Breeding places of mosquito larvae and pupae in Bandung City

T Respati* and Y Feriandi
Public Health Department Faculty of Medicine, Universitas Islam Bandung, Jl. Tamansari 22 Bandung Indonesia 40116

*titik.respati@unisba.ac.id

Abstract. Mosquitoes are main vector on the transmission of a number of pathogens include arthropod-borne viruses (arboviruses), parasitic worms, and protozoa. The diseases include malaria, West Nile virus, chikungunya virus, dengue fever, yellow fever, Rift Valley fever, and many more. This study aims to analyze the breeding places that affect the presence of mosquitoes’ larvae and pupa. The survey with stratified random sampling method applied to 2035 houses and inspected 5984 containers. The survey conducted from March to July 2015. The analysis used was correlation analysis and generalized estimating equation (GEE). Volume influences the presence of larvae in containers whereas the presence of pupa as a proxy of adult mosquitoes is related to the volume of containers, plant-covered containers in total and in part, and containers that are entirely and partially closed. In conclusions, breeding places containing larvae and pupa are large volume containers that are not closed or partially closed with water sources from rainwater and well water.

1. Introduction
Arboviruses is short for Arthropod-Borne Virus is a group of viral infectious diseases transmitted by Arthropods (mosquito). The diseases classified as Arboviruses which have been reported and often cause outbreak in Indonesia include Dengue Hemorrhagic Fever (DHF), Chikungunya and Japanese Encephalitis (JE) [1,2]. Dengue Hemorrhagic Fever (DHF) is the main Arboviruses in Indonesia. In the last three years (2008-2010) the average number of dengue cases was 150,882 cases with an average of 1,321 deaths. While Chikungunya in 2011 reported 1270 cases without death, the Chikungunya case reported in Aceh, DKI Jakarta, West Java, East Java, Gorontalo, West Sulawesi, Bali, and NTB. Although there appears to be a decrease in the number of cases reported but outbreaks are still possible in some areas such that vigilance and prevention efforts need to be increased [3-5]. Most health centres do not carry out regular larvae routine monitoring activities, in addition to the activities of larvae (monitoring) cadres monitoring do not work in most areas due to limited budget allocations in the regions for both activities. The main program of cleaning the breeding sites called “pemberantasan sarang nyamuk “ (PSN) applied since a long time ago, however to date the results were varied across the country [6-8].

Mosquito breeding sites are closely related to macro and micro-ecological factors that are determined by human activities individually or collectively [9,10]. Social factors including eradication and prevention; provision of public facilities such as sanitation and clean water; and community participation...
including prevention activities, knowledge, and behavior of the community regarding DHF [11-13]. Water supply is usually limited to certain times so that the community holds water in containers. This container is a vulnerable place for contamination of several biological agents including mosquito larvae. Several studies have shown that the management of container water utilization is essential in determining the dynamic population of mosquitoes [14-16]. This study aims to analyze the factors that affect the presence of larvae and pupa which can be used to develop guidance in the management and prevention of them.

2. Method

This research is a survey in 16 villages in the city of Bandung. The research is part of research entitled Eco health System Dynamics Model to Reduce Mosquito as an Effort to Cut Transmission of Dengue Hemorrhagic Fever. Sampling was carried out by stratified random sampling method. The entomology survey was carried out using modified data collection instruments from the World Health Organization on Behalf of the Special Program for Research and Training in Tropical Diseases [8]. Each container in the house grouped by place, type of material, diameter, capacity, final status semi-closed / open), color (light/dark), exposure to sunlight, and prevention efforts such as the use of abate, or the activity of raising fish. Only containers containing water examined. The larvae survey method used is a visual method as follows, each container containing water checked in a calm water state, if no larvae found for 30 seconds to one minute, then repeated observations made. The analysis used is correlation analysis to see the relationship between variables and multivariable analysis using the generalized estimating equation (GEE) using SPSS Ver. 17. This research has obtained a research permit from the National Unity and Regional Community Protection Agency (BKBPM) West Java Provincial Government no. 070/3799 / BKBPM.

3. Results

The survey was conducted in 2035 houses from March to July 2015 at the end of each week (Saturday and Sunday) to ensure that the occupants of the house were in the house. The number of containers found and inspected was 5984 pieces.

Table 1 are the results of the presence of larvae in containers affected by volume; the higher the volume of the container, the more likely there are larvae. Water sources related to the presence of larvae come from wells and rainwater. Containers that are closed entirely and partly also relate to the presence of larvae.

| Table 1. The presence of larvae and the contributing factors. |
|---------------------------------------------------------------|
| **Type** | **Univariable** | **Model** | **Univariable** | **Model** |
|          | **Est. Par.** | **RSE** | **p Value** | **Est. Par.** | **RSE** | **p Value** |
| Containers |          |          |            |            |          |          |            |
| A         | 0.1004    | 0.2086   | 0.6304     |           |          |          |            |
| B         | 0.2476    | 0.2247   | 0.2704     |           |          |          |            |
| C         | Reference | -        | -          |            |          |          |            |
| Log volume | 0.3041    | 0.0409   | < 0.0001   | 0.2966     | 0.0421   | < 0.0001 |
| Containers Materials |          |          |            |            |          |          |            |
| Cement    | Reference | -        | -          |           |          |          |            |
| Ceramic   | 0.0676    | 0.1358   | 0.6188     |           |          |          |            |
| Plastic   | -0.9315   | 0.1209   | < 0.0001   |           |          |          |            |
| Rubber    | 0.6236    | 0.5299   | 0.2393     |           |          |          |            |
| Fiber     | 0.0191    | 0.2703   | 0.9436     |           |          |          |            |
| Others    | -0.7195   | 0.2090   | 0.0006     |           |          |          |            |
| Container Color |          |          |            |            |          |          |            |
| Black     | Reference | -        | -          |           |          |          |            |
| Blue      | 0.0061    | 0.0831   | 0.9412     |           |          |          |            |
| Red       | -0.1007   | 0.1526   | 0.5093     |           |          |          |            |
| Green     | -0.3341   | 0.1420   | 0.0186     |           |          |          |            |
| Pink      | 0.5599    | 0.2013   | 0.0054     |           |          |          |            |
| Yellow    | 0.5602    | 0.3602   | 0.1199     |           |          |          |            |
| Others    | -0.0548   | 0.0939   | 0.5597     |           |          |          |            |
### Table 1. Cont.

| Type                  | Est. Par. | Univariable RSE | p Value | Est. Par. | Model RSE | p Value |
|-----------------------|-----------|-----------------|---------|-----------|-----------|---------|
| **Water Source**      |           |                 |         |           |           |         |
| Municipal water supply| 0.2822    | 0.1392          | 0.0426  | 0.4613    | 0.2211    | 0.0369  |
| Others                | 1.1229    | 0.2274          | < 0.0001| 0.9353    | 0.3673    | 0.0109  |
| Rains                 | 0.4814    | 0.1106          | < 0.0001| 0.4906    | 0.1256    | < 0.0001|
| **Vegetation Coverage**|          |                 |         |           |           |         |
| Total                 | 0.7920    | 0.2553          | 0.0019  | 0.6585    | 0.4090    | 0.1074  |
| Partial               | 0.5256    | 0.1899          | 0.0056  | 0.1236    | 0.2599    | 0.6345  |
| **Container Location**|          |                 |         |           |           |         |
| Outside               | 0.3847    | 0.1310          | 0.0033  | 0.0240    | 0.1835    | 0.8960  |
| Inside                | Reference | -               | -       | Reference | -         | -       |
| **Container with Temephos**|      |                 |         |           |           |         |
| Yes                   | 0.5455    | 0.2254          | 0.0155  | 0.2115    | 0.3298    | 0.5214  |
| No                    | Reference | -               | -       | Reference | -         | -       |
| **Container with Lid**|          |                 |         |           |           |         |
| Total                 | 0.3550    | 0.1196          | 0.0030  | 0.5000    | 0.1671    | 0.0028  |
| Partial               | 0.6991    | 0.1879          | 0.0002  | 0.8272    | 0.2405    | 0.0006  |
| **Notes**: RSE = robust standard error. Category A: container for everyday use; Category B: container with water not use for storage (ex. Flower pots); Category C: Specific (Fish ponds).

Table 2 shows the existence of pupa as a proxy for adult mosquitoes related to the volume of containers, plants which are entirely and partially covered, as well as containers that are entirely and partially closed.

### Table 2. The presence of pupae and the contributing factors.

| Type                  | Est. Par. | Univariable RSE | p Value | Est. Par. | Model RSE | p Value |
|-----------------------|-----------|-----------------|---------|-----------|-----------|---------|
| **Containers**        |           |                 |         |           |           |         |
| A                     | 0.3354    | 0.3045          | 0.2706  | -         | -         | -       |
| B                     | 0.2461    | 0.3129          | 0.4317  | -         | -         | -       |
| C                     | Reference | -               | -       | Reference | -         | -       |
| Log volume            | 0.4185    | 0.0526          | < 0.0001| 0.4309    | 0.0557    | < 0.0001|
| **Containers Materials**|       |                 |         |           |           |         |
| Cement                | Reference | -               | -       | Reference | -         | -       |
| Ceramic               | 0.2982    | 0.1931          | 0.1225  | -         | -         | -       |
| Plastic               | -0.7236   | 0.1791          | < 0.0001| -         | -         | -       |
| Rubber                | 1.1049    | 0.5642          | 0.0502  | -         | -         | -       |
| Fiber                 | -0.0176   | 0.4378          | 0.9679  | -         | -         | -       |
| Others                | -0.5183   | 0.3028          | 0.0869  | -         | -         | -       |
| **Container Color**   |           |                 |         |           |           |         |
| Black                 | Reference | -               | -       | Reference | -         | -       |
| Blue                  | 0.2379    | 0.1228          | 0.0527  | -         | -         | -       |
| Red                   | -0.5126   | 0.2890          | 0.0761  | -         | -         | -       |
| Green                 | -1.2703   | 0.2568          | < 0.0001| -         | -         | -       |
| Pink                  | 0.0561    | 0.3814          | 0.8832  | -         | -         | -       |
| Yellow                | -0.2339   | 0.6608          | 0.7234  | -         | -         | -       |
| Others                | -0.3924   | 0.1560          | 0.0119  | -         | -         | -       |
| **Water Source**      |           |                 |         |           |           |         |
| Municipal water supply| Reference | -               | -       | Reference | -         | -       |
| Others                | -0.6016   | 0.2150          | 0.0051  | -0.8078   | 0.4123    | 0.0501  |
| Rains                 | 0.6093    | 0.2935          | 0.0379  | -0.1534   | 0.5555    | 0.7825  |
| Wells                 | -0.5048   | 0.1655          | 0.0023  | -0.7881   | 0.1835    | < 0.0001|
Table 2. Cont.

| Type                  | Type       | Est. Par. | RSE  | p Value | Est. Par. | RSE  | p Value |
|-----------------------|------------|-----------|------|---------|-----------|------|---------|
| Vegetation Coverage   | Total      | 1.0859    | 0.3493| 0.0019  | 1.3809    | 0.4796| 0.0040  |
|                       | Partial    | 0.7722    | 0.2447| 0.0016  | 0.8249    | 0.3203| 0.0100  |
|                       | None       | Reference | -    | -       | Reference | -    | -       |
| Container Location    | Outside    | 0.2857    | 0.1720| 0.0968  | 0.1193    | 0.2483| 0.6310  |
|                       | Inside     | Reference | -    | -       | Reference | -    | -       |
| Container with Temephos| Yes        | 0.2819    | 0.2761| 0.3074  |           |      |         |
|                       | No         | Reference | -    | -       | Reference | -    | -       |
| Container with Lid    | Total      | 0.4236    | 0.1692| 0.0123  | 0.6680    | 0.2565| 0.0092  |
|                       | Partial    | 1.0009    | 0.2942| 0.0007  | 0.9123    | 0.4174| 0.0288  |
|                       | None       | Reference | -    | -       | Reference | -    | -       |

Notes: RSE = robust standard error. Category A; container for everyday use; Category B; Container with water not use for storage (ex. Flower pots); Category C; Specific (Fish ponds)

4. Discussion
Very rapid population growth has led to widespread use of land as settlements in the city of Bandung. More settlements in the form of horizontal settlements and complex or residential clusters cause land functions to change. Land use as a settlement is closely related to Arbovirus disease because it deals with mosquito habitat. Unplanned settlements, inadequate basic sanitation facilities along with poorly maintained environmental hygiene increase the risk of dengue virus transmission [8,17].

Rain affects the larvae in two ways, namely causing a decrease in temperature and increasing the humidity of the air relative. Aedes spp. Mosquitoes. For example, to survive at low temperatures, but the metabolism will decrease if the temperature drops below the critical temperature. Temperatures more than 35°C will slow physiological processes. With an average mosquito growth, the optimum temperature of 25-27°C, the city of Bandung is an ideal area for the growth of these mosquitoes [4].

The level of Aedes aegypti infestation in Indonesia is measured using the ABJ value which shows the percentage of houses that are free of mosquito larvae. The standard provided by the Ministry of Health for ABJ is 80% for non-endemic areas and ≥ 95% for endemic areas [17]. The city of Bandung is a DHF endemic area, so the number to achieve is ≥ 95%. The results showed that none of the regions reached that number. This result is not following data from the Bandung City Health Office which states that the entire city of Bandung achieved an ABJ> 95% which means that it is following national standards. Some reasons for the difference in numbers include the first routine inspection method conducted by cadres giving the homeowner the opportunity to clean up the breeding place because the inspection schedule had given previously. Considering the size of the index, which is entirely above the standards, we need to be aware that the city of Bandung is very vulnerable to dengue outbreaks. Seeing the difference between the results of the study and the results of the report in ABJ figures, the use of ABJ as an indicator of PSN's success in preventing dengue transmission seems to need to evaluate.

Outdoor homes are influenced by terraced houses perhaps because residents of terraced houses pay less attention to breeding places on the upper floors of the house than residents of one-story houses because they are not directly visible to residents. Direct observation in the field shows that the presence of the second floor of a house tends to use as a place to store unused goods, flower pots, and laundry and washing areas. This finding can be one of the concerns when submitting the PSN program to pay more attention to the condition of multi-story buildings.

This study is limited to only examining the house and the surrounding environment while the puddles that formed outside the yard are not the subject of this study so that the existence of larvae in these places not included in the calculation.
5. Conclusion

Containers which contain larvae and or pupae are large volume containers that are not partially closed or covered with water sources from rainwater and well water. This type of productive container as a mosquito breeding place is a large volume container, partially closed either by plants or container lid.

Acknowledgments

Authors would like to thanks Poltekes Bandung, the Health Office Bandung City, the Bandung Agency for Environmental Control (BPLH), Indonesian Institute of Aeronautics and Space/LAPAN Bandung, Bandung Meteorologi dan Geofisika (BMG) Bandung and the Office of Bandung City Major.

References

[1] Weaver S C and Reisen W K 2010 Present and Future Arboviral Threats Antiviral Research 85 1-36
[2] Conway M J, Colpitts T M and Fikrig E 2014 Role of the Vector in Arbovirus Transmission Annu Rev Virol 1(1) 71-88
[3] Respati T, Raksanagara A, Djuhaeni H, Sofyan A and Shandriasti A 2017 Ecohealth System Dynamic Model for a Planning Tool for the Reduction of Breeding Sites IOP Conference Series: Materials Science and Engineering 12108
[4] Wai K T, Arunachalam N, Tana S, Espino F, Kittayapong P, Abeyewickreme W, et al. 2012 Estimating dengue vector abundance in the wet and dry season: implications for targeted vector control in urban and peri-urban Asia Pathog Glob Health 106(8) 436–45
[5] Kementerian Kesehatan Republik Indonesia 2018 “Demam Berdarah Dengue (DBD)” [Online] Retrieved from: http://www.depkes.go.id/development/site/depkes/index.php?cid=1-17042500004&id=demam-berdarah-dengue-dbd-.html [Accessed on 2018 May 26]
[6] Faridah L, Respati T, Sudigdoadi S and Sukandar H 2017 Gambaran Partisipasi Masyarakat terhadap Pengendalian Vektor Melalui Kajian Tempat Perkembangbiakan Aedes aegypti di Kota Bandung Maj Kedokt Bandung 49(1) 43–7
[7] Respati T, Raksanegara A, Djuhaeni H, Sofyan A, Agustian D, Faridah L, et al. 2016 Berbagai Faktor yang Memengaruhi Kejadian Demam Berdarah Dengue di Kota Bandung Aspirator 9(November) 91–6
[8] Respati T, Feriandi Y, Ndoen E, Raksanegara A, Djuhaeni H, Sofyan A, et al. 2018 A Qualitative Ecohealth Model of Dengue Fever (DF) in Bandung, Indonesia International Journal Tropical Diseases 1(1) 1–12
[9] Brisbois B W and All S H Climate change, vector-borne disease and interdisciplinary research: Social science perspectives on an environment and health controversy Ecohealth 7(4) 425–38
[10] Tana S, Abeyewickreme W, Arunachalam N, Espino F, Kittayapong P, Wai K, et al. 2012 Eco-Bio-Social Research on Dengue in Asia: General Principles and a Case Study from Indonesia Ecohealth Research in Practice, Innovative Applications of an Ecosystem Approach to Health 1 255-271
[11] Luz P M, Vanni T, Medlock J, Paltiel A D and Galvani A P 2011 Dengue vector control strategies in an urban setting: An economic modelling assessment Lancet 377(9778) 1673–80
[12] Respati T, Nurhayati E, Feriandi Y, Yulianto F and Sakinah K 2016 Pemanfaatan Kalender 4M Sebagai Alat Bantu Meningkatkan Peran Serta Masyarakat dalam Pemberantasan dan Pencegahan Demam Berdarah Glob Med Heal Communication 4(2) 121–8
[13] Bartram J, Lewis K, Lenton R and Wright A 2005 Focusing on improved water and sanitation for health Lancet 365(9461) 810–2
[14] Garelli F M, Espinosa M O, Weinberg D, Coto H D, Gaspe M S and Gürtler R E 2009 Patterns of Aedes aegypti (Diptera: Culicidae) Infestation and Container Productivity Measured Using Pupal and Stegomyia Indices in Northern Argentina J Med Entomol 46(5) 1176–86
[15] Ooi E, Goh K and Gubler D J 2006 Dengue Prevention and 35 Years of Vector Control in Singapore Vector Control in Singapore Emerging infectious diseases 12(6) 887–93
[16] Messer W B, Vitarana U T, Sivananthan K, Elvtigala J, Preethimala L D, Ramesh R, et al. 2002 Epidemiology of dengue in Sri lanka before and after the emergence of epidemic dengue hemorrhagic fever *Am J Trop Med Hyg*. 66(6) 765–73

[17] Respati T, Raksanagara A, Djuhaeni H and Sofyan A 2017 “patial Distribution of Dengue Hemorrhagic Fever (DHF) in Urban Setting of Bandung City Distribusi Spasial Kasus Demam Berdarah Dengue di Daerah Urban Kota Bandung *Glob Med Heal Commun*. 5(22) 212–8