Mosquito Larval Density, Incidence Rate, CFR, and Domestic Water Storage System During Transmission of Dengue Hemorrhagic Fever in Kupang, East Nusa Tenggara, 2012

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ABSTRACT

Introduction: The number of dengue cases in the city of Kupang was quite high when compared to previous years. Number of deaths due to dengue fever was also considered high. When compared between the months of January, February and March 2012 with January, February and March of 2011, there was an epidemiologically significant increase in cases (the increase was higher than 2-fold). In epidemiological sense, this situation was considered as dengue outbreak or extraordinary event.
Objectives: To calculate and investigate mosquito larval density (density rate), incidence rate, case fatality rate (CFR), and water storage system in community.
Methods: This research was a descriptive survey study using a cross sectional design. The size of samples to be studied was 300 samples allocated evenly to the 10 kelurahan (urban villages), including Bakunase, Kuanino, Bonipoi, Nunhila, Oetete, Sikumana, TDM, Pasir Panjang, Penfui, and Kelapa Lima.
Results: The mosquito larval density in Kupang consisting of CI = 39.80%, HI = 67%, BI = 1.97 and LFI (larva free index) = 33%. Incidence Rate (IR) = 0.3% and Case Fatality Rate (CFR) = 1.2%. Types of containers used here were Drum, water tanks, Jars/buckets/pot, and others (kettles, jerrycans, cooking pots). The majority of containers used were drums. Water storage duration was on average 3-7 days.
Conclusion: The density of larvae in the city is quite high based on CI, HI, BI, and LFI. The mortality rate (CFR) is far in excess of the national standard, where it is directly proportional to the density of Aedes larvae.The drum is the most commonly container used. Water distribution system from the PDAM of the Kupang city constitutes a major factor causing people to store water for a long time.

Keywords: larval density, Incidence Rate, CFR, water storage system

INTISARI

Pendahuluan: Angka kasus DBD di Kota Kupang cukup tinggi bila dibandingkan dengan tahun-tahun sebelumnya. Apabila dibandingkan antara bulan Januari, Pebruari dan Maret Tahun 2012 dengan bulan Januari, Pebruari dan Maret tahun 2011, telah terjadi peningkatan kasus yang bermakna secara epidemiologis (peningkatannya lebih dari 2 kali lipat), secara epidemiologis keadaan ini sudah dikatakan Kejadian Luar biasa atau KLB.
Tujuan: Untuk menghitung kepadatan jentik nyamuk (Density Rate), incidens rate kasus, angka case fatality rate (CFR), Sistim Penyimpanan air masyarakat.

Metode: Jenis penelitian ini adalah penelitian Survey Deskriptif dengan rancangan/ desain penelitian adalah Cross Sectional study (Studi Potong Melintang). Besar sampel yang diteliti adalah 300 sampel lalu di alokasikan secara merata pada 10 kelurahan yaitu Kelurahan Bakunase, Kuanino, Bonipoi, Nunhila, Oetete, Sikumana, TDM, Pasir Panjang, Penfui, Kelapa Lima.
Hasil: Angka kepadatan jentik nyamuk di Kota Kupang terdiri dari CI=39,80%, HI=67%, BI=1,97 dan LFI=33%. Incidence Rate (IR) = 0,3% dan Case Fatality Rate (CFR) =1,2%. Jenis Kontainer yang digunakan adalah Drum, Bak Air, Tempayan/ Ember/ Gentong, dll (Ceret, Jerigen, Periuk), yang terbanyak adalah drum. Lama penyimpanan air rata-rata 3-7 hari.
Simpulan: Tingkat kepadatan jentik nyamuk di Kota Kupang cukup tinggi berdasarkan angka CI, HI, BI, dan ABJ. Angka kematian (CFR) melebihi standar nasional Jenis container yang terbanyak adalah drum. Sistem pendistribusian air dari PDAM Kota Kupang menjadi faktor penyebab utama warga menyimpan air dalam waktu yang lama.

Kata Kunci: kepadatan jentik nyamuk, Insidence Rate, CFR, Sistem Penyimpanan Air

INTRODUCTION

In Indonesia, dengue cases were first reported in the Jakarta and Surabaya in 1968 with the number of cases as many as 58 people (IR = 0.05 per 100,000) and 24 of them died (CFR = 41.3%). Year after year its distribution area expanded and the number of reported cases continues to rise despite the Case Fatality Rate tends to decrease. The whole area of Indonesia possess risk for contracting dengue disease, because the virus causes and transmitters vector widespread both at home and in public place, unless the area is more than 1000 meters height above sea level[1].

Based on Indonesian Health Profile in 2007[2], during the years 2003-2007 the numbers of dengue cases in Indonesia showed a significant increase. In 2003 recorded 51.516 cases (IR = 23.87; CFR = 1.5; in 2004 recorded 79.462 cases (IR = 37.11; CFR = 1.2) in 2005 recorded 95.279 cases (IR = 43.42; CFR = 1.36) in 2006 recorded 114.656 cases (IR = 52.48; CFR = 1.04); in 2007 recorded 158.115 cases (IR = 71, 78; CFR = 1.01). In 2006 cases of dengue fever in East Nusa Tenggara Province recorded 251 cases (IR = 6.4; CFR = 1.2) and a significant increase in 2007 was 518 cases (IR = 13.1; CFR = 2.1) .

The number of dengue cases in the city of Kupang was quite high when compared to previous years. Number of deaths due to dengue fever was also considered high. Ten people died and the CFR (case fatality rate) was calculated at 1,4%[3]. When compared between the months of January, February and March 2012 with January, February and March of 2011, there was an epidemiologically significant increase in cases (the increase was higher than 2-fold). In epidemiological sense, this situation was considered as dengue outbreak or extraordinary event.

One of the efforts made to reduce the incidence of dengue in each city / region and to eradicate the dengue vector mosquitoes is by monitoring the population density of Aedes aegypti mosquito larvae in urban villages, namely by conducting surveys of mosquitoes and larvae. By calculating the population density of mosquitoes and larvae in each village, we will obtain a picture of the number of Aedes larvae-positive house (house index), number of larvae-positive containers (water reservoirs) (container index), the number of positive containers per 100 houses (Breteau index) and larva free index (LFI) in every urban village, so that eradication efforts would be more effective, because it involves the participation of the community members.

Indicators of Aedes larvae density above (HI, CI, LFI, BI) also indirectly describe the hygiene behavior of people, especially the behavior of closing and cleaning water reservoirs, as well as the behavior of storing water (water storage pattern).

The higher the house index, container index, and Breteau index, the lower the hygiene behavior of people or even less public awareness of the threat of dengue fever.

With the above considerations, it is deemed necessary to investigate and calculate the population density of Aedes mosquito larvae in some areas during the transmission of dengue hemorrhagic fever, as well as accurately calculate incidence rate and case fatality rate (CFR) due to dengue fever during the dengue transmission in order to carry out appropriate interventions for eradication measures involving active role of community members.

MATERIAL AND METHODS

This study was conducted in Kupang city in several urban villages. Population of this study was the entire houses in the villages having the highest number of cases and the death rates in the city, including 10 urban villages of Bakunase, Kuanino, Bonipoi, Nunhila, Oetete, Sikumana, TDM, Pasir Panjang, Penfui, and Kelapa Lima. Sample was drawn using non-random sampling technique. Sampling population was determined using *judgment sampling*/purposive sampling technique[4]. The number of samples required in this study were 300 houses.

This method used was a descriptive survey study using cross sectional design. Population density of Aedes aegypti mosquito larvae based on calculation of the population density of Aedes aegypti mosquito larvae, which is done visually by looking at the presence or absence of larvae in each water reservoir examined without taking larvae. Size used for the density of larvae is: HI, CI, BI, and LFI. It is considered dense when: HI = > 5%, CI = > 0,5%, BI = > 0,5%[5]. It is considered positive for larvae when there are mosquito larvae and their body position forms an angle in the water or on water surface. House Index (HI) was a percentage of Aedes larvae-positive houses examined. It is considered not eligible when HI > 5 %. Container Index (CI) was a percentage of water reservoirs/ containers which are positive for the presence of Aedes larvae and considered not eligible when CI > 5 %. Breteau Index (BI) was a measure of the density of mosquito larvae by counting houses which are positive for Aedes larvae per 100 houses. It is considered not eligible when BI > 5 %. Larva Free Index (LFI) was one of the indicators for the density of Aedes aegypti mosquito larvae by calculating what percentage of houses that are free of Aedes larvae. Incidence rate based on a morbidity rate due to the dengue hemorrhagic fever during the transmission period of November 2011 - May 2012. A percentage of the IR would be seen from month to month. Case Fatality rate (CFR) based on the mortality rate due to dengue hemorrhagic fever transmission during the period of the November 2011 - May 2012.

Water Storage Systems in Household based on a water storage system in the houses ranging from the type of container used, caps used / no caps used and water storage duration in households. It is considered eligible when containers are good and clean with caps, water storage duration maximum for 3 days. It is considered not eligible: when it does not comply with the above criteria.

RESULT AND DISCUSSIONS

1. Types of Containers

Types of containers found in every house, whether they are inside or outside home, are drums, water tanks, jars/buckets/pots and others such as showed in Table 1.

Table 1. Types and number of containers inside and outside home in the research area of the Kupang City in 2012

No	Type of Containers	Number of water-holding containers	Number of containers with larvae (positive for larvae)
Inside home			
1.	Drums	149	112
2.	Water tanks	231	136
3.	Jars/buckets/pots	246	41
4.	Others (*)	146	13
Outside home			
1.	Drums	363	218
2.	Water tanks	173	76
3.	Jars/buckets/pots	230	34
4.	Others (*)	121	30
TOTAL		**1659**	**660**

(*) Jerry cans, kettles, cooking pot

Table 1 shows that after an investigation of the types of containers that are used by people inside the house, including drums, water tanks and jars/bucket/pots. It is known that there are 149 water-holding drums, 112 of which are positive for larvae; 231 water-holding tanks, 136 of which are positive for larvae; 246 water-holding jars/buckets/pots, 41 of which are positive for larvae; 146 other water-holding containers, 13 of which are positive for larvae. While the types of containers outside home include: drums, water tanks and jars/bucket/pots. It is known that there are 363 water-holding drums, 218 of which are positive for larvae; 173 water-holding tanks, 76 of which are positive for larvae; 230 water-holding jars/buckets/pots, 34 of which are positive for larvae; 121 other water-holding containers, 30 of which are positive for larvae.

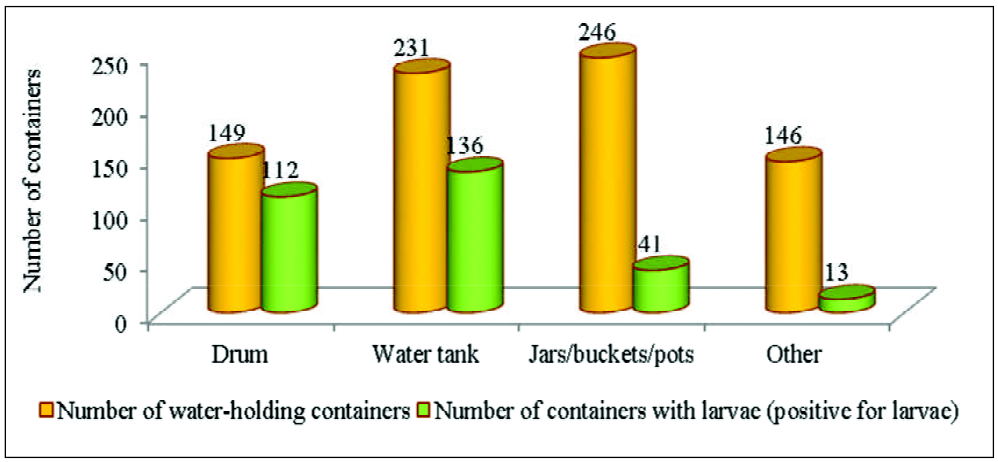

Figure 1. Type of containers inside home

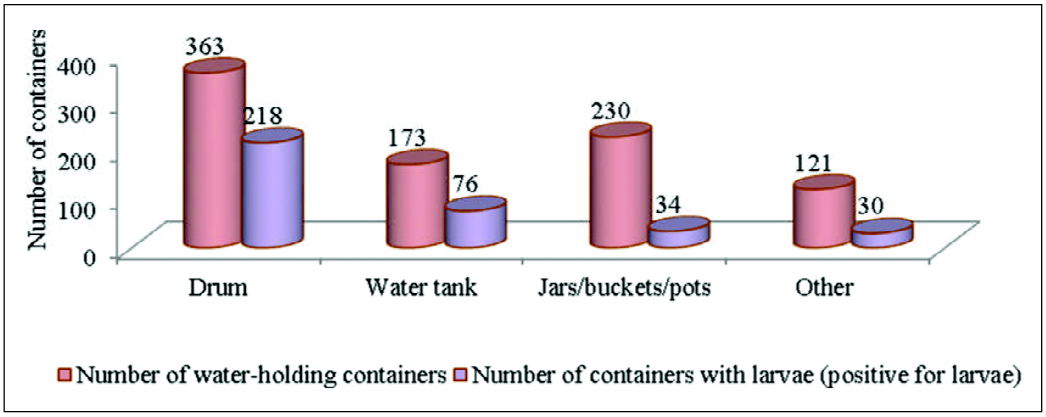

Figure 2. Type of containers outside home

Figure 2 shows that the types of containers outside home which are most commonly positive for larvae are drums (218 containers), followed by the water tanks (76 containers), jars/ buckets/pots (34 containers) and 30 other containers.

These three containers are commonly used by people as water reservoir and water storage for daily needs. Hasyimi[6] said that the use of water reservoirs in the settlements where the daily water needs are managed by the PDAM often causes problems for mosquito vector breeding since many people store their water in certain places. For this reason the Aedes mosquito breeding places tend to increase thus expanding the transmission of dengue virus. In fact, according to the WHO[7], environmental management method to control the presence of *Aedes aegypti* and *Aedes albopictus* and reduce contact between humans and mosquitoes is done through improved water availability and storage. However, it is necessary to provide an adequate outreach or education to the community members about water management in the water reservoirs in ways which can minimize the transmission of dengue since the habit of storing water has been going on for a long time and continues to be done despite obtaining water for their daily needs is no longer an obstacle in the areas.

2. Number of Containers Positive for Larvae

The results of the research against 300 houses in Kupang City show that there are 1659 water reservoirs (containers), which consist of drums, water tanks, buckets/pot/jars, and others (jerry cans, kettles, cooking pots). These containers are located inside and outside home. The numbers of containers positive for Aedes larvae are 660 containers (40%).

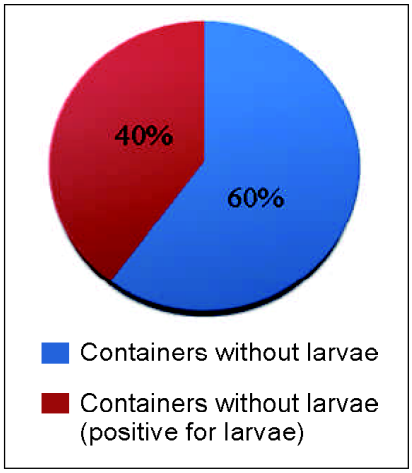

Figure 3. Percentage of containers with larvae (positive for larvae)

Figure 3 shows that the percentage of Aedes larvae-positive containers is at 40%. This figure far exceeds the standard.

3. Larvae density is calculated using formula of the CI, HI, BI and LFI.

The larvae density is calculated using formula of the container index (CI), house index (HI), Breteau index (BI) and larvae free index (LFI). The results of the study in Kupang City show larvae density below.

Table 2. Results of Container Index, House Index, Breteau Index and Larva Free Index in Kupang City, 2012

No	Urban villages	Container Index (CI)	House Index (HI)	Breteau Index (BI)	Larva free index (LFI)
1	Bakunase	29 %	66%	1.4	37%
2	Kuanino	16 %	44%	0.7	57%
3	Bonipoi	42 %	60%	2.4	40%
4	Nunhila	46 %	87%	2.8	40%
5	Oetete	46 %	80%	2.4	20%
6	Sikumana	44 %	63%	2.8	37%
7	TDM	39 %	70%	2.4	30%
8	Pasir Panjang	37 %	57%	1.6	43%
9	Penfui	45 %	67%	1.8	33%
10	Kelapa Lima	37 %	80%	1.4	20%
	Averages	**39,80 %**	**67%**	**1.97**	**33%**

Table 2 relating to the results of Container Index, Index House, Breteau Index and Larvae Free Index demonstrates that the highest percentage of Container Index is found in Nunhila and Oetete by 46%; the lowest percentage is found in Kuanino by 16%. The highest percentage of House Index is found in Nunhila by 87%, the lowest found in the Kuanino by 44%.

The highest Breteau Index is found in Sikumana and Nunhila by 2.8, the lowest Breteau Index found in Kuanino by 0.7. While the highest percentage of larvae free index (LFI) is found in Kuanino by 57%, the lowest in Kelapa Lima and Oetete by 20%. As a whole, the container index (CI) is recorded at 39.80%, or average at 40%, House index (HI) at 67% and larvae free index (LFI) at 33%.

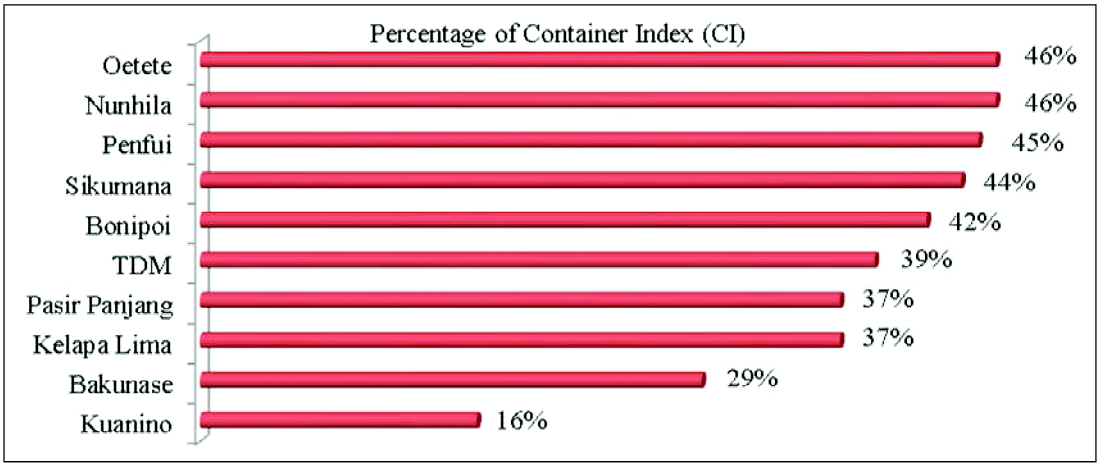

Figure 4. Percentage of Container Index (CI) in Urban Villages in Kupang City, 2012

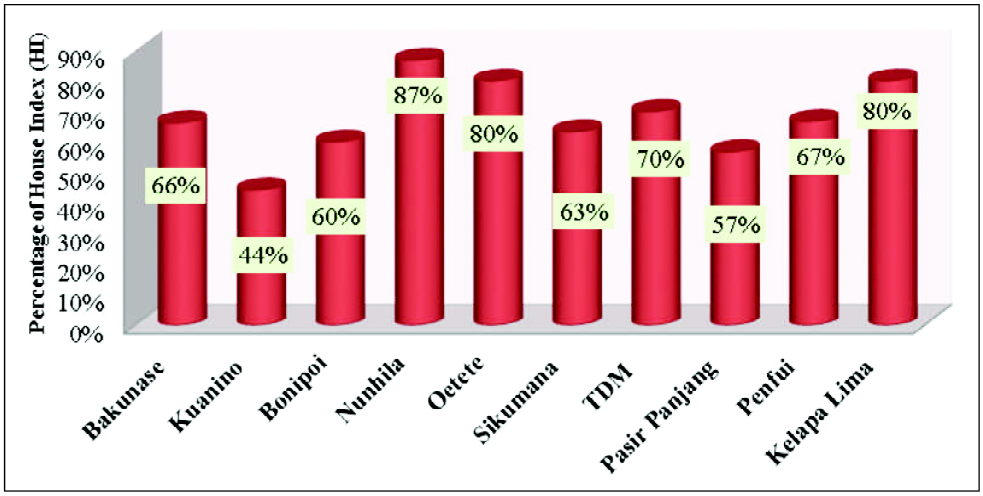

Figure 5. Percentage of House Index (HI) in Urban Villages in Kupang City, 2012

Regarding Figure 5 of the House Index (HI), it appears that the HIs are recorded at 66% in Bakunase, 44% in Kuanino, 60% in Bonipoi, 87% in Nunhila, 80% in Oetete, 63% in Sikumana, 70% in TDM, 57% in Pasir Panjang, 67% in Penfui and by 80% in Kelapa Lima.

The highest percentage of the HI is found in Nunhila by 87%, while the lowest in the Kuanino by 44%. Overall HI averages taken from the 10 urban villages amount to 67%. It means that of the 300 houses examined, 201 of which are positive for mosquito larvae. This suggests that potential cases of dengue fever in the city are still very high. This is supported by the statement from *Pant and Self* [8] that an area is considered to be at high risk for the transmission of dengue disease when the area has HI value above 10%. Meanwhile, according to the WHO[9] the area with HI value greater than 5% generally will become dengue fever-prone area. Therefore, people and government must work harder to make extra efforts to eradicate dengue by providing education (*outreach*) about clean and healthy life style, fogging, the launching of "community service" each Friday by cleaning gutters and draining water-holding containers, etc.

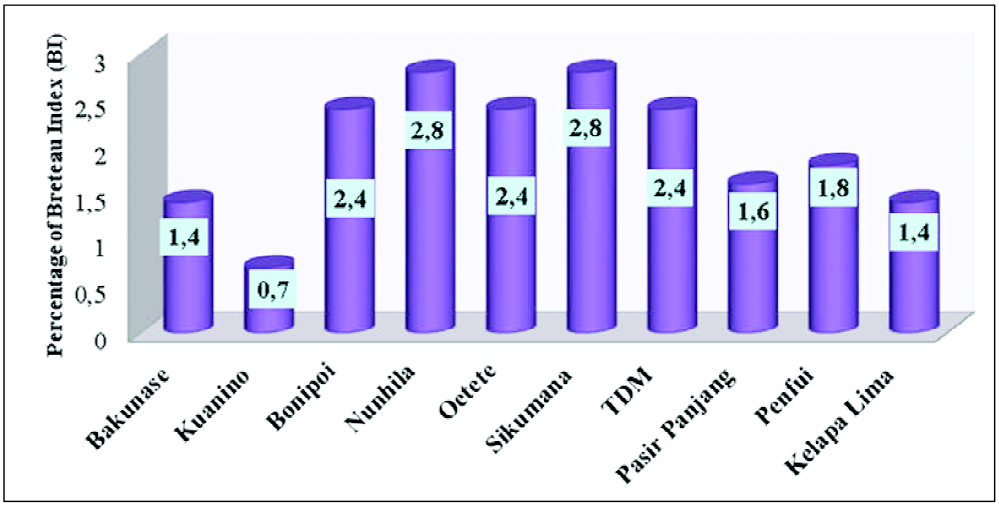

Figure 6. Percentage of Breteau Index (BI) in Urban Villages in Kupang City, 2012

Regarding Figure 6 of the Breteau Index (BI), it appears that the BIs are recorded at 1.4 in Bakunase, 0.7 in Kuanino, 2.4 in Bonipoi, 2.8 in Nunhila, 2.4 in Oetete, 2.8 in Sikumana, 2.4 in TDM, 1.6 in Pasir Panjang, Nunhila and Sikumana by 2.8, while the lowest in Kuanino by 0.7. The overall BI 1,8 in Penfui and 1.4 in Kelapa Lima villages. The highest BIs are found in average of the ten urban villages is recorded at 1.97.

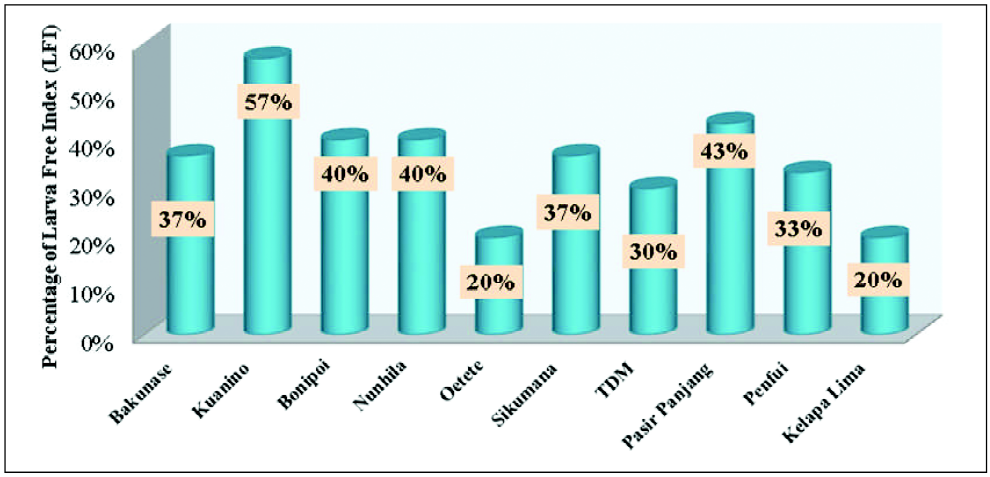

Figure 7. Percentage of Larva Free Index (LFI) in Urban Villages in Kupang City, 2012

Regarding Figure 7 of the larva free index (LFI), it appears that the percentage of the LFI is recorded at 37% in Bakunase, 57% in Kuanino, 40% in Bonipoi, 40% in Nunhila, 20% in Oetete, 37% in Sikumana, 30% in TDM, 43% in Pasir Panjang, 33% in Penfui and 20% in Kelapa Lima village. The highest LFI occurs in Kuanino by 57%, while the lowest in the Oetete by 20%. The higher LFI percentage may reflect the lower potential incidence of Dengue Fever in the relevant area, and the lower LFI percentage may imply the higher potential incidence of Dengue Fever in the area. Overall LFI average of the ten villages amounts to 33%.

To prevent the dengue transmission, the Ministry of Health of the Republic of Indonesia has established larva free index (LFI) in each area at least 95%. The relatively low LFI (less than 95%) will enhance the chances of transmission of dengue virus. The results are showed in the graph 1.7 where the highest LFI is found in Kuanino by 57%. This figure is certainly still far from the target as determined by the Ministry of Health at least 95%. The lowest percentage is found in Oetete and Kelapa by 20%. This very low LFI may be susceptible to the outbreak of dengue.

1. Incidence Rate (IR) and Case Fatality Rate (CFR) in Kupang City

During the period of November 2011 to April 2012 the morbidity rate (incidence rate) and case fatality rate (CFR) in the city of Kupang are as follows:

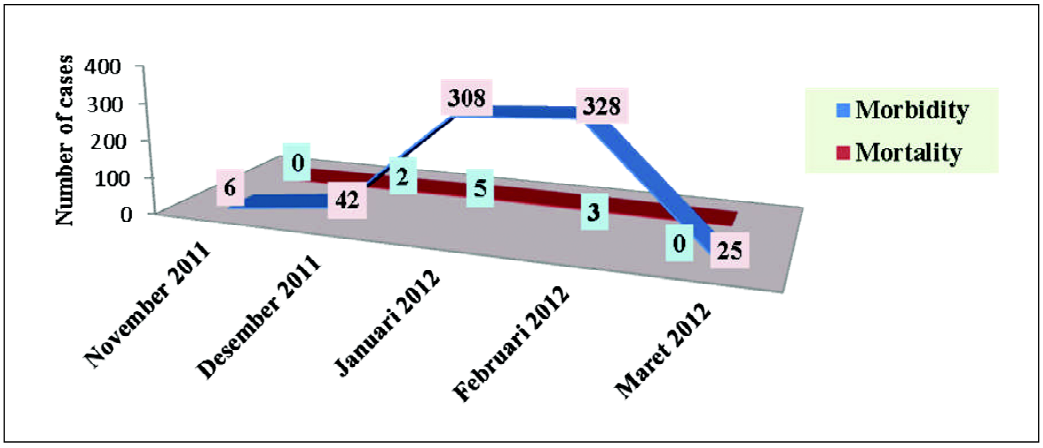

Figure 8. Number of Morbidity and Mortality Cases in Kupang City During November 2011 – Maret 2012

Figure 8 regarding morbidity (cases) and mortality rates above shows that there were six morbidities (cases) in November 2011, 42 cases in December 2011, 308 cases in January 2012, 328 cases in February 2012, and 25 cases in March 2012. Regarding these results, it appears that the peak increase in morbidities occurred in January 2012 and February 2012. Furthermore, the graph 1.9 also indicates that mortalities were highest in January 2012 by 5 deaths, followed by February 2012 by 3 deaths, and December 2011 by two deaths.

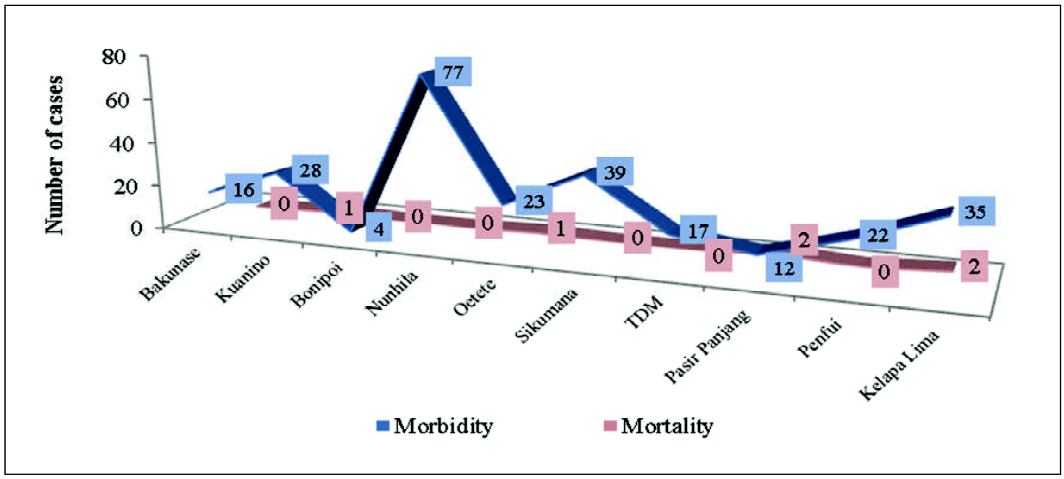

Figure 9. Number of Morbidity and Mortality Cases in Urban Villages in Kupang City, 2012

Figure 9 indicates that the morbidity rates were highest in Nunhila at 77 cases followed by Sikumana at 39 cases, Kelapa Lima at 35 cases, Kuanino at 28 cases, Oetete at 23 cases, Penfui at 22 cases, TDM at 17 cases, Bakunase at 16 cases, Pasir Panjang at 12 cases, and Bonipoi at 4 cases. From these data it can be concluded that the morbidity rate in the city is still very high. Thus, the health workers, community members and governments must make every effort to tackle and prevent an increase in the incidence/ dengue cases.

In addition to morbidity rates, the table 1.10 also reveals mortality rates in which the highest mortality rate occurred in Kepala Lima and Pasir Panjang villages at two death cases, followed by Oetete and Kuanino at one death case.

The population of the city of Kupang in 2011 amounted to 349.344 people consisting of 179.323 men and 170.021 women. The numbers of patients with dengue fever during the period of November 2011 to April 2012 were 852 people. Overall incidence rate was 0.3% and the CFR was 1.2%. This rate is relatively high compared to the national standard of CFR 0%, and the incidence was classified as outbreak of dengue hemorrhagic fever. These morbidity and mortality data are closely related to the high density of Aedes larvae in the city.

CONCLUSION

Density of mosquito larvae in the Kupang city consists of CI = 39.80%, HI = 67%, BI = 1.97 and LFI = 33%. All these figures show that the density of larvae in the city is quite high.

Incidence Rate (IR) = 0.3% and Case Fatality Rate (CFR) = 1.2%. This mortality rate (CFR) is far in excess of the national standard, where it is directly proportional to the density of Aedes larvae.

Types of containers used here are drums, water tanks, jars/bucket/ pot, and other (kettles, Jerry cans, cooking pots). The drum is the most commonly container used. Water storage duration is on average 3-7 days. Long storage duration becomes a good medium for the breeding of Aedes aegypti mosquito larvae. Water distribution system from the PDAM of the Kupang city constitutes a major factor causing people to store water for a long time.

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