Potential Of Transmission Of The Dengue Virus Based On Entomological Index And Maya Index In Kalumata And North Mangga Dua villages,Ternate City

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Abstract
Dengue hemorrhagic fever (DHF) is the result of the interaction between the dengue virus, humans and environmental factors. Dengue fever can be spread through the bite of the Aedes aegypti mosquito. Knowledge related to larval habitat is very important to limit the spread of Dengue virus by reducing the population level of Ae. aegypti. This study aims to determine the potential for dengue virus transmission based on the Entomological Index and Maya Index. The study was conducted in 2 villages in Ternate City for 1 month. To calculate the entomological index value, it is done by observing the characteristics of the habitat, namely by observing the container that is the habitat of Ae. aegypti. The calculated parameters are Container Index (CI), Breteau Index (BI), House Index (HI), Density Figure (DF), and calculate the BRI and HRI values to determine the virtual index. Based on the results of the study, it is known that the entomological index value of Kalumata and North Mangga Dua villages is CI 20.71%, HI 84.0% and BI 361%, with the average DF being in the high category (DF = 7 and 9). The virtual nidex value is in the medium category, namely MI = 55%, with a large BRI value = 56% (high category) and HRI = 45.5% (medium category), meaning that Kalumata and North Mangga Dua villages have the potential for virus transmission to occur Dengue

Keywords: *Dengue Virus Transmission, Entomological Index, Maya Index.*

I. INTRODUCTION

The development of dengue fever cases in recent years has no decreasing signs. Dengue fever is caused by dengue virus infection and always spread through vectors. Dengue virus is known as an important cause of dengue fever in both tropical and subtropical regions. Dengue hemorrhagic fever (known as DHF) is resulted from the interaction between pathogen (Dengue virus), host (human) and environmental factors. The DHF cases in Indonesia have spread across 472 regencies/cities in 34 provinces. The deaths caused by DHF occurred in 219 regencies/cities. Meanwhile, the Ministry of Health recorded that the number of people infected by the DHF had reached 313 cases in three first weeks of January, 2022. Of hundreds of confirmed dengue cases, 7 people died. The Ministry of Health also recorded that the number of people suspected with DHF cases had reached 7,316 people.[1] The data on DHF cases in Ternate in early 2022 had recorded 7 cases and 1 death case. This showed that the DHF cases had never disappeared from Ternate (Ternate Education Office. [*2*] Ternate had 77 sub-districts consisting of 33 endemic villages, 27 sporadic villages and 5 potential villages, while the villages free from dengue cases were 12 villages (Ternate Education Office. [*3*] This showed that Ternate had the potential for dengue virus transmission. The efforts to control the development of dengue virus transmission included limiting the development of vector. According to the Ministry of Health of the Republic of Indonesia, to overcome the transmission of dengue virus, the spread of vectors in nature was limited. The main vector of dengue virus is *Aedes aegypti* mosquitoes. Dengue virus could be rapidly transmitted and result in the patients' death. [4]

The activities possibly made to prevent the spread of dengue vectors include the mosquito-nest eradication (known as PSN) and 3M Plus programs. The PSN and 3M PLUS programs are activities made to close all water reservoirs, drain the water reservoirs, dispose/burn the used goods and prevent from the mosquito bites), or fogging/fumigation when the occurring cases meet the criteria. [5] However, the implementation of PSN-3M *Plus* programs made by the Ternate Health Office had not been maximally successful. One important factor causing the spread of DHF was DHF epidemiological changes from time to time due to the vector bionomic, environmental, and demographic transformation changes [6], which eventually affected the dengue virus distribution pattern changes occurring in the research areas/[7] Ternate is an endemic area potentially spreading the Dengue virus. According to Sirisena *et al*., the spread of dengue virus was also influenced by regional characteristics, such as high population density, urbanization, rainfall, and high humidity frequently found in the dengue endemic areas. [8] One important factor to control the DHF vectors is by monitoring the vector population. Vector monitoring was performed to measure the number of entomological indicators to limit the vector population density in the field. The observed entomological indicators included House Index (HI), Breteau Index (BI), Container Index (CI), and Ovitrap Index (OI).[9] According to Konansi *et al*. entomological indicator data were greatly important in provision of initial data to determine the vector control programs.[10] This will easily determine the priority areas in controlling the vectors. This research is expected to obtain the vector entomological data to provide information related to the condition of vector entomology in Ternate. High endemic areas in Ternate were suspected due to the lack of information on vector entomology data and eventually caused the dengue vector control in Ternate less effective. This research aimed to analyze the Entomological Index, Maya Index, and the presence of *Aedes aegypti* larvae distributions in two endemic sub-districts of the working areas of Kalumata Public Health Center, Ternate.

II. METHOD

This study was considered as survey research with a descriptive research method using a cross sectional approach. The research data were collected in October 2021 from two sub-districts: Kalumata and North Mangga Dua sub-districts in the working area of Kalumata Public Health Center, South Ternate District. The research samples were 200 houses consisting of 100 houses in Kalumata sub-district and another 100 houses in North Mangga Dua sub-district. The container checking was performed on water reservoirs (containers) inside and outside the houses. The checked container types consisted of controllable site (CS) container type, that is, a container type which can be controlled, and disposable site (DS) container type, that is, a container type which cannot be controlled. The measured entomological indicators included house index (HI) Container index (CI), and Breteau index (BI). These indicators were used to determine the DHF transmission potentials based on larval density or density figure (DF).

$$\textbf{\textit{House Index}}\ \textbf{(HI)} = \frac{\text{Number of houses found larvae}}{\text{Number of houses found inspected}} \times 100\%$$

$$\textbf{\textit{Container Index}}\ \textbf{(CI)} = \frac{\text{Number of containers that are positive for larvae}}{\text{Number of containers inspected}} \times 100\%$$

$$\textbf{\textit{Breteau Index}}\ \textbf{(BI)} = \frac{\text{Number of containers found larvae}}{\text{Number of houses inspected}}$$

Larval density is categorized into three: low density if DF equal to 1, medium density if DF equal to 2 – 5, high density if DF equal to 6 – 9. The calculation of larval density, according to WHO. [11], can be seen from the following Table 1.

Tabel 1. Larva Index Aedes sp.

Density Figure (DF)	*House Index (HI)*	*Containers Index (CI)*	*Breteau index (BI*
1	1-3	1-2	1-4
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
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

Source ; WHO 2013

Density figure can be categorized into:

DF = 1 = low density

DF = 2-5 = medium density

DF = 6-9 = high density

To measure the cleanliness level of an area, BRI and HRI indicators were used. Breeding risk index is the availability of a place which has the potential as the mosquitos' breeding sites, while the status of hygiene risk index is the cleanliness state of home environment. BRI and HRI can be classified into high, medium, and low categories which calculation was according to the following Table 2: [12]

$$Breeding\ \ Risk\ \ Indicator\ (\mathrm{HRI}) \quad = \frac{\text{Number of disposable containers (DC)}}{\text{Average disposable container (DC)}}$$

$$Hygiene\ Risk\ Indicator\ (\mathrm{HRI})$$
$$\text{Number controllab le container (CC)}$$

Table 2. Matrix 3x3 Components of Breeding Risk Indicator (BRI) and Hygiene Risk Indicator (HRI) on Maya Index

Category		BRI		
		1 (RENDAH)	2 (SEDANG)	3 (TINGGI)
HRI	1 (Low)	BRI1/HR1 (Low)	BRI2/HRI1 (Low)	BRI3/HRI1 (Currently)
	2 (Currently)	BRI1/HR2 (Low)	BRI2/HRI2 (Currently)	BRI3/HRI2 (High)
	3 (High)	BRI1/HRI3 (Currently)	BRI2/HRI3 (High)	BRI3/HRI3 (High)

Source: Astuti et al. [12]

The data obtained will be analyzed using SPSS 17

III. RESULTS

Characteristics of Larvae-Containing Containers

This research was conducted in Kalumata and North Manga Dua Sub-districts, in the Working Areas of Kalumata Public Health Center, South Ternate District (Figure 1). The survey was conducted on 200 houses with the samples of all water reservoirs inside and outside the houses. The collected containers as the research data in this study were shown in Table 3.

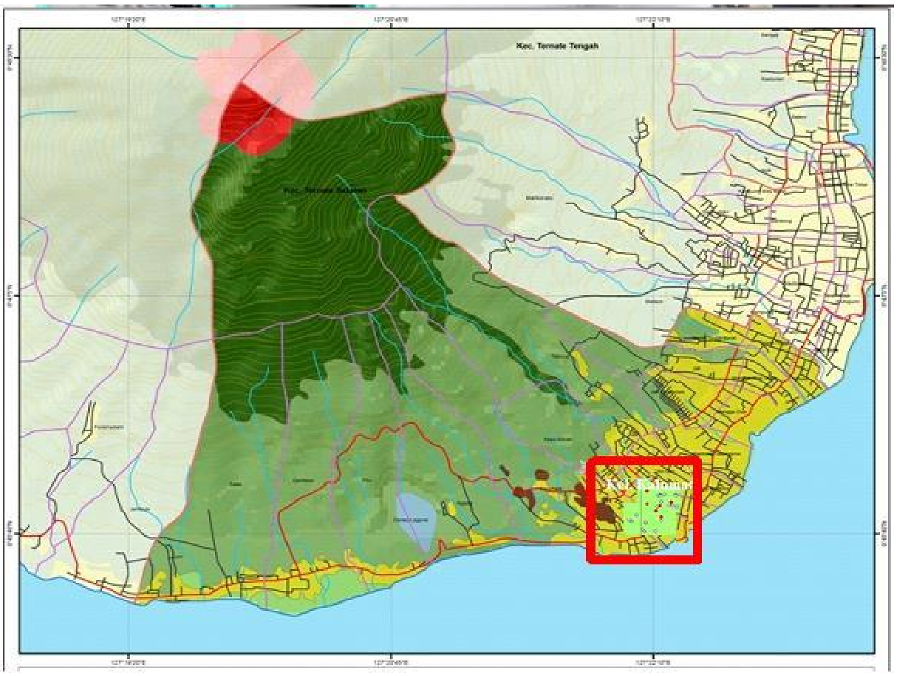

Fig 1. The research location is Kalumata and North Mangga Dua Villages in the Kalumata Health Center Work Area, South Ternate District.

Table 3. Container Distribution in Kalumata and North Mangga Dua Villages, in the Work Area of the Kalumata Health Center, South Ternate District.

No	Coantiner Type	Quantity of Containers	Larvae Positive Contaner	Larvae Negative Contaner
***Controllable Site (CS)* (TPA)**		**1200**	**590**	**610**
1	Bathtub	200	105	95
2	Toilet tub	200	75	125
3	Drum	375	175	200
4	Bucket	425	235	190
***Disposable sites (DS)* (Non TPA)**		**1943**	**158**	**1785**
1	used cans	225	75	150
2	Used tires	23	2	21
3	Used glasses/bottles	123	7	116
4	Vase/Flower pot	560	0	560
5	Pool/Aquarium	12	0	12
6	Dispenser	375	0	375
7	Sink	150	0	150
5	Coconut shell	350	5	345
6	Bamboo cut	20	12	8
7	Used drums	105	57	48
Basic material				
1	Cement	225	107	49
3	Plastic	2567	531	2036
4	Glass	11	0	11
5	Zinc	56	35	190
6	Wood	4	0	4
7	Ceramic	280	75	105
Base color				
1	Red	92	21	71
2	Yellow	45	25	20
3	Blue	752	127	625
4	White	786	122	664
5	Black	323	201	122
6	Green	700	120	580
7	Gray	370	125	245
8	orange	75	7	68
Container location				
1	Outside the building	1873	333	1540
2	Inside the building	1270	415	855
Container Close Condition				
1	Closed	575	105	470
2	Not closed	2568	643	1925

Water sources				
1	PDAM	3531	745	2387
2	Non-PDAM	12	3	8

Based on the habitat characteristics, it was known that there were 1200 controllable site (CS) containers, 590 of which positively had the larvae. There were also 1943 uncontrollable water reservoirs (Disposable site (DS)) containers, 158 of which positively had the larvae. The containers found were dominated by 786 white containers, 752 blue containers, and 700 green containers. The largest materials contained in the containers were plastic (2567 containers), ceramic (280 containers), and cement (225 containers). The containers located outside the houses were 1873 containers, while those inside the houses were and 1270 containers. The closed containers were 575 containers, while the unclosed ones were 2568 containers. The water source of 197 houses was from the Local Water Supply Utility (known as *PDAM)*, while that of only 3 houses located in the coastal areas was from the well water.

Entomologi Index *Aedes aegypti* Larvae

Table 4. The larval density of *Ae. aegypti* in Kalumata and North Mangga Dua Villages in the Kalumata Health Center Work Area, South Ternate District

No	Village	R	R*	Kont	Kont*	CI/DF	HI/DF	BI/DF
1	Kalumata	100	75	1350	387	28,67/7	75,0/8	387,0/9
2	North Mangga Dua	100	84	1743	361	20,71/6	84,0/9	361,0/9
	Total	200	96	3143	748			

Keterangan: R = Home checked ; R* = Larva positive house; Kont = Container checked; Kont* = Larvae Positive Container; CI = *Container index*; BI = *Breteau index*; HI = *House index*

Table 4. showed that in Kalumata sub-district, there were 100 houses surveyed and consisted of 75 houses positively had the larvae, with 387 containers positively had the larvae. Meanwhile, the percentages of CI, HI, and BI were respectively 28.67%, 75.0%, and 387% with the average DF classified into high category (DF = 7-9). Meanwhile in North Mangga Dua Sub-district, 84 houses positively had the larvae with 361 containers positively had the larvae. The percentages of CI, HI, and BI were respectively 20.71%, 84.0%, and 361% with the average DF classified into high category (DF = 7 and 9).The results presented in Table 5 showed that the houses used as the research sample which had the potential to become the habitat for *Ae. aegypti* and was classified into high category was BRI = 56%. The cleanliness level was in medium category with the HRI value = 45.5%. meanwhile, the virtual index value was in the medium category with MI = 55%.

IV. DISCUSSION

3143 containers as the research data were obtained during the survey from two subdistricts. Of all surveyed container types, there were 748 containers positively had the larvae. There were 1200 controlled (Controllable Site (CS)) containers, and 590 containers positively had the larvae. Meanwhile, there were 1943 uncontrolled (Disposable site (DS)) containers, 158 of which positively had the larvae. Bucket, bath tub, and toilet tub were three container types found in the respondent's houses and greatly potential for *Ae. aegypti* to breed. Those three containers were actually easy to control, so that the presence of *Ae. aegypti* was possibly reduced. However, public awareness on the importance of cleaning the buckets, bath tub, and toilet tub had created potential habitats for *Ae. a*to develop.[13] Many people often collected water due to the lack of clean water availability to meet their daily needs and impacted on preventing from the dengue vectors. According to Rismawati and Nurmala, the people's habits collecting clean water in containers for a long time will result in the presence of dengue vectors.[14], Furthermore, Sunaryanti and Iswahyuni, explained in their research that there was a positive relationship between people's attitudes and behaviors in Jelok Village, Cepogo, Boyolali to prevent from DHF in its areas.[15] People's understanding to eradicate the mosquito nests is greatly important, so that the presence of *Ae. aegypti* can be controlled. Implementing the mosquito-nest eradication properly and correctly to the containers will free the areas from *Ae. Aegypti* larvae. The uncontrolled containers (disposable containers) from waste or used goods tended to be poorly noticed by the people.[9] According to Prasetyowati and Ginanjar, to minimize the presence of *Aedes sp.* around the people can be done by improving the environmental sanitation through good management of waste and used goods.[16]

The research results on 200 houses of two sub-districts in the working areas of Kalumata Public Health Center showed that the larval density level was in high category with the DF value of 6-9. The average entomological index value was at high risk of more than the entomological index value set by WHO: CI≤5%, HI>10 and BI>50%).[16] This indicated that the larvae population density in two sub-districts had a high transmission potential. Similar result of research was also reported in 2019 on 20 urban villages of Ternate, in which the entomological index values of *Ae. Aegypti,* such as CI, HI, and BI in Ternate were in high category.[9] These results were different from the results of research conducted by Prasetyowati and Ginanjar in the East Jakarta areas in 2017 with the entomological index values at medium category. These results were influenced by the number of water reservoirs deliberately provided by people followed with poor environmental sanitation[16] Many factors affected the high value of entomological index, such large number of containers which had the potential to become the habitats of *Ae. aegypti* larvae spread in the surveyed two sub-districts. Based on the container index survey data, it showed that the opportunities to create more habitats were from the containers inside the houses.[9] has previously explained that many containers found with larvae were those inside the houses. Perwitasari *et al*. similarly explained that the containers mostly contained *Ae. aegypti* were those inside the houses.[17]

The virtual index data analysis on two sub-districts of Ternate was in moderate risk level category (55%). Based on the survey results, it was found that the houses used as samples which had the potential to become the habitats of *Ae. aegypti* were in high category with BRI = 56%. Meanwhile, the environmental cleanliness level was in medium category with the BRI value of 45.5%. These data indicated that the container conditions found during the survey had the potential to become a habitat for the development of *Ae. aegypti*. This showed that those two sub-districts in the working areas of Kalumata Public Health Center had the opportunities to transmit the dengue diseases. Novita *et al*. explained that if the virtual index is found in moderate to high category, dengue virus transmission is increasing in these areas.[18] The results of research conducted by Parsetyowati *et al*. in Bandung showed that the virtual index value of 77.74% in medium category had the Dengue virus transmission potential.[19] Taslisia *et al.* similarly reported that their research conducted in Salido Village, Jurai IV District, South Pesisir Regency was in medium category with the virtual index value of 93%.[20]

V. CONCLUSIONS

Based on the research results, it was known that the entomological index value of Kalumata and North Mangga Dua Sub-district has CI of 20.71%, HI of 84.0% and BI of 361%, with the average DF in high category (DF = 7 and 9). The virtual index value was in medium category: MI = 55%, with a large BRI value = 56% (high category) and HRI = 45.5% (medium category). It meant that Kalumata and North Mangga Dua sub-districts had the potential for Dengue virus transmission to occur.

The results of research conducted in two sub-districts in the working areas of Kalumata Public Health Center were recommended to be implemented in all working areas of Kalumata Public Health Center and the other sub-districts located in other working areas of Public Health Centers in Ternate. Thus, more appropriate and even control patterns could be determined in all sub-districts in Ternate.

VI. ACKNOWLEDGMENTS

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