne diseases, these efforts have not been able to significantly decrease the FLI. The challenge may stem from ineffective program implementation or a lack of community participation in prevention efforts, regardless of the reported decrease in cases. Therefore, a thorough evaluation of existing programs is needed, along with enhancing community awareness and participation in eliminating mosquito breeding sites to reduce the risk of vector-borne disease transmission in the future.

Conflict of Interest

All authors must make a formal statement at the time of submission indicating any potential conflict of interest that might constitute an embarrassment to any authors if it were not declared and were to emerge after publication. Such conflicts might include, but are not limited to, shareholding in or receipt of a grant or consultancy fee from a company whose product features in the submitted manuscript or which manufactures a competing product.

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