Research Article

The Characteristics Probabilities and Risks Prediction of Containers as Potential Breeding Sites for Aedes Aegypti Mosquitoes

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ABSTRACT

Characterization of the Aedes aegypti larval container is an important factor influencing mosquito reproduction patterns and is an important aspect of integrated vector control. The study purpose to identify the characteristics and predict the risk of water reservoirs that have the potential as a breeding place for the Aedes aegypti mosquito. The study was using descriptive with a quantitative approach. It was conducted in the West Banjarmasin District which consisted of 9 villages (Kuin Selatan, Kuin Cerucuk, Belitung Selatan, Pelambuan, Belitung Utara, Telaga Biru, Telawang, Teluk Tiram, and Basirih). The population was all households in West Banjarmasin District with a total of 10.003 houses. A sample of 100 houses was taken using proportional random sampling. The results showed that 77.8% of households use tap water sources and there are 44,4% use dark colored containers. Most of the households have a water reservoir in the house (88.9%) and in Teluk Tiram Village about 66.70% of the households drain the water reservoir for more than 7 days. Concluded that the characteristics of most water reservoirs were tap water sources, dark in color, located inside the house, and cleaned more than 7 days with the highest risk value was 73.13%.

Keywords: Aedes aegypti, characteristic, dengue fever, risk

INTRODUCTION

Dengue fever has become a disease outbreak in several areas in Indonesia. One of them is in South Kalimantan Province. The Case Fatality Rate (CFR) of dengue fever in South Kalimantan Province increased from 2019 to 2020, from 0.6%[1] to 1.3%.[2] Based on the Health Profile of South Kalimantan Province data in 2019, the incidence of Dengue Fever occurred in Banjarmasin City as many as 263 incidents. It had increased in 2020 to 474 incidents.[1,2] West Banjarmasin District is the highest area incidence of Dengue Fever in Banjarmasin City.[3]

These data indicate that Dengue Fever is a problem that requires control measures so that the incidence of the disease does not continue to increase. One of the control efforts which is possible to do is to break the chain of transmission by eradicating the breeding sites for the dengue fever vector, the Aedes aegypti mosquito.[3]

Several studies have proven the relationship between the characteristics of water reservoirs and the presence of larvae. Based on Hidayah, et al [4] study result, it is known that the characteristic factors of water reservoirs that most influence the presence of larvae are the type of water source, color, location, and frequency of draining the water reservoir. Based on those four distinguishing characteristics, one can predict the probability of larvae in water reservoirs.[5] The findings of this study have been turned into a web-based application. It can facilitate data collection and risk calculations in predicting the incidence of Dengue Fever.[6,7]

Based on this, a basis for determining the dengue fever control program in West Banjarmasin District is possible by identifying the characteristics and predicting the risk of water reservoirs that have the potential as breeding sites for the Aedes aegypti mosquito. The possibility of prediction and the risk of the larvae's existence can be used as basic data for areas with a high risk of dengue fever.

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Furthermore, prevention programs can be developed, such as designing the characteristics of water reservoirs so that there is no potential for breeding.

This research purpose is to identify the characteristics and predict the risk of water reservoirs that have the potential as a breeding place for the Aedes aegypti mosquitos. The data obtained can later be used as a reference to determine the most appropriate action in Dengue Fever prevention.

METHOD

This research is descriptive research with a quantitative approach to describe the characteristic probability and risk of larvae present in water reservoirs. The study was conducted in the West Banjarmasin District which consists of 9 villages (Kuin Selatan, Kuin Cerucuk, Belitung Selatan, Pelambuan, Belitung Utara, Telaga Biru, Telawang, Teluk Tiram, and Basirih) on August to October 2022. The population in this study were all households in the District of West Banjarmasin with a total of 10.003 houses. A sample of 100 houses was obtained based on the results of calculations using the Slovin formula.[8]

$$n = \frac{N}{1 + Ne^2}$$

Information:
n: Sample number
N: Population number
Ne: Confidence degree

$$n = \frac{10.003}{1 + (0{,}1)^2} \rightarrow n = \frac{10.003}{1 + 0{,}01} \rightarrow n = 100$$

The research sample was taken using proportional random sampling for the representation of each village. The proportion sample for each village is counted by using the following formula.[9] and the chosen sample among the population in each village is s taken by simple random sampling (Table 1).

$$n\,Village = \frac{Villages' Population}{Total\ Population}\ x\ total\ sample$$

Example counting for Pelambuan Village:

$$n\,Pelambuan = \frac{1.324}{10.003}\ x\ 100 = 12$$

Data collection was carried out using the observation method. The data obtained were analyzed univariately, calculating the percentage of each characteristic in each village.

Table 1. Number of Samples per Village

No	Villages	Population	Sample
1	Pelambuan	1324	12
2	Kuin Selatan	1336	13
3	Kuin Cerucuk	970	10
4	Belitung Utara	946	10
5	Belitung Selatan	837	9
6	Telaga Biru	960	10
7	Telawang	786	8
8	Teluk Tiram	645	6
9	Basirih	2199	22
	Total	10.003	100

The model equation developed by Hidayah et al[4] serves as the foundation for determining the types of characteristics of water reservoirs that can be used as breeding sites for the Aedes aegypti mosquito. Four dominant factors as the basis related to the presence of larvae are the type of water source, the color of the container, the location of the container, and the frequency of draining the container.

$y = -1{,}791 + 0{,}829\ X_1 + 0{,}857\ X_2 + 0{,}812\ X_3 + 1{,}123$ Informationons:
X_1: Type of water source
X_2: Containers color
X_3: Containers location
X_4: Frequency of draining the container

Efactortors has 2 scores, they are score 0 and 1. The description of scorers is presented in Table 2.

Table 2. The Description of Each Factors Score

Code	Factors	Score 0	Score 1
X_1	Type of water source	Tap water	Well water
X_2	Containers color	Light	Dark
X_3	Containers location	Outside	Inside
X_4	Frequency of draining the container	≤7 days	>7 days

Based on the equation model and the scores, there are 16 probability characteristics of water reservoirs along with the calculated risk values which are presented in Table 3.

Table 3. Container Characteristics Probability and Predicted Risk Value of Being an Aedes aegypti Mosquito Breeding Site

No	Probabilities	Code	Risk Value (%)
1	Nontap water, dark color, placed outside, cleaned more than 7 days	R01	86,18
2	Nontap water, dark color, placed outside, cleaned less than 7 days	R02	67,04
3	Nontap water, dark color, placed inside, cleaned more than 7 days	R03	73,46
4	Nontap water, dark color, placed inside, cleaned less than 7 days	R04	47,38
5	Nontap water, light color, placed outside, cleaned more than 7 days	R05	72,57
6	Nontap water, light color, placed outside, cleaned less than 7 days	R06	46,26
7	Nontap water, light color, placed inside, cleaned more than 7 days	R07	54,02
8	Nontap water, light color, placed inside cleaned less than 7 days	R08	27,65
9	Tap water, dark color, placed outside, cleaned more than 7 days	R09	73,13
10	Tap water, dark color, placed outside, cleaned less than 7 days	R10	46,97
11	Tap water, dark color, placed inside, cleaned more than 7 days	R11	28,21
12	Tap water, dark color, placed inside, cleaned less than 7 days	R12	54,71
13	Tap water, light color, placed outside, cleaned more than 7 days	R13	53,59
14	Tap water, light color, placed outside, cleaned less than 7 days	R14	27,31
15	Tap water, light color, placed inside, cleaned more than 7 days	R15	33,89
16	Tap water, light color, placed inside cleaned less than 7 days	R16	14,30

RESULT AND DISCUSSION

The results showed that the characteristics of containers were based on the type of water source (Figure 1), color (Figure 2), location (Figure 3), and frequency of draining the water reservoir (Figure 4). Based on the results obtained, it is known that most households in West Banjarmasin District use tap water sources. Seven of the 9 villages (77.8%) use tap water.

Households that use well water are found in 2 villages, Telawang (14.30%) and Basirih (27.30%) (Figure 1).

This is because there is easy access to clean water facilities in West Banjarmasin District which is part of the urban area of Banjarmasin City. The people who use the well water source are due to save on the use of tap water which is only for drinking, while for daily needs such as washing and cooking using well water.

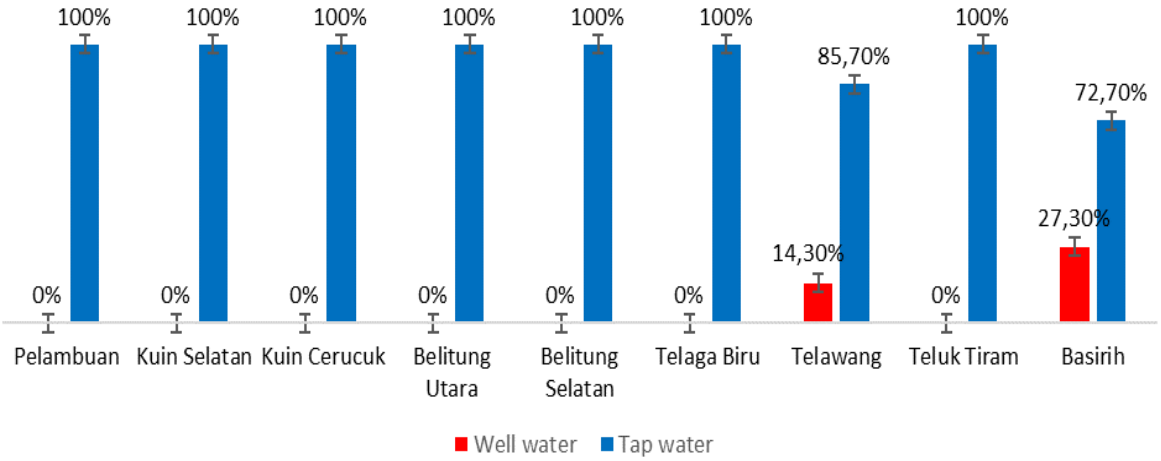

Figure 1. Characteristics of containers by type of water source per village

The relationship between types of water sources and the presence of larvae is possible due to the content of each of these water sources. Well, water sources are indicated to be richer in microorganisms that can be a source of food during breeding in water reservoirs.[5,10] In addition, Aedes aegypti mosquito eggs will develop in suitable water characteristic conditions where organic matter, microbial communities, and aquatic insects contained in the breeding water also affect the life cycle of Aedes aegypti.[5]

Information on the density of mosquito larvae is used as a predictor of potential disease transmission. Aedes sp. likes to lay their eggs in clean water such as wells and tap water. Millah's[11] research concluded that all types of water, regardless of the number of occupants of the house, and whether or not the house is close to a river have the same risk of getting larvae. Therefore residents are advised to maintain the cleanliness of all containers, especially water tanks.

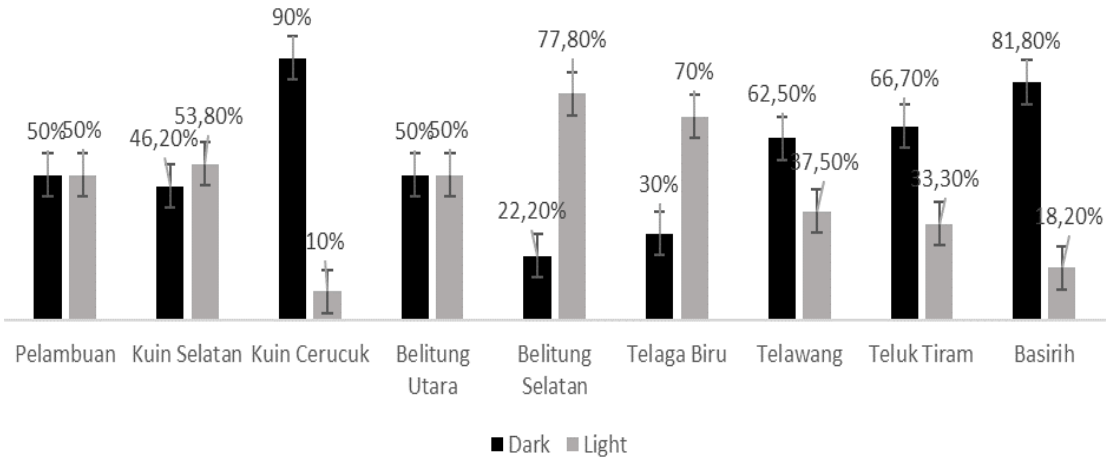

Figure 2. Characteristics of containers by color per village

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In Figure 2, it is known that there are 4 villages (Kuin Cerucuk, Telawang, Teluk Tiram, and Basirih) where most of the households have dark-colored red containers. As for the light-colored ones, there are 3 villages (South Kuin, South Belitung, and Telaga Biru), while in 2 villages (Pelambuan and North Belitung) the proportions are equally large between dark and light. Dark water reservoirs have proven to be preferred by mosquitoes to lay their eggs. Adult mosquitoes usually lay their eggs on the walls of water reservoirs such as barrels, rock and tree holes, etc. above the water line.[12]

Dark colors can provide a sense of security and calm for the Aedes aegypti mosquito at the time of laying eggs so that more eggs are placed in water reservoirs.[5] Most of the households in the West Banjarmasin sub-district have a water reservoir placed inside the house (88.9%) (Figure 3).

In contrast to the results of Fauzan's research, where there was no significant relationship between the color of the container and the presence of larvae in this study, it occurred because there were many other factors that could allow mosquitoes to breed. Therefore, the thing that can be done is by increasing public knowledge about the importance of maintaining the cleanliness of the surrounding environment.[13]

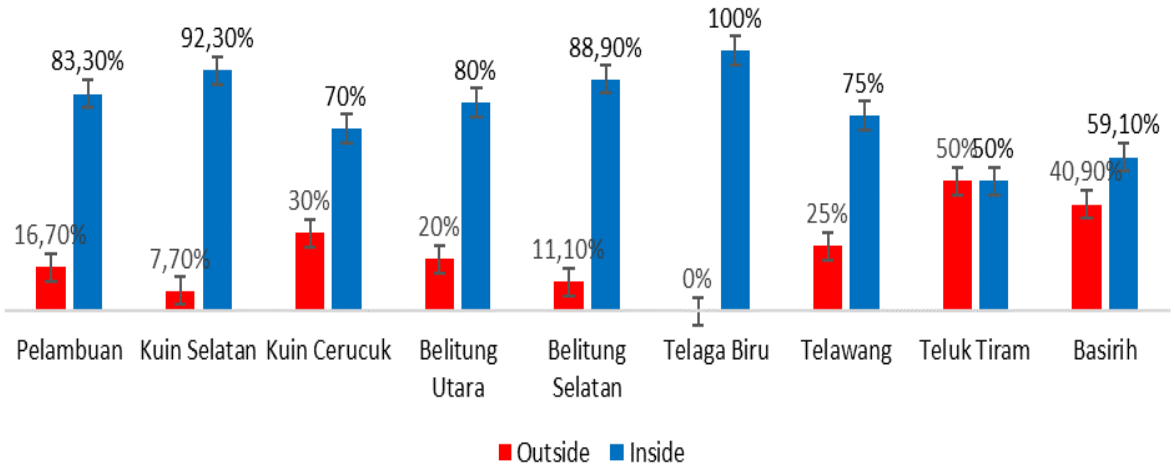

Figure 3. Characteristics of containers by location per village

The location of the water reservoir is one of the factors associated with the presence of larvae.[4] Aedes mosquitoes are widespread and have both indoor and outdoor breeding habitats.[14]

Based on this, households with containers located inside the house tend to be at risk of becoming a breeding site for the *Aedes aegypti* mosquito. Mosquitoes prefer to lay their eggs inside the house due to the dark conditions of the house due to lack of light so the air tends to be humid.[5,15]

Research by Rosita, et al [16], based on the location of the water reservoirs, out of 248 inside the house there were 71 larvae (28.6%), and 177 water reservoirs did not have larvae (71.4%), while of the 32 water reservoirs located outside the house, 2 were water reservoirs contained larvae (6.2%) and 30 water water reservoirs did not contain larvae (93.8%).

More Aedes aegypti mosquito larvae were found in the house because it was affected by the dark conditions of the house due to the lack of lighting so the air became humid.

Aedes aegypti mosquitoes prefer to be found inside buildings or houses. Aedes albopictus mosquitoes prefer to rest outside buildings or houses. Light intensity is the main factor affecting the bionomics of the Aedes aegypti mosquito, which transmits dengue fever, namely low light intensity (≤ 50 lux) is a good condition for mosquitoes.[16]

The frequency of drainage of water reservoirs is known to affect the presence of larvae. People in West Banjarmasin District are known to have a frequency of draining water reservoirs of less than 7 days. However, in Teluk Tiram Village, around 66.70% of households drain water reservoirs for more than 7 days (Figure 4).

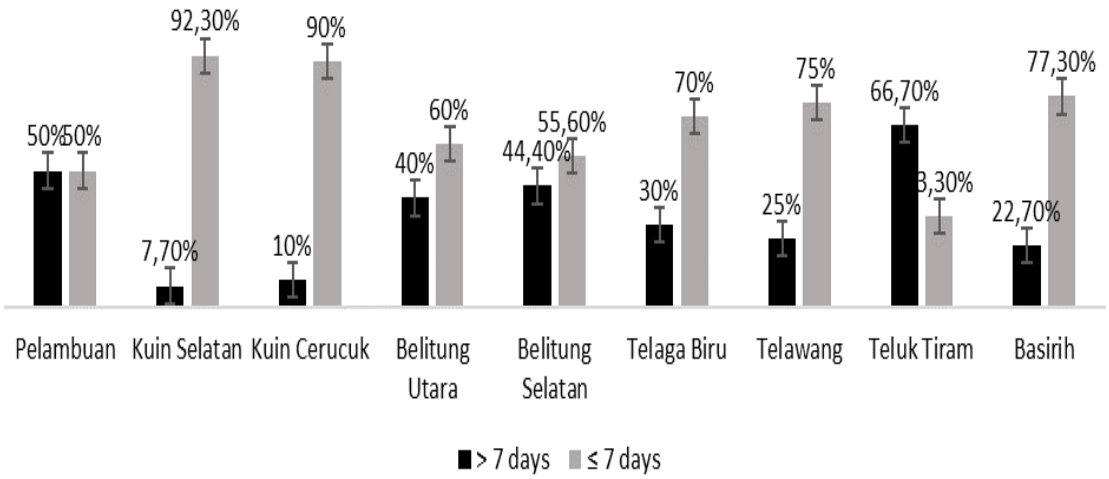

Figure 4. Characteristics of containers by the container's dry frequency per village

This can be an effort to eradicate the Aedes aegypti mosquito breeding sites because mosquitoes cannot freely lay eggs and breed. The development of mosquitoes from eggs to adult mosquitoes takes approximately 7 days.[5,17]

The results of the percentage probability of water reservoir characteristics and the risk value as a breeding site for the Aedes aegypti mosquito in the West Banjarmasin District are presented in Figure 5.

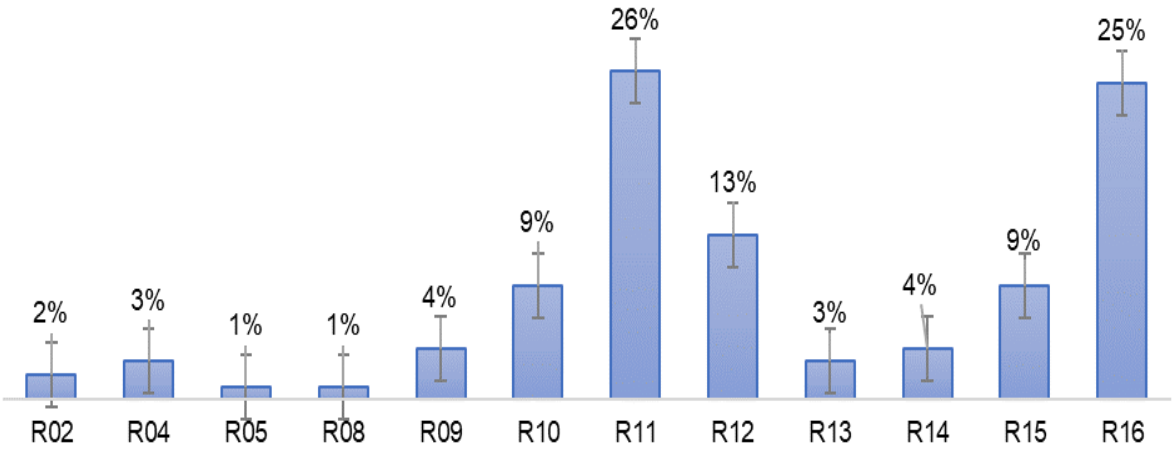

Figure 5. Percentage Frequency Probability of water reservoir characteristics

The probability of the characteristics of water reservoirs in West Banjarmasin Sub-district is mostly the code R11 (tap water, dark color, located inside, cleaned more than 7 days) which is 26%. Among the 16 probabilities, there are 12 probabilities for the characteristics of water reservoirs in the District of West Banjarmasin (Figure 5). The highest risk value for water reservoirs that have the potential as breeding sites for Aedes aegypti mosquitoes is the code R09 = 73.13% (4%).

There are many challenges to be faced in finding better options to prevent and treat the transmission of dengue fever. Inadequate vector control has contributed to the persistence and progression of the disease.[10,18]

From Anwar and Rahman's [19] research, it can be concluded that cleaning the containers actions are still not running optimally, thus affecting the high index of Aedes aegypti mosquito larvae in the area. if the PSN action is carried out by the respondent then the container index will be low. Vice versa if the PSN action is not carried out then the container index will be high.

CONCLUSION

It was concluded that most of the households in the West Banjarmasin sub-district have the characteristics of water reservoirs with tap water sources, dark in color, located inside the house, and cleaned for more

than 7 days. The risk value of water reservoirs being the highest breeding place for Aedes aegypti mosquitoes is 73.13%.

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