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Research Report

The Fluctuation of *Aedes Aegypti* in Endemic Area of Dengue Hemorrhagic Fever in Surabaya City, Indonesia

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ABSTRACT

This research was aimed to describe the density pattern and the fluctuation of Aedes aegypti larval based on the season in dengue haemorrhagic fever (DHF) endemic area in Surabaya city. The population of the research was the house of people together with its breeding sites either inside and outside the house. The 55 houses were randomly chosen in 11 RWs in Nginden Subdistrict. The sample of this research was Aedes aegypti larva obtained from its breeding sites. The sample sizes were all of the larval in the containers existed in the chosen houses. The samples of the larval were taken and carried for identification and documentation of the species. This research was applied in the same houses in January, March, and May 2008 in rainy season. The results indicated that the highest larval index occurred in January with House Index (HI) 76.8%, Container Index (CI) 40.5%, and Breteau Index (BI) 137.5%. There was a decrease in March with HI 63.3%, CI 31.3%, and BI 92.7%. It continued to decrease in May with HI 42.6%, CI 21.1%, and BI 57.4%. All of those larval indices in the three observed months showed a high percentage of larval which was much higher than the safe limit or the critical threshold (5%) as defined by WHO. It implied that people in Nginden Subdistrict were threaten by the infection of DHF. The three indices achieved the peak in January, which was also the peak of the rainy season. It gradually decreased in March and May as the rainy season decreased its intensity of rain. Larval Density Index (LDI) also showed a high value. There were 173 larval/house in January, 187 larval/house in March, and 84.8 larval/house in May. The containers or breeding sites of Aedes were mostly found in January then their existences gradually decreased in March and May. Traditional bath tub was the most productive container inside the house, while drum and bucket were the most productive containers outside the house. Other containers which contributed abundance of larval were refrigerator, flower pot, well, and PDAM meter box.

Keywords: *The fluctuation of Aedes aegypti population, larval index, container, season*

INTRODUCTION

Dengue hemorrhagic fever (DHF) has been one of serious health problems in Indonesia. This disease was firstly reported in Surabaya and Jakarta in 1968 (Sumarmo, 1987) then it spread to the entire cities and provinces in Indonesia (Suroso, 1996: Suroso and Umar, 1999). Since the first spreading, Surabaya has become an endemic area for dengue fever with several outbreaks which resulted many victims. From 1997 to 2004, there were 123 subdistricts as the endemic areas of DHF. Three subdistricts were categorized as sporadic DHF and only seven subdistricts which were free from DHF (Health Office of Surabaya, 2005). Nginden subdistrict in Sukolilo district was one of subdistrict and district with endemic dengue fever in Surabaya. It was reported that there was one case of DHF in Nginden subdistrict in 2004. It increased into seven cases in 2005 and nine cases in 2006. Moreover, it was reported that from seven cases occurred in 2007, two out of seven patients died (Health Center of Menur, 2007).

The process of the spread of DHF is influenced by several factors such as host, agent, and environment. The host factor is a person who suffers from DHF. The agent factor is dengue virus which causes DHF and the environment factor is the surrounding environment which supports the life of mosquitoes. Therefore, they remain living and breeding. It is also supported by the season or weather factor.

Efforts to prevent and eradicate the disease have been done either by the government of Surabaya, other related institutions, and the society. One of the ways to break the dengue transmission chain is by eradicating the vectors

called *Aedes aegypti* and *Ae. albopictus* as the mosquito transmitter of dengue fever. Various efforts have been performed but the results are not satisfied enough. It is indicated by the data of vector population density of DHF which are still high and occur in every year (Yotopranoto *et al.*, 2005; Yotopranoto *et al.*, 2007).

The seasonal factor is also significant to the bionomics of *Ae. aegypti* such as rain, air temperature, and air moisture. Seasonal factor is a supporting factor in the reproduction and the distribution of dengue vector and it is very potential to cause outbreak (Prasittisuk and Andjapraridze, 1996; Gubler, 1998, Sukri *et al.,* 2003). In this study, an observation towards the fluctuation of *Ae. aegypti* and environmental factors supporting its existence during the rainy season had been performed in Nginden subdistrict, Sukolilo district, Surabaya, in 2008.

SAMPLE AND METHOD

Sample

Sample of this study was larval stage of *Ae. aegypti* taken from breeding sites or containers both inside (indoor) and outside (outdoor) observed houses. Types of containers were identified and measured based on their type and location either inside or outside the house.

Sample Determination

There were 11 RWs in Nginden subdistrict, Sukolilo district, Surabaya with regular cases of dengue fever in the last three years. In every RW, five houses were randomly chosen using cluster random sampling and used RW as the cluster.

Sampling Method

In the chosen houses, types and number of containers were identified and measured either from inside (indoor) or outside (outdoor) the houses. All of *Ae. aegypti* larval were taken from the entire containers using a dipper and plastic pipette and counted to count the number of larval. Then, larval were taken into a container with 5% formalin solution. Each container was labeled then it was taken to Entomology Laboratory in Institute of Tropical Disease (ITD) Airlangga University to identify and document the species.

Time of Sampling

Sampling was done in January, March and May 2008 in rainy season. Sampling was done in the same houses in every month of survey.

Data Analysis

The data were analyzed through the measurements of House Index (HI), Container Index (CI), Breteau Index (BI), and Larval Density Index (LDI).

House Index (HI) = $\frac{\text{Number of } Ae.\ aegypti\ larval \text{ in infested houses}}{\text{Number of inspected houses}} \times 100\%$

Container Index (CI) = $\frac{\text{Number of containers with } Ae.\ aegypti\ larval}{\text{Number of inspected containers}} \times 100\%$

Breteau Index (BI) = $\frac{\text{Number of containers with } Ae.\ aegypti\ larval}{\text{Number of inspected houses}} \times 100\%$

Larval Density Index (LDI) = $\frac{\text{Number of } Ae.\ aegypti\ larval}{\text{Number of inspected houses}} \times 100\%$

RESULT AND DISCUSSION

Dengue hemorrhagic fever incidences in Nginden subdistrict annually occurred from 2004 to 2006. When this study was performed, there had been eight cases of DHF. It indicated that it continued to occur every year. In this study, 55 houses were randomly chosen. The containers which contained *Aedes larval* were identified. The larval inside the containers were caught, counted, and identified regarding their species and number. The number of containers was used to measure HI, CI, and BI. Beside that, the LDI also be measured in order to observe the density of *Aedes*. The results of the measurements were stated in table 1, picture 1, table 2, and picture 2. This study was performed in the selected months in January, March, and May 2008 which rainy season occurred. Therefore, the fluctuation of *Ae. aegypti* population could be analyzed based on the time and season.

Table 1. House Index (HI), Container Index (CI) dan Breteau Index (BI) *Aedes* in Nginden Subdistrict, Sukolilo District, Surabaya 2008.

Month	Larval Index		
	House Index (%)	Container Index (%)	Breteau Index (%)
January	76.8	40.5	137.5
March	63.6	31.3	92.7
May	42.6	21.1	57.4

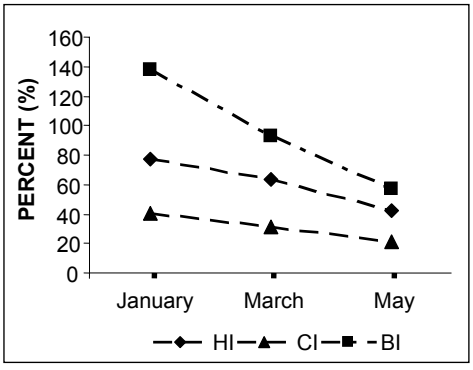

Figure 1. House Index (HI), Container Index (HI) and Breteau Index (BI) *Aedes* di Nginden subdistrict, Sukolilo district, Surabaya 2008.

Table 2. Larval Density Index (LDI) *Aedes* in Nginden subdistrict, Sukolilo district, Surabaya 2008

	Month		
	January	March	May
Number of larval/ house	173	187.8	84.8

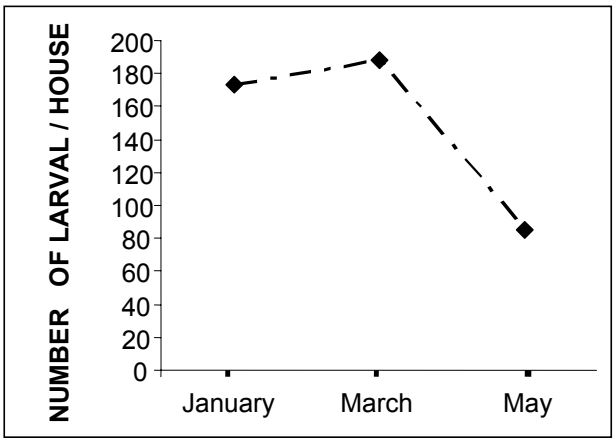

Figure 2. Larval Density Index (LDI) *Aedes* in Nginden subdistrict, Sukolilo district, Surabaya 2008

Table 1 and figure 1 indicated that HI, CI, and BI in January were in the highest position compared to the other months. It decreased in March and May. LDI in January was lower than March (table 2 and figure 2) but it still showed a high level of larval population because it was the peak of rainy season in Surabaya. Usually, the peak of rainy season was in January and February. It was indicated through the high value of HI 76.8%. It implied that 76.8% inspected houses contained *Ae. aegypti.* It was supported with the high value of BI 137.5% which meant that there were many containers containing *Ae. aegypti* larval in the houses. Rainy season made the empty containers outside the houses filled with water which were usually empty in dry season. They were used as breeding sites for *Ae. aegypti.* Moreover, during the rainy season, the air moisture was also high (95%) causing the air so moist and full of vapor. These conditions advantaged the life of mosquitoes because they could live longer in moist air than in dry air. They preferred warm temperature (25–30° C). If mosquitoes have longer time to live, they have more opportunity to breed that may cause the increase of their population. Warmer weather also affected dengue virus inside the body of *Ae. aegypti.* It would easily develop, the warmer the weather, the shorter the incubation period. General incubation period of dengue virus type 2 is about 12 days in 30° C, but it becomes 7 days in 32–35° C. The shorten of five days of incubation period of virus inside of mosquito would multiply the potency of transmission up to three times higher than in the normal temperature. It closely related to global warming issue (Science Daily, 1998; Hales *et al.,* 2002; Kairi, 2007). In short, warm weather will cause the mosquitoes to be more dangerous and infectious with dengue virus inside them which are ready to infect human.

In the following months, March and May, there was decreased HI, BI, and CI compared to January. The reason was because the rainy season had passed its peak causing decreased rain intensity. It was indicated in the less types and number of containers found in March and May as shown in table 3. However, LDI of *Ae. aegypti* larva was higher in March than in January. It implied that the probability of dengue fever distribution was still high in March. On the other hand, people started to realize that the mosquitoes would probably infect them with dengue fever so that they voluntarily cleaned water containers that might contain the larval or pupae of *Ae. aegypti.*

Table 3. Types of Breeding Places of *Aedes* Larval in Nginden subdistrict, Sukolilo district, Surabaya 2008

Containers/Breeding sites	Indoor			Outdoor		
	January	March	May	January	March	May
Traditional Bath Tub	37	31	10	8	2	4
Gentong	8	3	1	8	6	5
Refrigerator's reservoir	3	-	1	-	-	-
Bucket	2	1	-	-	-	-
Water closed	1	3	1	-	-	-
Aquarium	1	1	-	-	-	-
Well	-	-	1	2	4	1
Flower pot	-	-	-	3	1	-
Drum	-	-	-	2	-	-
Used Tyre	-	-	-	1	-	-
Used aquarium	-	-	-	1	-	-
Pond	-	-	-	1	-	-
PDAM Meter Box	-	-	-	-	1	-
Total	52	40	15	26	14	10

The analysis result in May indicated that HI, BI, and CI decreased compared to January and March (figure 1) because of less intensity of rain. However, the case of DHF still occurred in the months after January, which were in March, April, and May. It indicated that unobserved houses might contain *Ae. aegypti* larval. From these unobserved houses, the virus was started to be distributed by the mosquitoes.

There were many types of breeding sites of *Ae. aegypti* in Nginden subdistrict located inside or outside the houses. Overall, there were more breeding sites inside the houses in every observed month. It had higher potency to be the breeding sites of *Ae. aegypti.* Traditional bath tub was the most productive container inside the house because people mostly take a bath twice a day so they need to store the water in it. It was different with people who lived abroad and Indonesian people of high community because they mostly used bath tub or shower when the water was automatically flushed or discarded after bathing.

Gentong or traditional water container made of earthenware was one of potential containers especially for the people who did not use PDAM water or had stuck stream of PDAM water. They needed to store the water for their daily needs. Usually the water container mostly made of plastic but some of them made of earthenware or cement (Tsuda *et al.*, 2002). It was almost the same as what happened in Laos when people provide water containers in front of their houses to wash their feet before entering the house also in Vietnam (Huber *et al.*, 2003). This habit also existed in several regions in Indonesia such as in Bali, Lombok, Sumbawa, Riau, and other places. In the south Thailand, the type of container mostly used for the breeding sites was metal box, cement tube, and earthenware container both inside and outside the house, while *Ae. albopictus* mostly bred in tree's hole, coconut shell, rind, water tube, metal box, and flower pot (Kittayapong and Strickman, 1993; Preechaporn *et al*., 2007).

Other breeding sites inside the house in Nginden subdistrict were refrigerator, bucket, aquarium without any fish inside, *wudlu* point (water container for clean up body before pray) and well. The most productive container located outside the house was *gentong* or traditional water container and followed by traditional bath tub, well, flower pot, water reservoir, used tyre, used aquarium, pond, and PDAM meter box. In this study, wells in both inside and outside the house had a significant contribution to the density of *Ae. aegypti* population. The wall characteristic of well which made of cement and brick was preferable for attaching eggs. The mosquitoes also liked to attach their eggs in flower pot because it also made of cement and brick. In fact, there would be no egg in the pond, pool, or well which made of soil or contained soil. It seemed that they did not attach their eggs in the soil or a surface made of soil. Hasyimi and Soekirno (2004) stated that in their research location in Tanjung Priok, Jakarta, certain subdistrict indicated several types of container of *Ae. aegypti.* The most productive containers were crock and traditional bath tub in other subdistrict. It probably happened because in some areas, it was difficult to get water so they have to store the water to drink and cook, while they used the water from well to take a bath in a public bathroom.

The result showed that the number of containers either inside or outside the house decreased month by month. One of the reasons was that people started to feel ashamed when *Aedes* larval or pupae were found in their houses. Therefore, the awareness to voluntarily clean their houses increased so there were no more larval found in their houses in the following months. It also might be caused by the decrease rain intensity affecting the decrease of containers especially which were located outside the house in March and May.

There are some containers that must be carefully controled because many people don not aware that those places can be so potential for breeding sites such as water storage box of refrigerator. It always contains water but it is rarely replaced or emptied. While in outside the house, flower pot, well, and PDAM meter box were the neglected water storages potentially used by the *Ae. aegypti* to breed. The data of various containers were suitable with the study of Yotopranoto *et al.* (2007) in Sawahan district, and Tambaksari district, Surabaya which were endemic areas with the highest cases of dengue fever at that time. Gionar *et al.* (2001) also stated that well was categorized as breeding site in Gondokusuman, Jogjakarta. Eighty nine wells were observed and 35% wells were positive containing *Ae. aegypti* larval in dry season and 51% wells positive in rainy season. Most of the wells made of brick and cement.

Another factor causing the high values of HI, BI, and CI was the low awareness of people towards environment problem and the danger of dengue fever. Many people had known about dengue hemorrhagic fever and its distribution including PKK members and leaders in RW but it was lack of implementation or direct action to prevent the disease (Yotopranoto *et al*, 2005). Continuous and sustainable efforts are needed to change the people's behavior so that they are aware of dengue fever and actively prevent and eradicate the vector of the disease, *Ae. aegypti.*

CONCLUSION AND SUGGESTION

Conclusion

From the results of the research examining the larval of *Aedes aegypti* in Nginden subdistrict, Sukolilo district, Surabaya, during the rainy season in January, March, and May 2008, it can be concluded that:

1. The fluctuation of larval population of *Ae. aegypti* occurs and follows the intensity of rain which falls in every observed month (January, March, and May).
2. Larval Indices (House index, Container Index, and Breteau Index) always exceed the safe level (5%).
3. Larval Density Index of *Ae. aegypti* is always high.
4. The most productive containers of *Ae. aegypti* breeding site is traditional bath tub and followed by traditional water container and other water containers.

SUGGESTION

1. It is necessary to examine the fluctuation of larva population of *Ae. aegypti* in Nginden subdistrict during the dry season.
2. It is important to observe the existence of *Ae. aegypti* in upper-class houses in Nginden subdistrict.
3. It is needed to perform continuous or sustainable counseling to the society to increase their awareness towards DHF and their active participation to prevent DHF especially the vector of the disease.

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