PRE-ADULT SURVEY TO IDENTIFY THE KEY CONTAINER HABITAT OF *AEDES AEGYPTI* (L.) IN DENGUE ENDEMIC AREAS OF BANTEN PROVINCE, INDONESIA

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Abstract. Key containers are various kinds of water reservoirs where most of dengue vector breeding in them. Identification of key containers is important in order to know what dengue vector population control's target. This study aimed to know the type of containers in the dengue endemic areas of Banten Province and determine the key containers as the main target in vector control. A survey has been done in Cilegon (Bendungan, Panggung Rawi, and Samangraya), Serang (Cipare, Banjaragung, and Unyur), South Tangerang (Bendabaru, Baktijaya, Jalupang). Larvae survey conducted on 100 houses in each location by observing the presence or absence of mosquito larvae in water reservoirs (containers) act as potential breeding sites of *Aedes aegypti* both inside and outside of the house. The survey results were the types of containers, container number, container number with positive mosquito larvae, the key container, and entomology indices in each area. Various types of containers found in nine endemic villages in Banten Province with the most identified containers were buckets, Concrete water storage tanks for bathrooms, and water trays dispenser. A key container in Cilegon and Serang is concrete water storage tanks for bathrooms while in South Tangerang City area is a bucket. Entomology indices in all areas show that all survey areas have a moderate transmission of dengue fever.

Keywords: *Aedes aegypti*, pre-adult survey, key container, dengue, endemic area

INTRODUCTION

Dengue fever caused by dengue virus has spread across all provinces in Indonesia. The first case happened in 1968 where only two provinces reported cases of dengue virus infection with Incidence Rate (IR) 0.05/100,000 population, but in 2014, cases of dengue virus infection distributed in all provinces with IR 39.8/100,000 populations. Bali (IR 204.22), East Kalimantan (IR 135.46) and North Kalimantan (IR 128.51) are the highest contributor to the number of dengue cases in 2014. The number of districts with dengue infection cases in Indonesia increased from 412 (82.9%) in 2013 to 433 (84.74%) in 2014 (Vector Borne Diseases Control Directorate, 2014).

Banten Province is a young province in Indonesia, but dengue infection cases in Banten are rapidly spread. In 2014 Banten was in the 21st rank out of 34 provinces in Indonesia with the number dengue cases

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was 3,002 (IR 25.37/100,000 population). All districts in Banten are endemic areas but districts with the highest cases of dengue are South Tangerang City, Cilegon City and Serang City (Provincial Health Authorities of Banten, 2014).

The existence of hosts, viruses and vectors makes transmission of dengue fever in this region still exists until now. This is caused by the environment conditions, which remained favorable for vector breeding sites. *Aedes aegypti* is the main vector of dengue in urban areas; it lives and breeds in containers close to human habitation. Various types of containers are highly potential for *Ae.aegypti* breeding site. According to Yotopranoto *et al* (1998) potential breeding grounds for Aedes in several cities in Indonesia are containers using for daily life such as drums, jars, bathtubs and buckets.

Key container is the type of water reservoir that has the greatest role as a dengue vector breeding site. Identification of the key container is important in order to know what dengue vector population control's target. Knowing key containers can reduce drastically the density of female mosquitoes, but only for a short period of time, Maciel de Freitas and Lourenço-de-Olivei (2011) have demonstrated it. Identified key container is expected to help the control's focus; especially those carried out by the community themselves.

This study aimed to identify the type of container in the endemic area of Banten Province and determine the key containers as the main target in vector control. This study also included entomology indices as a indicators of the potential transmission of dengue virus in that area.

MATERIALS AND METHODS

Bendabaru,Baktijaya, Pondok Jagung, Cipare, Banjar Agung, Unyur , Bendungan, Panggung Rawi and Samangraya are nine subdistricts which located in three high endemic districts. They were selected as the sampling location because the numbers of dengue infection cases in those cities are the highest in Banten Province in 2014 (Provincial Health Authorities of Banten, 2014). This study used a simple random sampling with household as the sampling unit. The total samples were 900 households (300 households in each district).

Container surveyed in every household is a container of water, made of artificial ingredients and able to collect water indoors or outdoors. In each household, inspection for all potential artificial container-breeding sites of dengue vectors was performed. Every room of each household was searched systematically for containers. All artificial containers were inspected for the presence of mosquito larvae through gross examination with the unaided eyes. A flashlight was used for dark-color containers where mosquito larvae are harder to be seen. The number of inspected containers, type of containers, and the number of containers with at least one mosquito larva were recorded. Using the WHO list of recognized containers (WHO, 2003) (Table 1), each inspected container was classified as either recognized container or unrecognized container. The larvae were taken by using a plastic pipette for small containers and dipper, which were modified into larvae filters, for big containers and then all the larvae are inserted into plastic water bottles. All samples were taken to the laboratory, and the larval representatives were randomly selected to be identified using identification keys (Rueda, 2004).

Data was analysed by descriptive statistics, *ie*, frequency and percentage

distributions, were utilized to describe the containers identified in this survey. Key container identified by the types of containers, which mostly has positive larvae indoors and outdoors. Breteau Index, House Index and Container Index for each type of container were computed using the following formulas:

$$CI = \frac{\text{Number of positive containers}}{\text{Total number of inspected container breeding sites}} \times 100$$

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

$$BI = \frac{\text{Number of positive artificial containers}}{\text{Total number of inspected households}} \times 100$$

RESULTS

Among 900 houses, 304 (33.8%) artificial containers harbored *Ae.aegypti* larvae. Among 2,575 water containers, 400 (15.53%) have larvae of *Ae.aegypti*. One type of unrecognized artificial containers were found positive for *Ae.aegypti* larvae. In Cilegon city most of population used well as water sources. Based on the results of survey in three sub-districts, bucket is the most commonly used container, but the most positive larvae containers were Concrete water storage tanks for bathrooms (Table 1).

Serang city (Cipare, Banjaragung and Unyur) have two types of water sources: wells and tap water. Most of the types of containers commonly found in Serang City are buckets, but most of the larvae positives containers found were concrete water storage tanks for bathrooms, except in Unyur where buckets were dominantly positive for larvae. While the types of containers that have larvae of *Ae.aegypti* the most are concrete water storage tanks for bathrooms (Table 2).

Most of the population in South Tangerang City used wells and tap waters as a source of water. Types of containers that predominately used are buckets followed by Concrete water storage tanks for bathrooms. In Bendabaru and Jalupang, mostly buckets are a container that has larvae of *Ae.aegypti*, but in Baktijaya, a containers which have larvae of *Ae.aegypti* the most are discarded bottles and tin cans. Container types found in three villages in South Tangerang are presented in Table 3.

Among 2,575 water containers examined, 874 containers found in Cilegon, 869 containers found in Serang and 832 containers found in South Tangerang. Serang have the highest Container Index (CI) with eight types recognized containers and 2 types of artificial unrecognized containers examined. Almost all types of containers inspected have at least one container positive for *Ae.aegypti* larvae. On the other side, Cilegon has 9 recognized containers and 3 unrecognized containers with a CI of 16.6 and South Tangerang city has a CI of 11.7 with 8 recognized containers and 3 unrecognized containers. Types of unrecognized container found in all research areas were water dispenser, pan, tank, and garden sprinkle tube and fish pool. Unrecognized containers that mostly contribute for the presence of larvae is water dispenser (Table 4).

With 304 out of 900 households having containers positive for *Ae.aegypti* larvae, the highest House Index owned by Cilegon (HI=38), followed by Serang (HI=36) and South Tangerang (HI=27.3). Serang was a district with the highest Breteau Index (BI=52.7) followed by Cilegon (BI=48.3) and South Tangerang (BI=32.3) (Table 4).

Table 1
Aedes larval surveys in containers in Cilegon.

Type of container	Bendungan		Panggung Rawi		Samangraya		
	Total number of containers inspected	Number of positive containers	Total number of containers inspected	Number of positive containers	Total number of containers inspected	Number of positive containers	Total number of positive containers
Recognized containers							
Concrete water storage tanks for bathrooms	106	17	88	28	105	26	71
Discarded tires	1	1	0	0	0	0	1
Discarded bottles and tin cans	4	2	2	1	0	0	3
Metal drums for water storage	1	0	0	0	4	0	0
Buckets	124	14	129	9	81	7	30
Plastic containers	47	8	23	4	22	4	16
Water trays of refrigerators	21	1	18	0	26	0	1
Pots	1	1	0	0	1	1	2
Animal water container	5	0	1	0	0	0	0
Unrecognized containers							
Water trays of dispenser	11	2	26	12	24	5	19
Aquarium	0	0	1	0	1	0	0
Pan	0	0	1	0	0	0	0
Total	321	46	289	54	264	43	143

Table 2
Aedes larval survey in containers in Serang.

Type of container	Banjaragung		Unyur		Cipare		Total number of positive containers
	Total number of containers inspected	Number of positive containers	Total number of containers inspected	Number of positive containers	Total number of containers inspected	Number of positive containers	
Recognized containers							
Concrete water storage tanks for bathrooms	52	12	52	9	83	45	66
Discarded bottles and tin cans	6	5	1	1	4	3	9
Pots	0	0	1	1	0	0	1
Metal drums for water storage	1	0	5	0	2	2	2
Buckets	108	5	148	13	104	17	35
Plastic containers	49	5	39	3	30	2	10
Water trays of refrigerators	26	3	24	0	13	0	3
Animal water container	2	0	2	0	0	0	0
Unrecognized containers							
Dispenser	46	7	33	7	37	11	25
Fish Pool	0	0	1	1	0	0	1
Total	290	37	306	35	273	80	152

Table 3
Aedes larval survey in containers in South Tangerang.

Type of container	Jalupang		Baktijaya		Bendararu		
	Total number of containers inspected	Number of positive containers	Total number of containers inspected	Number of positive containers	Total number of containers inspected	Number of positive containers	Total number of positive containers
Recognized containers							
Concrete water storage tanks for bathrooms	38	6	42	2	38	7	15
Discarded bottles and tin cans	5	5	10	10	8	5	20
Metal drums for water storage	21	4	14	0	20	1	5
Buckets	163	14	170	6	127	13	33
Plastic containers	8	0	8	2	8	2	6
Water trays of refrigerators	2	2	2	0	0	0	2
Animal water container	1	0	1	0	0	0	1
Unrecognized containers							
Aquarium	0	0	2	2	1	1	2
Water dispenser	38	6	33	4	21	2	12
Flower sprinkle tube	0	0	1	1	0	0	1
Total	288	37	300	27	237	32	97

Table 4
Aedes indices of Cilegon City, Serang City and South Tangerang City.

	CI	HI	BI
Cilegon City	16.3	38	47.6
Bendungan	14.3	32	46
Panggung Rawi	18.6	48	54
Samangraya	16.2	34	43
Serang City	17.4	36	50.6
Banjaragung	12.7	28	37
Unyur	11.4	28	35
Cipare	29.3	52	80
South Tangerang City	11.7	27.3	32.3
Pondok Jagung	12.8	31	37
Baktijaya	9.0	25	27
Bendabaru	13.5	26	32

CI, Container Index; HI, House Index, BI, Breateau Index.

DISCUSSION

Containers around houses can be a potential place for Aedes breeding. In endemic areas, Aedes around people's houses need to be controlled in order to prevent the transmission of dengue infection in that area. Based on our survey, most of the types of containers in nine sub- district are similar. Concrete water storage tanks for bathrooms, buckets, water dispenser, plastic containers, water trays of refrigerator and several other containers are found in almost every subdistrict. Concrete water storage tanks for bathrooms and buckets are containers that dominant in all areas. Concrete water storage tanks for bathrooms and buckets are containers that commonly used as a reservoir of water for daily needs such as bathing, cooking and washing.

Most of the types of containers found in survey areas were daily used containers and were easy to control the presence of Aedes. But the Aedes larvae were still found in these containers. Containers that mostly have larvae are buckets, Concrete water storage tanks for bathrooms and water dispenser. According to Zuhriyah *et al* (2012), Concrete water storage tanks for bathrooms and tank /bucket of water for cooking, are containers that are commonly found in urban and rural communities, but due to improper lid, these containers can become a breeding place for Aedes larvae. Besides the Concrete water storage tanks for bathrooms and buckets, Aedes larvae were also found in water trays of dispensers. Water tray of dispenser often inadvertently hold water from the tap and its location is hidden, so it is rarely seen (Purnama and Baskoro, 2012).

Bucket is the most common container found in Serang and Cilegon, but Concrete water storage tanks for bathrooms are the most common containers that have Aedes larvae. According to Ramdja *et al* (2000) Concrete water storage tanks for bathrooms is a great potential breeding place for Aedes larvae because its volume are greater than others containers. Moreover, it is uncommon for people to clean it at least once a week (Purnama and Baskoro, 2012). It usually less exposed to the sun and it is located in a blind spot.

Buckets are the most common containers used by urban people. Using of buckets instead of concrete water storage tanks for bathrooms because it is practical and it does not need a large place. People also used buckets to store water in large quantities as a backup where water supply is limited. The use of bucket as a water container should help in controlling larva, but in fact in some areas, bucket became key containers for the presence of larvae. People are still negligent in controlling the presence of larvae in controlled containers. Controlled containers such as bucket, concrete water storage tanks for bathrooms, aquarium, plastic containers should be cleaned regularly at least once a week (Sunaryo *et al*, 2014).

Key containers were different in each area, depending on local conditions. Buckets are the key containers in Cilegon and Serang but Concrete water storage tanks for bathrooms are the key container in South Tangerang. Differences of key container in survey areas are depended on the pattern of water storage use in each area. For example, people of Cilegon still used a large Concrete water storage tanks for bathrooms to store the water from wells. Those of Serang also use Concrete water storage, especially in communal bathrooms. Buckets in both cities are widely used to store water for cooking. It is different in South Tangerang where people use buckets for water reservoir in everyday purposes. People use lots of buckets in order to store water for a long time because of limited water supply for daily use. They were negligent to drain it or cleaned it. These conditions give a chance for larvae of Aedes to become adults (Sunaryo *et al*, 2014).

The existence of Concrete water storage tanks for bathrooms as key containers not only encountered in the study areas, in other places, Concrete water storage tanks for bathrooms which have larvae were also found in Samui, Thailand (Thavara *et al,* 2001), in Hanoi, Vietnam (Tran *et al*, 1999), Banjarmasin, Indonesia (Zubaidah *et al*, 2014), and in Cambodia (Seng *et al*, 2009). Different society and environment may have different key container. Sometimes we found containers, which are actually a few in numbers, yet have high positive containers. Focks and Chadee (1997) explained rare containers yet high productivity is called Rare but Extremely Productive Container (REPC). REPC needs more attention because of its higher productivity and sometimes not needed before.

Discarded bottles and tin cans are types of containers that are rarely controlled but highly potential as a breeding place of Aedes (Ibrahim *et al*, 2009). Discarded bottles and tin cans found in all areas also have larvae in them. In South Tangerang, the presence of discarded bottles and tin cans, which have larvae of Aedes, is the second rank after the bucket. The existence of these containers cannot be ignored. Efforts to improve environmental sanitation with waste management for discarded bottles and tin cans are needed to minimize the presence of Aedes around population (Dhewantara and Dinata, 2015).

Awareness about the environmental sanitation is necessary to be applied by residents for preventing dengue incidence. Mosquitoes control activities should be carried out regularly at least once a week, because percentage of larvae density in every house is quite high. Entomology indices in nine areas remained to be in moderate transmission of dengue. The community must improve the environmental sanitation to control dengue vector, thus dengue fever in the region can be controlled.

The most common containers found in Banten Province are buckets, Concrete water storage tanks for bathrooms, and water trays of dispenser. The key container in the city of Cilegon and Serang is Concrete water storage tank for bathroom while in South Tangerang City area are buckets. Entomology indices in all areas show that all survey areas have a moderate transmission of dengue fever.

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