



## The Influence of Vegetation and House Index on Male Mosquitoes DHF Vector Abundance on Kawengen Sub-District

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### Abstract

*The environmental conditions of an area can be a major risk factor for potential outbreaks of DHF. High vector population give an effect to the transmission vector-borne diseases. DHF vector population is related with vector DHF mating pattern. Adult male mosquitoes vector DHF plays an important role. Mating proportion was 1:1. Knowing density of male mosquitoes, can easily estimate the number of female mosquitoes. Conducted using observational analytics and male mosquito population surveillance approach. This study aim is to know the effect of variations in the presence of vegetation and House Index (HI) on the high abundance of mosquito populations. Using a light trap and total sampling technique to take adult mosquitoes. Results shows Kawengen, has variety of monoecious, rice field and also fruits (Musa, Mangifera, Psidium guavajava, Annona muricata), flowers (Plumeria, Hibiscus), bamboo, teak. Vegetation density in low-moderate category. Kawengen has moderate density (HI=36%). The number of trapped Aedes sp. male mosquitoes was 6.52%. Variety and density of plants give a support the abundance of male mosquitoes. As a resting and feeding place. The larvae density affects the sex ratio of mosquitoes.*

### INTRODUCTION

DHF is transmitted through vector bites. *Aedes aegypti* is the main vector of DHF & *Aedes albopictus* as a potential vector. It is estimated that 40% of the world's population living in tropical & sub-tropical countries are at high risk of DENV infection, with a high mortality rate. The last few decades, shows the global prevalence of DHF, tends to increase & the risk of outbreaks. Indonesia is a tropical country & has a high risk of dengue, also potential can occur an outbreak. Tropical area has a potential habitat for dengue vector breeding, so that DHF transmission is easy to happen.

One indicator of the success of DHF control is the Larvae-Absence Rate (LAR) reaching the target  $\geq 95\%$ . It is known LAR in Indonesia in 2018 was 80.09%. Reporting LAR in the Central Java Province in 2017 was 84.73% (Central Java Province Health Office, 2018). LAR recent data in Semarang Regency data from April to July 2018 is around 84% (Semarang Regency Health Office, 2018). This condition shows LAR achievements in all regions have not met the planned targets.

Kawengen Village is located in Ungaran Timur Subdistrict, Semarang Regency. That has the potential for dengue outbreaks. This can be

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seen in the data from the Ungaran Timur Basic Health Research. Showing that Kawengen Village has a highest rank in the population with a history of dengue cases, compared to other villages in Ungaran Timur (Mluweh Village and Kalikayen Village). Although, for DHF diagnosis of the population in Kawengen Village is ranked last, after Kalikayen and Mluweh Village. The status of Kawengen Village with the highest rank in the population with a history of DHF, makes Kawengen Village has a high risk of DHF outbreak. This relates to the activity of DENV which has the ability to ADE & dengue virus serotypes. The possibility of repeat infection can occur easily, due to the high population with a history of DHF. Repetition of infection can trigger outbreaks & speed up the transmission of viruses in the host also DHF vector. Environmental conditions in Kawengen Village also support the potential for an outbreak. Dense & varied areas of vegetation that have potential as a breeding sites and abundance of DHF vector populations (Anker & Arima, 2011; Murray et al., 2013, Sukendra, 2015).

DHF vector population affects the speed of DHF transmission rate. DHF vector population is related to mating vector DHF pattern. Adult of male mosquitoes vector DHF plays an important role in the pattern of mating DHF. The proportion of mating between adult male and female mosquitoes is 1: 1. Even though the life span of male mosquitoes is shorter than female mosquitoes. Fertile female mosquitoes only mate once during their lifetime, to fertilize an egg. For this reason it is necessary to investigate the population or density of male mosquito vector DBD (Beier et al, 2014; Dejenie et al., 2011; Gardner et al., 2013; Lounibos & Escher, 2008).

Environmental factors that affect the DHF case, that is a dense area with a variety of vegetation. Vegetation that can be potential as breeding site. Can affect the abundance of DHF vector populations. Cause *Aedes sp.* are easy to breed continuously throughout the year (Gardner et al., 2013; Dejenie et al., 2011). This environmental condition is a potential environmental factor for the breeding of Dengue vectors / Dengue-transmitting mosquitoes, that is *Aedes sp.* So that, the transmission of DHF continues to occur and it causes difficulties in reducing the number of IR / CFR DHF. The status of Kawengen Village with the highest rank for the population with a history of DHF, makes Kawengen Village has a high risk of DHF outbreaks. Judging from the environmental conditions, Kawengen Village area is still a lot of land in the form of gardens with lush

trees. Making Kawengen Village has a potential habitat for the development of DHF vector populations.

DHF vector population affects the speed of DHF transmission rate. DHF vector population is related with mating behavior pattern of vector DHF. Adult male mosquitoes vector DHF plays an important role in the pattern of mating DHF. The proportion of mating between adult male and female mosquitoes is 1: 1. Even though the life span of male mosquitoes is shorter than female mosquitoes. Fertile female mosquitoes only mate once during their lifetime, to fertilize an egg. The density of mosquitoes can be known from the entomology index, such as the House index (HI). House index can be used to monitor *Aedes sp.* as a dengue virus vector (Dejenie et al., 2011; Lounibos & Escher, 2008; Ferraguti et al., 2016; Purnama & Baskoro, 2012).

For this reason, it is necessary to investigate the environmental effects of vegetation and the entomology index (HI) with the abundance of male mosquitoes from the DHF vector. Seasonal or vector-mediated diseases (vector borne disease) can be easily analyzed using mapping in the context of the environment and landscape. This analysis is useful to find out the level of vulnerability of an area of a particular disease occurrence. By knowing the zonation of the region that describes the level of vulnerability of transmission of a disease. Controlling and eliminating the disease chain can be done appropriately (Hugo et al, 2014; Purnama & Baskoro, 2012; Widayani, 2010). This study aim is to know the effect of variations in the presence of vegetation and House Index (HI) on the high abundance of mosquito populations.

## METHOD

This is a qualitative research and using the male mosquito population surveillance method through analytic observational research approaches. This method is used to determine the geographical distribution of vegetation and mosquito species, and the density of DHF vectors. The study was conducted to analyze the characteristics of vegetation, House index, and abundance of male *Aedes sp.* transmitting DHF.

The location of the study was conducted in Kawengen Village. Kawengen Village consists of 5 hamlets: Selelu, Jatirejo, Genurid, Kawengen, and Watupawon. A total of 5 light traps were placed in each hamlet, with location determination adjusted for inclusion and exclusion.

The population in this study were all mosquitoes (males). That male mosquitoes were po-

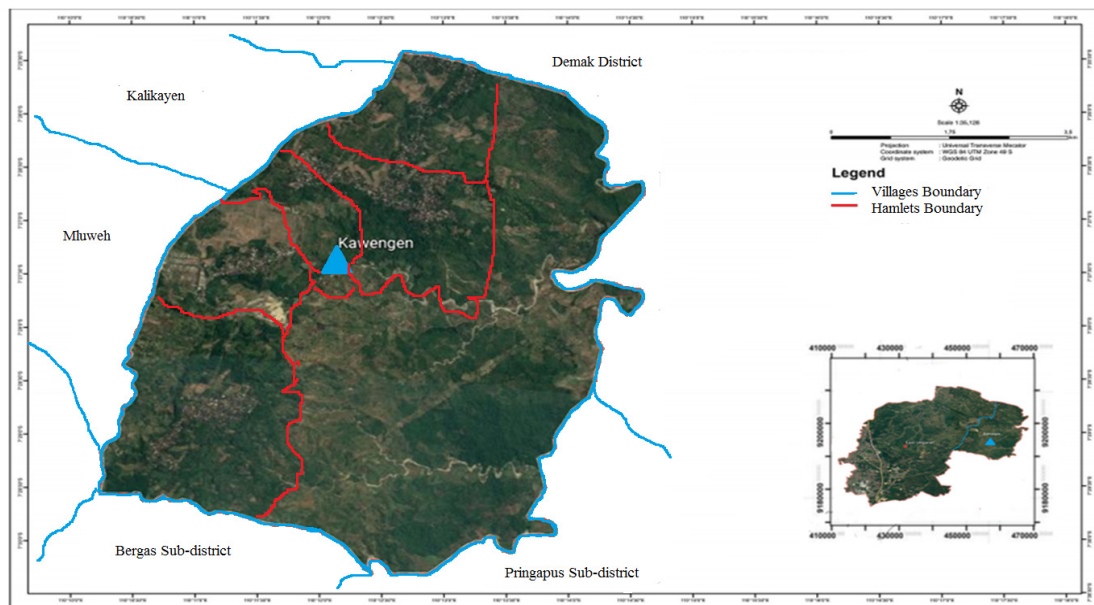


Figure 1. Kawengen Village Region Image Map.

tential as dengue vectors in Kawengen Village, Ungaran Timur Sub-district. The research sample was taken from all potential mosquito (male) populations as dengue vectors in Kawengen Village, Ungaran Timur Sub-district. Mosquito sampling technique is done by purposive random sampling and by placing a light traps. Mosquitoes sample taken using Male Mosquito Population Surveillance method. Inclusion criteria are all potential habitats for dengue vector mosquito breeding in Kawengen Village that habitats are permanent condition. Exclusion criterias that are if potential place of mosquito breeding sites under go change, expansion or shrinkage occurs, there are permanent or temporary puddles of water within 1 year until the time of research.

The initial stage of the study, using qualitative methods. To analyze the environmental characteristics of the population with a history of DHF in Kawengen Village, Ungaran Timur. By observing the environment around the residents.

The next stage of research, using the method of male mosquito population surveillance. This method is used to determine the geographical distribution of DHF vectors, DHF vector densities, and vegetation. Male mosquito population surveillance is done by using a light trap to capture the DHF vector. The coordinates of the light traps location and other indicators are recorded using the worksheet form. The light trap is filled with attractants as well as 1-2 units of insect killer in each placement location. Breeding site and vegetation observations were made at a radius of 100 m from the population with dengue

history cases. Placement of light traps in the outside houses, the dwelling in accordance with the inclusion / exclusion criteria and with a radius of 100m from the population of dengue history cases. The height of the light trap placement is 1 m from the ground surface, and the radius of 100 m from the house of DHF sufferers. Light trap installation is carried out for 1 month and monitored every 2 days.

Male mosquito vectors of dengue were caught in light traps, and then collected and transported to the laboratory for identification. The number, gender, species, preference vector of dengue looking for food, and recording the coordinates of light trap placement using GPS. As well as observing the characteristics of breeding and resting places, also vegetation.

Univariate analysis to determine the characteristics of vegetation, density and type of mosquitoes. Spatial analysis of vegetation cover distribution on map and the male mosquito vector of dengue in the Kawengen Village of Ungaran Timur Sub-district, using Arc GIS software.

## RESULTS AND DISCUSSION

Dengue Fever (DF) and Dengue Hemorrhagic Fever (DHF) is one of the public health problems in Indonesia. That tends to be more wide-spread and can cause social also economic impacts. Indonesia is one of the countries included in the region which is endemic to the spread of dengue disease. DF and DHF are diseases caused by dengue virus and transmitted by *Aedes sp.* (*Ae. aegypti* and *Ae. albopictus*).

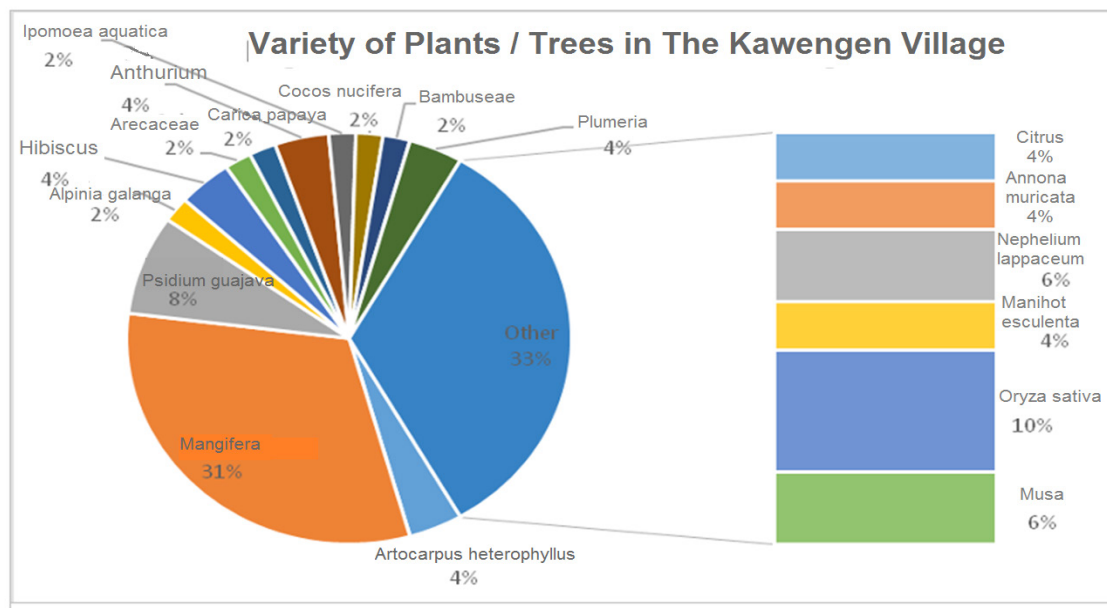


Figure 2. Variation of Plants / Trees located in the Kawengen Village.

The existence of DHF vector is influenced by environmental factors including climate, vegetation, mosquito breeding. Based on Figure 1. and Figure 2. it appears that Kawengen Village area located in areas with plenty of vegetation. Variations in the presence and density of vegetation, especially vegetation that can hold rainwater, has the potential to be a mosquito breeding places. In Figure 1. Kawengen village is seen almost all of its area, is a green area with medium-high category of vegetation density.

Vegetation density has an impact on mosquito abundance. Dense vegetation tends to provide a barrier for sunlight to touch the ground. This causes the soil to be kept moist and become shady. This condition makes the vegetation dense area into an adaptive environment for mosquito life. Dense vegetation affects the mosquito breeding rate. As well as having high potential as a breeding place and resting place for mosquitoes (Ferraguti et al, 2016; Osorio et al, 2014; Rohani et al., 2014).

Residential areas close to vegetation, making it easy for female mosquitoes to find blood food. In this study, it was shown that almost all samples of houses directly bordered by the variety of vegetation. Especially vegetation with a distance <100m from the resident's house. Meanwhile, the *Aedes sp.* flying range is 100m. Indicating this condition affects the feeding preference and biting rate of mosquitoes. Female mosquitoes will more easily reach blood food sources (humans), so it is possible to have a higher biting rate. A high biting rate, influences the speed of transmission of

disease transmission and the possibility of much produce eggs (Dzul-Manzanilla et al., 2017; Ferraguti et al, 2016; Smallegange et al., 2010).

The variety of vegetation that is close to residential areas, is also very potential for the presence of male mosquitoes. Male mosquitoes can easily find resting places and sources of feed. Although *Aedes sp.* are classified as indoor mosquitoes, but the distance between vegetation and the house is very close. This condition allows the male mosquito is also resting on vegetation. Besides as a resting place, male mosquitoes are also easily to reach the feed in the form of nectar. Based on Figure 2. many kinds of vegetation are found near residents' houses and classified as monooecious plants / trees. Magifera trees are most often found, which is around 36%. Plants that have potential as breeding sites are also found, because they are able to hold rainwater. Vegetation that are able to hold water: Musa (6%), Bambuseae (2%), and Hibiscus (4%) (Schmidt et al., 2011; Rohani et al., 2014; Beier et al., 2014).

The existence of breeding place is also related to the media distribution both natural and artificial breeding. Natural breeding places can be holes in trees, leaves that can hold water, etc. While artificial breeding can be in the form of a bathtub, dispenser, bucket, etc. The existence of breeding places inside and outside or surrounding the homes of residents, can affect the population or the density of mosquitoes in an area. Especially in areas that have lots of open water containers, this condition is closely related to the occurrence of dengue cases (Dewi & Sukendra, 2018).

Table 1. Characteristics of Entomology Indicators for Each Hamlet in Kawengen Village, Ungaran Timur Sub-district

Hamlets	HI (%)	CI (%)
Hamlet 1	40	8
Hamlet 2	0	0
Hamlet 3	60	71.4
Hamlet 4	0	0
Hamlet 5	80	80

Based on Table 1. it appears that 3 out of 5 hamlets in Kawengen Village have House Index (HI) values that are classified as high categories. Although overall, Kawengen Village has a HI value of 36%, which is included in the medium category. HI values were high, indicating that there are still many positive houses with larvae, and found many positive containers with larvae. Containers with larvae indicate the existence of larvae, which have the potential to transmit DHF. The larvae found in containers indicate that gravid female mosquitoes lay eggs in containers. Gravid females signify success in mating with male mosquitoes. *Ae. aegypti* at one time, capable of laying around 100-400 eggs and placed on the walls of water containers (Purnomo & Basoro, 2012; Rohani et al., 2014; Scott & Morison, 2015).

The results of the Container Index (CI) in Kawengen Village classified as medium-high. The medium-high CI category shows that mos-

quitoes easily find containers to lay eggs. And the eggs were able to hatch properly. Eggs that successfully hatched, indicating the eggs had been fertilized by male mosquitoes. Although there are other factors, which contribute to hatching eggs. These are temperature, humidity, light intensity, and other physical factors (Rohani et al., 2014; Beier et al., 2014; Villarreal et al., 2018).

The larvae density affects the sex ratio of mosquitoes. HI as an indicator of mosquito larvae density, can affect mosquito density. This relates to mosquito breeding patterns, with a proportion of 1: 1 (Viilareal et al., 2018; Dzul-Manzanilla et al., 2017; Anker & Arima, 2011). In Figure 3. shows the proportion of mosquitoes found in Kawengen Village. In *Aedes sp.* especially in Hamlet 1, the proportion of male and female mosquitoes was found to be 40: 60. These conditions indicate the existence of males in the population is high.

HI with medium-high category, indicates that many gravid female mosquitoes are able to

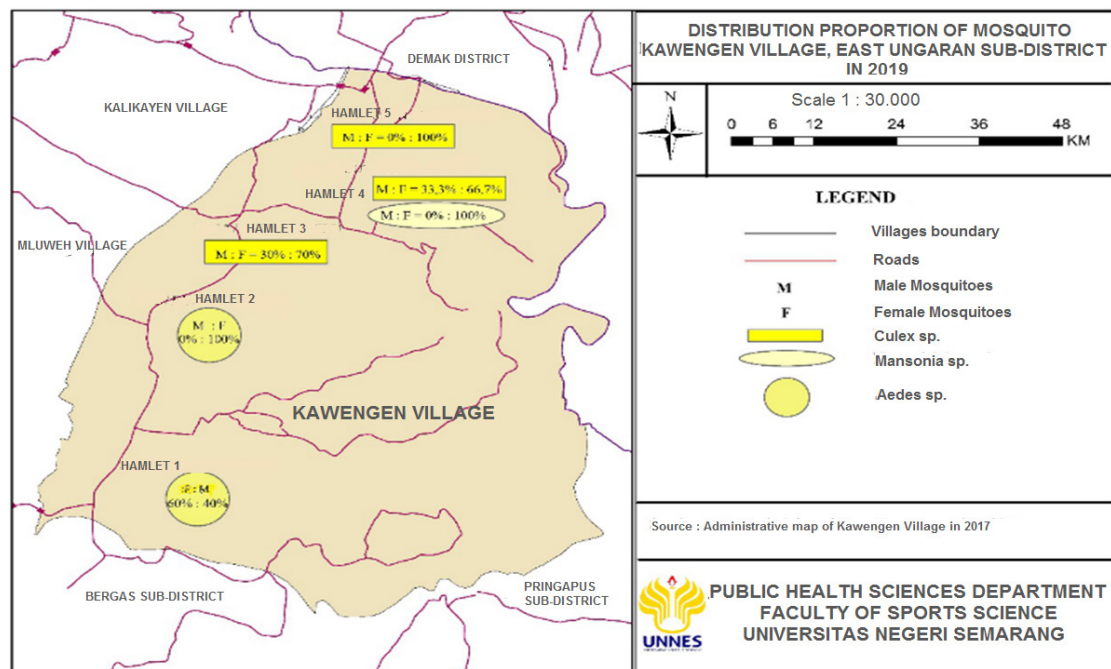


Figure 3. Proportion of Mosquito Distribution in Kawengen Village

lay eggs in containers and hatch into larvae. The large number of gravid female mosquitoes and capable of hatching eggs, shows that female mosquitoes have mated with male mosquitoes. It can be assumed that there are also many male mosquitoes in a population, according to the mating ratio of male and female *Aedes sp.* which is 1: 1.

## CONCLUSION

The existence and diversity of vegetation has the potential to be a resting place and a source of food for male mosquitoes. As well as the density of mosquitoes based on HI values, which are classified as medium-high. This condition has an influence on the abundance ratio of male mosquitoes in the population. Vegetation and HI contribute to the abundance of male mosquitoes in a mosquito population.

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