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Density of *Aedes aegypti* larvae in elementary schools in the endemic and non endemic areas DHF Kupang city

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Abstract--Dengue Hemorrhagic Fever (DHF) has become a public health problem in Indonesia, especially affecting children aged < 15 years. This study aim to analyze the density of *Aedes sp* larvae in elementary schools in the endemic and non-endemic DHF in Kupang City. This study located in 12 elementary schools in the endemic area of DHF and 7 elementary schools in non-endemic. Data were collected by trained field officers through a survey of the conditions and types of water container and the density of *Aedes sp* larvae. Data were analyzed descriptively and displayed with tables by percentage. The results showed that the condition of water container was not covered, that are 92.2% and 93.3%, respectively. The water reservoirs that are positive for *Aedes aegypti* larvae in endemic and non-endemic DHF that are bathtub (39.4% and 35.7), and in crock (37.2% and 0.0%). The *Aedes sp* larval density was 33.3% for Container Index, both in endemic area, and House Index in endemic and non-endemic DHF 85.7% and 60%, respectively. All larvae collected were 100% *Aedes aegypti*. It was concluded that the density of *Aedes aegypti* larvae an integrated and cross-institutional effort to control the dengue vector is needed to prevent dengue transmission, especially in school areas.

Keywords---density, *Aedes aegypti*, elementary school, endemic, DHF, non-endemic DHF.

Introduction

Dengue Hemorrhagic Fever (DHF) has become a public health problem in Indonesia for the last 47 years. Since 1968 there has been an increase in the number of provinces and districts/cities from 2 provinces and 2 districts/cities, to 34 provinces (100%) and 436 (85%) districts/cities in 2015. In 2015, the number of reported dengue patients was 126,675 cases (Incidence Rate = 49.50 per 100,000 population and Case Fatality Rate = 0.97%). There was an increase in the number of cases in 2015 compared to 2014 IR 39.80 per 100,000 population. The increase and spread of dengue cases can be caused by high population mobility, urban area development, climate change, population changes and distribution and other epidemiological factors (Kemenkes RI, 2016).

The several provinces in Indonesia that were affected by DHF, one of them was NTT Province, especially in Kupang City. According to data from the Kupang City Health Office (2014 - 2016), the number of cases has increased in the last three years, in 2014 there were 102 cases with a case fatality rate (CFR 0%), in 2015 there were 239 cases with 3 died (CFR 1.25%) and in 2016 there were 385 cases (CFR 0%). Based data from the Kupang City Health Office in 2019, there were 146 cases of dengue fever in Kelapa Lima District, 82 cases in Kota Lama District, 139 cases in Maulafa District, 175 cases in Oebobo District, 60 cases in Kota Raja District, 97 cases in Alak District. . From the cases in the last period, there were 265 morbidity rates or 68.83% that occurred in patients aged < 15 years. The Base data above, it can be seen that the sufferers up to those who died from DHF, most of them were at school age, especially elementary school age. This is in accordance with the opinion of the Ministry of Health (2005), that the potential places for dengue transmission to occur, including schools which are a gathering place for people from various regions, so that the possibility of dengue virus transmission is quite large. In addition, this age is an age group that is susceptible to dengue which is transmitted by the *Aedes sp*.

For survival, *Aedes sp* mosquitoes need a place to breed, including water reservoirs for daily needs such as drums, reservoir tanks, crock, bathtubs, and buckets. In addition, water reservoirs are not for daily use, such as flower vases, ant traps, and used goods (tyres, cans, bottles, plastic, etc.). In addition to the breeding ground for *Aedes sp*. also need a place to rest inside or outside the building adjacent to the breeding grounds, a rather dark and humid place. The Ministry of Health (2005) explain that *Aedes sp* mosquitoes look for their prey during the day. Biting and blood sucking activity is usually from morning to evening, with two peaks of activity between 09.00 – 10.00 and 16.00 – 17.00. Unlike other mosquitoes, *Aedes sp* has the habit of sucking blood repeatedly in a gonotrophic cycle, to fill its stomach with blood. Thus this mosquito is very effective as a disease transmitter. Based on this description, the possibility of elementary school students getting dengue transmission by *Aedes sp* mosquitoes from other students who have been infected with the Dengue virus is very large, because at

one of the peaks of *Aedes sp* activity. sucking blood at 09.00 – 10.00, students are still following lessons at school, resulting in increasing number of victims.

Based on some of the descriptions above, the researchers conducted a study on the analysis of the density of *Aedes aegypti* larvae in Elementary schools in endemic and non-endemic areas of dengue hemorrhagic fever in Kupang City. From the results of this study, it is expected to provide information to educational institutions in this case elementary schools and health agencies related to the risk of DHF transmission, so that control can be done against the breeding of *Aedes sp*. The aim of the study was to analyze the risk of *Aedes aegypti* larva density in Elementary schools in endemic and non-endemic areas of dengue hemorrhagic fever in Kupang City.

Method

This research is a descriptive study that is to describe the density of *Aedes aegypti* larvae in Elementary schools in endemic and non-endemic areas of dengue hemorrhagic fever in Kupang City. The variables studied were the condition of water reservoirs, Container Index, House Index *Aedes aegypti*. Sampling was carried out by purposive sampling, namely based on the criteria for endemic and non-endemic areas. The research sample was 12 schools with details of seven elementary schools located in the kelurahan with the most DHF cases which were included in the category of DHF Endemic Areas, namely Oesapa Village and Liliba Village, and five villages with no DHF cases which were included in the category of non-endemic DHF areas, namely Bonipoi Village. The study was conducted in October 2020. Checking the condition of water reservoirs and the presence of *Aedes aegypti* larvae. Inspection of the condition of water reservoirs is carried out by examining all water reservoirs that can be a breeding ground for *Aedes sp*. If at first glance (vision) does not find larvae, wait for about 0.5 – 1 minute to make sure that there are no larvae. After every inspection of water reservoirs in elementary schools, the results are recorded in the larva survey form. Then take 1 - 3 larvae in each water reservoir found *Aedes sp*. to identify the species in the Health Entomology Laboratory, Department of Sanitation.

Taking *Aedes sp*. from the larvae bottle from the survey, put in a petridis then added with water and heated over a bunsen fire. After the larvae died, they were transferred to the preparation using a small brush, then observed under a compound microscope with 4x and 10x magnification. Data on the condition of water reservoirs, container index, and larva-free numbers, are presented in the form of tables and maps, and analyzed descriptively. To determine the risk of DHF transmission in elementary schools in Kupang City, it was analyzed based on the density figure of *Aedes sp* larvae, namely the House Index and container index numbers. Qualitatively, the conclusions for each index are as follows (DF less than 1 : Low Qualification; DF 1 to 5 : Medium Qualification; DF more than 5 : High Qualification).

Result

Conditions of water reservoirs in elementary schools

Most of the water reservoirs used in elementary schools are not tightly closed, namely 92.2% in endemic areas and 93.3% in non-endemic areas. The bright colored water reservoirs are 58.8 in endemic areas and 60.0% in non-endemic areas. Conditions of water reservoirs (containers) used in Elementary schools in areas where DHF is endemic and not endemic for DHF are 68.6% and 46.7% clean, tightly closed 7.8% and 6.7% respectively. Meanwhile, the condition of light colored water reservoirs is 58.8 in endemic areas and 60.0% in non-endemic areas, as can be seen in table 1

Table 1
Condition of water reservoir in Elementary School in endemic and non-endemic areas of DHF in 2020

Water Reservoir Condition	Yes		No		Total	%
	Σ	%	Σ	%		
Endemic areas						
Clean	25	68,6	16	31,4	51	100,0
Tightly Closed	4	7,8	47	92,2	51	100,0
Light colored	30	58,8	21	41,2	51	100,0
Non Endemic areas						
Clean	7	46,7	8	53,3	15	100,0
Tightly Closed	1	6,7	14	93,3	15	100,0
Light colored	9	60,0	6	40,0	15	100,0

Container Index of *Aedes aegypti* larvae in elementary schools

All the *Aedes* larvae species found in this study are *Aedes aegypti* with a total of 66 larvae (100%) that collected form many type of container, as seen in Table 2

Table 2
Type of water reservoir (Container) in Elementary School in the endemic and non-endemic areas of DHF in 2020

Type of Water Reservoir	existence of <i>Ae. Aegypti</i>				amount	%
	+	%	-	%		
Endemic Area						
Drum	1	10,0	9	90,0	10	100,0
Bathhtub	13	39,4	20	60,6	33	100,0
Crock	3	37,2	5	62,8	8	100,0
Total	17	33,3	34	66,7	51	100,0
Non Endemic Area						
Drum	0	0,0	0	0,0	0	0,0
Bathhtub/WC	5	35,7	9	64,3	14	100,0
Crock	0	0,0	1	100,0	1	100,0

Total	5	33,3	10	66,7	15	100,0
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The container index of *Aedes aegypti* larvae in Elementary schools in endemic and non-endemic areas was at the same density level of 33.3% with a density at level 8 (DF=32-40).

Table 4
Container Index of Elementary Schools in endemic areas and non endemic for DHF in 2020

Location	Container				No	CI	DF
	+ Aedes	%	- Aedes	%			
Endemic DHF	17	33,3	34	66,7	51	33,3	8
Non Endemic DHF	5	33,3	10	66,7	15	33,3	8

House index of *Aedes aegypti* larvae in Elementary schools

Research on the House index of *Aedes aegypti* larvae by examining the presence of larvae in water reservoirs in 12 Elementary schools in DHF endemic areas and non-DHF endemic areas in Kupang City. The results of research on the House Index can be seen in table 5.

Table 5
House Index in Elementary Schools in endemic areas and not endemic for DHF in 2020

School areas	<i>Ae. Aegypti</i>				No	HI	DF
	+ Aedes	%	- Aedes	%			
Endemic area	6	85,7	1	14,3	7	85,7	9
Non Endemic DHF	3	60,0	2	40,0	5	60,0	8

Based on table 5 regarding the distribution of Elementary schools, there are 6 or 85.7% of Elementary schools that are positive for *Aedes aegypti* larvae in dengue endemic areas, while in non-endemic areas, 3 or 60.0% of Elementary schools are positive for *Aedes aegypti* larvae. House index of *Aedes aegypti* larvae in Elementary schools in DHF endemic areas is 85.7% with a density of level 9 (DF=77-100) and 60.0% in non-DHF endemic areas with a density of level 8 (DF=60-76)

Discussion

Conditions of water reservoirs in elementary schools

Based on the results of the study, the larvae found in water reservoirs (containers) in elementary schools were 100% *Aedes aegypti* larvae. The *Aedes aegypti* mosquito at the egg, larva and pupa stages is in the water, which is usually in fairly clean water and not directly on the ground. Nadesul (2007) stated that the *Aedes aegypti* mosquito prefers dark areas and black objects.

Furthermore, the Ministry of Health of the Republic of Indonesia (2007), stated that there are several types of *Aedes aegypti* mosquito breeding places, which include water reservoirs (TPA) for daily needs, such as drums, crock, bathtubs, buckets. In addition, it does not include water reservoirs (non-TPA), such as drinking places for pets (chickens, birds), used goods (cans, tires, bottles), flower vases, water dispenser reservoirs.

Bathtub/WC is a type of water reservoir that is widely used in elementary schools in areas where dengue is endemic and not endemic for dengue fever, besides that there are types of drums and crock. The type of water reservoir that was found mostly by *Aedes aegypti* larvae was the bath/WC (39.4%) in Elementary schools in DHF endemic areas and 35.7% in non-DHF endemic areas, compared to other types. These results are in line with the results of Beatrix's research (2016), bathtubs made of cement and ceramics (51%) are the type of Water Reservoir with the most *Aedes sp.* In another study conducted by Ambarita et al (2016), the dominant container found in pre-adult *Aedes* was a bathtub (33.4%), followed by buckets (18.2%) and drums (14.7%). Purnama (2012), also found that the most larval water reservoirs (TPA) were bathtubs (29.27%).

Based on the type, the most containers found in this study were bathtubs/WC. Bathtubs/WCs which are categorized as water reservoirs (TPA) have the potential to become the habitat of *Aedes aegypti* larvae. This shows that the bath/WC has great potential to become a habitat for *Aedes aegypti* larvae. Hasyimi's research in residential areas shows the same thing that the most common type of container found is bath tub (40%). The most productive container is a container with a wide diameter because it will make it easier for mosquitoes to get in and out and breed in that place. Research in Thailand showed more *Aedes* mosquitoes in artificial containers than in natural, more in places without covers than closed ones, preferring dark places to light. The number of bathtubs/WCs that are positive for *Aedes aegypti* larvae. in the Kupang City elementary school because most of the water was only drained or added without brushing the inner wall of the tub so that it was possible that there were still eggs stuck to the walls of the tub/WC. The difficulty of distributing water from PDAM so that the tub/WC is only filled with water without draining it. Containers that are rarely replaced/draind make it possible for mosquitoes to complete their pre-adult stage in that place. Unsealed water reservoirs are also a potential breeding ground for mosquitoes.

The container index number (33.3%), describes the container or water reservoir used in Elementary schools in areas where dengue is endemic and not endemic for dengue fever as a breeding ground for *Aedes aegypti* mosquitoes, namely egg, larva and pupa stages. Thus providing an opportunity for transmission of the dengue virus which causes dengue fever in elementary schools, especially for students who are very risky. Because according to the Indonesian Ministry of Health (2006.) more dengue fever in the age group less than 15 years, it means that elementary school age has a greater chance of getting dengue fever. The Kupang City Health Office also supports by describing the data for the most DHF sufferers (45%) in Kupang City in the last three years, aged 5-14 years, which is school age.

When viewed from the condition of the water reservoirs, most of them are not tightly closed, namely 92.2% in endemic areas and 93.3% in non-endemic areas of DHF. This condition causes the *Aedes aegypti* mosquito to lay eggs on the surface of the wall of the water reservoir (container) that is not closed. *Aedes aegypti* mosquitoes will find it easy to lay their eggs in an open container. The condition of the container that is not closed is more likely to allow mosquitoes to lay eggs and breed. Based on the results of this study, *Aedes aegypti* larvae were found more in containers that did not have lids, namely in elementary school bathtubs/WCs. In this study also found containers that have a lid but are not tightly closed and contain *Aedes aegypti*. If the container is filled with water and tightly closed then mosquitoes will not lay eggs and the mosquito population will be small. According to Hasyimi, 93% of mosquitoes are free to enter water reservoirs to breed, while only a small percentage are closed. The condition of the container that is not closed is more likely to allow mosquitoes to lay eggs and breed.

The selection of the *Aedes aegypti* mosquito laying place is influenced by the basic material of the container, because the eggs are placed attached to the walls of the water reservoir. The slippery walls of the container will prevent mosquitoes from holding on tightly, making it difficult to adjust their body position when laying eggs. According to Sari, container materials made of plastic are more commonly found in elementary schools in Semarang City (63.1%). The number of ceramic-based water reservoirs, namely bathtubs, which were found to be positive for *Aedes aegypti* larvae in Elementary school locations in areas where dengue is endemic and not endemic for dengue fever, is due to a lack of control, such as the lack of cleaning of the tub walls or draining the bath water, thus allowing moss to grow on the walls of the bathtub which causes moss to grow. made of ceramic which makes the walls of the bath become rough. The color of the container is one of the attractions for the female *Aedes aegypti* mosquito to lay eggs. The *Aedes aegypti* mosquito prefers to lay its eggs on the dark walls of containers. According to Budiyanto, the most common containers found by *Aedes aegypti* larvae in elementary schools in Baturaja City are containers made of dark colors. In this study, the most positive container colors for *Aedes aegypti* larvae were blue and brown (dark base color).

This is supported by the Indonesian Ministry of Health (2007), that the *Aedes sp.* in the form of puddles that are accommodated in a container commonly called a container and not in puddles of water on the ground. To lay their eggs, female mosquitoes are attracted to watery containers that are dark in color, open and especially those located in places protected from sunlight. Eggs are placed on the wall of the container above the water surface, when exposed to water, they will hatch into larvae, after 5-10 days the larvae will become pupae and two days later the pupae will hatch into adult mosquitoes. Under optimum conditions, egg growth to become an adult mosquito takes about 10 days (7-14 days). The length of time required is affected by temperature.

The condition of water reservoirs in elementary schools that are dark in color and do not have a cover and improper cleaning methods such as Water Reservoir walls should be brushed to remove mosquito eggs attached to the surface of the Water Reservoir walls. This supports the breeding of the *Aedes sp* mosquito as a

vector of dengue fever in the school environment, thereby creating a risk of transmission of dengue disease if there are students who have been infected with the virus or are sick with dengue. This is a very important factor in the transmission or occurrence of extraordinary events (KLB) of dengue fever in Kupang City.

Therefore, it is necessary to prevent dengue fever in schools through *Aedes aegypti* mosquito control activities carried out by managers and students. through the 3M plus program, namely draining and brushing water reservoirs at least 1-2 times a week, closing water reservoirs, recycling or reusing used goods, and sowing abate on water reservoirs that are difficult to clean and hold water for a long time. Prevention of the risk of dengue transmission in elementary schools lies in reducing the vector of dengue fever mosquitoes. Eliminating containers that can hold useless water (for example in flower pots), draining the bathtub once a week, and removing things that can lead to *Aedes sp.* mosquito nests, these activities can be useful for controlling diseases transmitted by *Aedes sp* mosquitoes.

Aedes sp. mosquito control program. What can be done and this is often implemented in Indonesia is 3M, namely (a) draining, i.e. draining the bathtub, to ensure that there are no mosquito larvae that develop in the water and no eggs are laying on the walls of the bathtub. (b) closing, namely closing the water reservoir so that no mosquitoes have access to the place to lay eggs. (c) burying, i.e. burying used goods so that they do not collect rainwater and become a place for laying eggs. In addition to physical control as mentioned above, control of *Aedes aegypti* larvae can be done by using larvae-killing insecticides (larvicides). The larvicide commonly used is temephos. The dose used is 1 ppm or 10 grams (\pm 1 tablespoon average) for every 100 liters of water). Temephos has a residual effect of 3 months. Abate application should be carried out 2-3 months before the rainy season and preferably 2 times. If this control is carried out by the entire community, including students and teachers, it is hoped that the *Aedes sp.* reduced to a level that does not cause harm to human health. For this reason, it is necessary to continuously educate and motivate students and teachers for a long period of time, because the presence of mosquito larvae is closely related to community behavior.

House index of *Aedes aegypti* larvae in Elementary schools

The results of the study in 12 elementary schools showed that schools that were positive for *Aedes aegypti* larvae or House Index in elementary schools in dengue endemic areas were 85.7% and 60.0% in non-endemic areas. This figure exceeds the standard of the Indonesian Ministry of Health, that the House Index must be < 5%. The high House Index score, supported by the majority of schools using open water reservoirs, does not clean water reservoirs properly and is dark in color. So with these conditions *Aedes aegypti* mosquitoes can breed optimally and can transmit dengue disease to students who are in the elementary school environment. The behavior of *Aedes aegypti* is diurnal or active from morning to noon. Biting activity is usually from morning to evening, with two peaks of activity between 09.00 – 10.00 and 16.00 – 17.00. Unlike other mosquitoes, *Aedes aegypti* has the habit of sucking blood repeatedly (multiple bites) in one

gonotrophic cycle, to fill its stomach with blood. Thus this mosquito is very effective as a disease transmitter.

Therefore, there needs to be an effort to prevent dengue fever, by controlling mosquitoes which are vectors of transmission, namely *Aedes sp.* Control can be done by carrying out 3M activities (draining, closing, and burying) as previously described. The goal is to prevent the development of egg, larval, and pupae stages, in addition to using larvicides namely Themepos or the trade term abate to kill *Aedes sp.* larvae. Another method that can be done is controlling adult mosquitoes, carried out by spraying (fumigation = fogging) with insecticides if there are reports of students being positive sufferers of DHF. Fogging is carried out by the District/City Health Office, Some things that must be considered in the implementation of fogging, namely the direction and speed of the wind must be at a time when the wind is calm, the temperature is not hot (morning at 10.00 or afternoon at 16.00). Before the fogging is carried out, it is hoped that the relevant agencies (puskesmas) will conduct a survey of the *Aedes sp.* as a vector first, so that activities are more effective in preventing the transmission of dengue fever in the school environment. Dengue fever often attacks children because children tend to sit in class during the morning until noon and their feet hidden under the table column are easy targets for these mosquitoes.

The risk of dengue transmission in Elementary schools

Based on data from the Kupang City Health Office in 2019 - September 2020, there was an increase in dengue cases in Kupang City, namely in 2019 as many as 699 cases, increasing to 755 cases. It means that DHF is still high and not decreasing, even though controlling program of DHF carried out every year. The results of the research that have been carried out show that the Container Index (CI) and House Index (HI) numbers in DHF endemic areas and non-DHF endemic areas exceed the Indonesian Ministry of Health standard, which is more than 5%. In addition, the larvae found in the school environment are *Aedes aegypti* larvae, which are the main vectors of dengue hemorrhagic fever. The level of risk of DHF transmission in the two regions can be seen from the House Index figures, namely 85.7% and 60.0% including density figures 9 and 8. According to WHO experts, DF 1 means that it is comparable to 1,000 female *Aedes aegypti* mosquitoes. per hectare (Depkes RI, 1996), so that if the DF is 9, it is estimated that there are 9,000 female *Aedes aegypti* mosquitoes per hectare in endemic areas. Meanwhile, it is estimated that there are 8,000 female *Aedes aegypti* mosquitoes per hectare in non-endemic areas of DHF. These conditions can pose a risk of transmission of DHF in the school environment, both in DHF endemic areas and in non-DHF endemic areas, especially for students, who have susceptibility to transmission of DHF.

DHF transmission can occur in public places and one of the potential places, namely in schools. This is supported by data from the Kupang City Health Office that cases in the last three years (2014 - 2016) there were 265 morbidity rates or 68.83% which occurred in patients aged < 15 years. The results of previous research in 42 elementary schools in Kupang City, there were six elementary schools that had students who had suffered from DHF in 2017. In addition, based on the results of research in other areas, namely Salatiga, conducted by

Suskamdani et al, (2007) showed that 32.2 % of dengue transmission occurs in schools. Transmission of DHF in schools also occurred in the Palu City area which showed the highest number of DHF cases for 3 consecutive years (2009 – 2011) occurred at school age children (5 – 14 years) (Palu City Health Office, 2012).

Considering the magnitude of the danger posed by the *Aedes aegypti* mosquito, efforts to control the breeding of these mosquitoes must immediately eradicate mosquito nests (PSN), including the 3M program, namely draining and closing, water reservoirs, and burying used goods that can accommodate water. In order for this activity to be successful in reducing the density of *Aedes aegypti* larvae, namely HI and CI, it needs to be carried out regularly and continuously by teachers and students. It is hoped that the school can include larva cleaning activities in the school environment in the school health unit (UKS) activity program which is a routine activity. It is necessary to form a group of larva monitoring interpreters or abbreviated as jumantik consisting of elementary school students and coordinated by a coaching teacher. The selection of supervisor teachers as coordinators in schools is one alternative that can support the implementation of sustainable eradication of dengue mosquito nests. So that the presence of *Aedes aegypti* larvae is no longer found in the school and will have an impact on reducing dengue cases. This is supported by the results of research by Hayani, et al (2006) in Palu City, Central Sulawesi, which showed that there was a significant effect of active teacher participation on increasing larva free rates (p value < 0.05).

Success in controlling dengue vectors in schools requires collaboration by building integrated school health services, improving working relationships between schools, health centers and the community. This is possible because all Elementary schools examined are located in urban areas, and in urban areas the *Aedes aegypti* mosquito is more dominant. In accordance with the results of the study larvae found 100% *Aedes aegypti*. The *Aedes aegypti* mosquito is the main epidemic vector but other species such as *Aedes albopictus* act as secondary vectors. Controlling dengue cases requires a comprehensive strategy from various parties, including community empowerment. Increasing the active role of the community in preventing and controlling DHF is one of the keys to success in efforts to control DHF

Conclusion

Most of the conditions for water reservoirs in Elementary schools in areas where DHF is endemic and not endemic for DHF are 92.2% and 93.3%, respectively. Container Index of *Aedes aegypti* larvae in Elementary schools in DHF endemic and non-DHF endemic areas exceeds the Indonesian Ministry of Health standard, which is > 5% categorized as high density with Density figure (DF) = 8 so that the potential for dengue transmission is very large. House Index of *Aedes aegypti* larvae in Elementary schools in DHF endemic and non-DHF endemic areas exceeds the Indonesian Ministry of Health standard, which is > 5% categorized as high density with Density figure (DF) = 9 and 8 so that the potential for dengue transmission is very large.

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