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Use of Ovitrap for The Spatial Mapping of *Aedes* spp. in The Endemic Area of Dengue Fever of Baitussalam District Aceh Besar

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Abstrak: Strategi pengendalian vektor demam berdarah melalui pemantauan berkala merupakan upaya mitigasi yang efektif. Pemantauan berkala vektor demam berdarah umumnya banyak dilakukan pada fase larva daripada fase telur. Pemantauan berkala telur *Aedes* dengan menggunakan *ovitrap* lebih efektif karena tidak dibatasi musim. Tujuan penelitian adalah untuk melakukan pemetaan spasial sebaran *Aedes* spp. dengan menggunakan *ovitrap* di Kecamatan Baitussalam Aceh Besar. Penelitian ini menggunakan metode observasi dan penetapan rumah sampel peletakkan *ovitrap* secara *purposive sampling*. Jumlah rumah yang diobservasi sebanyak 50 rumah pada 5 gampong/desa. Analisis menggunakan aplikasi *GPS Essentials* dan *software Google Earth Pro*. Hasil penelitian ditemukan ada 4 gampong tempat sebaran telur *Aedes* spp. di Kecamatan Batussalam Aceh Besar yaitu Gampong Blang Krueng, Gampong Baet, Gampong Kajhu, dan Gampong Cadek sedangkan di Gampong Lam Ujong tidak ditemukan ovitrap yang positif telur *Aedes*. *Ovitrap* menjadi metode yang efektif untuk pemetaan *Aedes* spp. dalam upaya pengendalian demam berdarah.
Kata kunci: *Aedes* spp; demam berdarah; ovitrap; pemetaan spasial.

Abstract: The strategy for controlling dengue vector through periodic monitoring is an effective mitigation effort. Periodic monitoring of dengue vectors is generally more often conducted in the larval stage rather than the egg stage. Monitoring *Aedes* eggs periodically using ovitraps is more effective because it is not restricted by season. The objective of this study is to conduct spatial mapping of *Aedes* spp. distribution using ovitraps in Baitussalam Subdistrict, Aceh Besar. This study used observational methods and purposive sampling to determine the sample houses for ovitrap placement. A total of 50 houses in 5 *gampong*/village were observed. Analysis was conducted using the GPS Essentials application and Google Earth Pro software. The results showed that there were 4 *gampong* with *Aedes* spp. egg distribution in Baitussalam Subdistrict, Aceh Besar, namely *Gampong* Blang Krueng, *Gampong* Baet, *Gampong* Kajhu, and *Gampong* Cadek, while in *Gampong* Lam Ujong, no ovitraps positive for *Aedes* eggs. Ovitraps are an effective method for mapping *Aedes* spp. in efforts to control dengue.
Keyword: *Aedes* spp; Dengue fever; ovitrap; spatial mapping.

1. Introduction

The geographic distribution of Dengue Hemorrhagic Fever (DHF) continues to expand and has become endemic in most tropical and subtropical regions [1]. In 1998, diseases transmitted by Aedes mosquitoes were considered the most important tropical infectious diseases after malaria. Changes in demographic infrastructure are one of the factors that have contributed to the increase in DHF cases [2]. Monitoring changes in demographic infrastructure is crucial to understanding the distribution of DHF cases in a given area.

Dengue hemorrhagic fever has been a public health problem worldwide, including in Indonesia, for more than five decades. To this day, dengue remains poorly controlled, as evidenced by the significant increase in dengue incidence worldwide and the annual outbreaks in Indonesia [3]. This has led to ongoing public concern about dengue. Therefore, strengthening the management of dengue control programs is necessary.

The vectors for dengue fever in Indonesia are *Aedes aegypti* and *Aedes albopictus* [4]. A well-designed surveillance system for the spatial distribution of *Aedes* is needed to provide robust entomological data on local mosquitoes. Strong entomological data can produce statistical information on mosquito behavior and population dynamics, such as population density under various geographical and climatic conditions [5]. This data can also be used to explore the impact of vector control strategies on population dynamics. Exploring mosquito population dynamics in a region is processed using Geographic Information Systems (GIS) [6]. GIS is used as a system for controlling and monitoring *Aedes* in real-time for spatial epidemiology [7]. One monitoring technique using GIS is the ovitrap.

Ovitraps are widely used as tools to monitor, detect, and control *Aedes* populations. Ovitrap-based mapping can provide estimates of *Aedes* populations in a region and act as an early warning signal to prevent potential dengue fever outbreaks [8]. Mapping the spatial distribution of *Aedes* using ovitraps can be a vector control strategy in dengue-endemic areas. Batussalam Subdistrict is one of the dengue-endemic subdistricts in Aceh Besar Regency.

The findings of this study will help identify locations with the potential for dengue virus transmission by mosquitoes.

2. Research Method

a. Study Area

Baitussalam Subdistrict, located in Aceh Besar Regency, lies between 5°34'38"N - 5°37'13"N and 95°21'20"E - 95°24'43"E, covering an area of 20.84 km² (2,084 hectares). The elevation of Baitussalam Subdistrict ranges from 0 to 8 meters above sea level [9]. Geographically, Baitussalam Subdistrict in Aceh Besar Regency is bordered by the Strait of Malacca to the north, the city of Banda Aceh to the south and east, and the city of Banda Aceh and the Strait of Malacca to the west [10]. Baitussalam Subdistrict in Aceh Besar Regency was chosen as the research area because it is one of the primary focus areas for the dengue fever outbreak in Aceh Province (Figure 1).

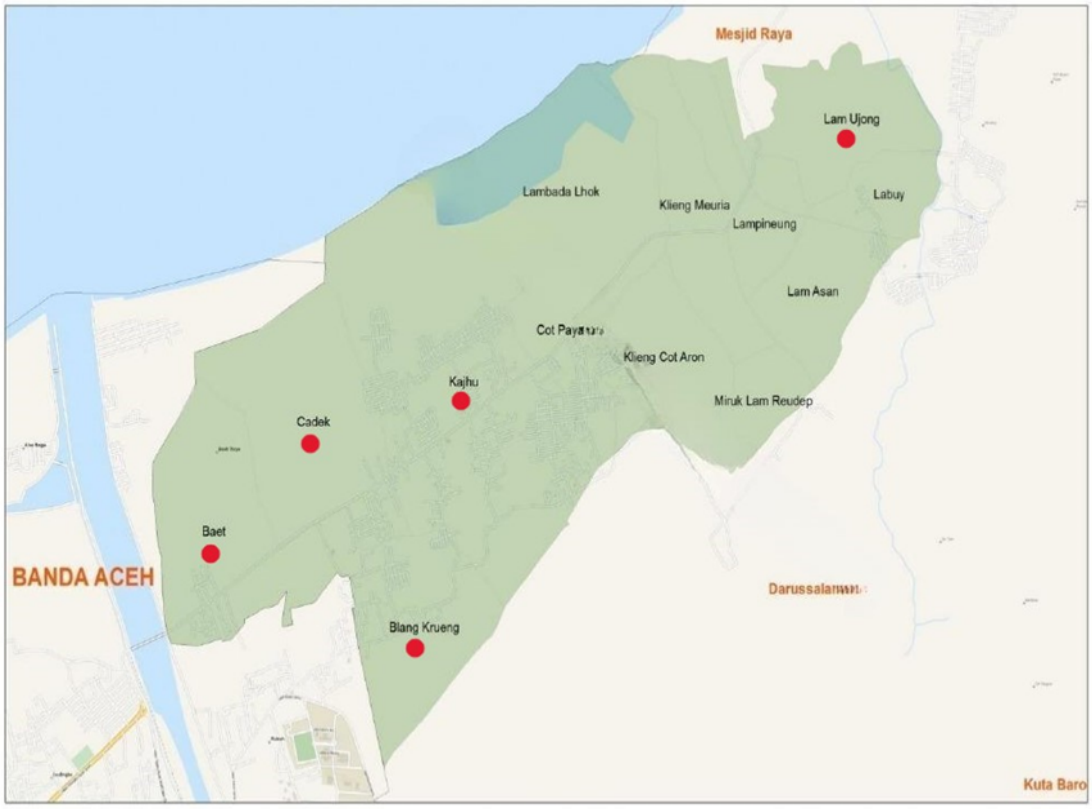

Figure 1. Location of study area. (Sources: BPS, 2022).

b. Ovitrap surveillance

Ovitrap surveys were conducted weekly in residential areas of Baitussalam Subdistrict, Aceh Besar Regency. The villages where ovitraps were placed include *Gampong* Blang Krueng, *Gampong* Baet, *Gampong* Cadek, *Gampong* Kajhu, and *Gampong* Lam Ujong. The ovitraps consisted of black plastic containers with the inner walls lined with filter paper and filled two-thirds with water, providing a site for female *Aedes* mosquitoes to lay eggs. Ovitraps were placed both inside and outside of houses. A total of 100 ovitraps were placed in 50 houses in Baitussalam Subdistrict, Aceh Besar Regency. Each ovitrap was labelled with a serial number, house address, and Global Positioning System (GPS) coordinates for data collection mapping.

c. Mosquito collection

Mosquito eggs, larvae, and pupae in the ovitraps were collected weekly. Eggs adhering to the filter paper were stored in ziplock bags. All larvae or pupae found were taken to the laboratory for species identification. Houses where *Aedes* mosquitoes were found were labelled as positive and marked with a red symbol. Houses where no *Aedes* eggs were found were labelled as negative and marked with a green symbol.

d. Data analysis

The data on the number of positive and negative houses with Aedes eggs were recorded and georeferenced using GPS Essentials (a navigation app based on OpenStreetMap for Android). The recorded tracks and waypoints were then exported as KML files. These KML files were subsequently imported into Google Maps and Google Earth. Next, distribution maps of positive and negative houses with *Aedes* eggs in Baitussalam Subdistrict, Aceh Besar Regency, were created. The mapping results will then be analyzed descriptively.

3. Results and Discussion

Baitussalam Subdistrict is a coastal area in Aceh Besar Regency that was impacted by the 2004 tsunami. The tsunami caused changes in the landscape, inevitably forcing the residents around the disaster site to adapt. Similarly,

animals and plants affected by the disaster underwent significant changes [11]. The rebuilding of settlements after the tsunami and human behavior in managing the new residential environment have inadvertently contributed to the creation of new habitats for *Aedes* mosquitoes [12].

Figure 2. Distribution of ovitraps in Baitussalam Subdistrict, Aceh Besar Regency. (: negative for *Aedes* eggs ; : positive for *Aedes* eggs).

Figure 2 shows the distribution of ovitraps at 5 research locations in Baitussalam Subdistrict, namely *Gampong* Blang Krueng, *Gampong* Baet, *Gampong* Cadek, *Gampong* Kajhu, and *Gampong* Lam Ujong. The results of the ovitrap examination found 10 positive ovitraps containing *Aedes* eggs, spread across 4 research locations. In the research location at *Gampong* Lam Ujong, negative *Aedes* eggs were found. The presence of *Aedes* in an area is influenced by various factors such as local community behavior, climate factors, environmental topography, vegetation factors, and other factors.

Based on dengue fever case data from 2009 to 2022 in Banda Aceh, which was also affected by the tsunami, climate factors such as rainfall and humidity were found to positively correlate with the increase in dengue fever cases [5]. Community behavior to meet daily needs, such as collecting and storing water at home, is one of the practices that can indirectly create habitats for *Aedes*.

Additionally, neglecting waste around the house that can collect water contributes to increasing the *Aedes* population [13]. Vegetation is an important factor for the survival of mosquitoes. The presence of plants in home gardens is a crucial factor for the survival of *Aedes*. Home garden plants can serve as places for mosquitoes to feed and rest [14]. The characteristics of an area play an important role in the presence of mosquitoes. Environmental characteristics, hydrological systems, and the presence of aquatic plants are likely related to the species diversity and community composition of mosquitoes in Banyuasin Regency [15]. The first step in studying the environmental characteristics of an area or home environment that serves as a habitat for *Aedes* is to conduct mapping. This mapping will later serve as the basis for more intensive control and monitoring efforts.

Figure 3. Distribution of ovitraps in *Gampong* Blang Krueng, Baitussalam Subdistrict (: negative for *Aedes* eggs ; : positive for *Aedes* eggs).

The distribution of ovitraps positive for *Aedes* eggs in *Gampong Blang Krueng* shows a clustered distribution (Figure 3). This is due to the close proximity of houses, which makes it very likely for female *Aedes* to move from one house to another to lay eggs. The pattern of dengue fever cases transmitted by *Aedes* is generally found to be clustered, especially in densely populated areas. This pattern is caused by a significant relationship between population density and the number of dengue cases or the *Aedes* population. Buffer analysis results show that dengue transmission by *Aedes* occurs within a radius of 100–300 meters from the case point [16].

Figure 4. Distribution of ovitraps in *Gampong* Baet, Baitussalam subdistrict (: negative for *Aedes* eggs ; : positive for *Aedes* eggs).

In the research location at *Gampong* Baet, only one house was found to be positive for *Aedes* eggs (Figure 4). However, this situation needs to be monitored carefully because female *Aedes* can fly to other houses to lay eggs. Continuous monitoring of *Aedes* abundance data and ovitraps, is important for controlling dengue fever epidemics [17].

Figure 5. Distribution of ovitraps in *Gampong* Kajhu, Baitussalam subdistrict (: negative for *Aedes* eggs ; : positive for *Aedes* eggs).

Gampong Kajhu is a densely populated area. This condition is due to the conversion of vacant agrarian lands into residential areas. The mobility of the incoming population in Gampong Kajhu is relatively high because this gampong is close to educational centers, with the majority of its residents being students [18]. The spread of dengue fever and other infectious diseases is closely

related to human activity and mobility [19]. Good transportation connections between regions further facilitate the spread of this disease to other areas, increasing the potential for dengue transmission [16].

Gampong Cadek, located in Baitussalam Subdistrict, Aceh Besar Regency, is a suburban area where the majority of the population works as farmers and livestock breeders [20]. However, over time, these lands have gradually been converted into residential areas.

Figure 6. Distribution of ovitraps in *Gampong* Cadek, Baitussalam subdistrict (: negative for *Aedes* eggs ; : positive for *Aedes* eggs).

In Figure 6, it can be seen that in the older residential areas, ovitraps positive for *Aedes* eggs were found, while in the newer residential areas, negative *Aedes* eggs were detected. This condition is related to the vegetation around the homes. Plants play an important role for *Aedes* as a source of food, a place to rest, and a shelter from predators. Vegetation also creates a shady and humid environment suitable for the development of adult mosquitoes [14].

Based on the ovitrap distribution map in *Gampong* Lam Ujong, no ovitraps positive for *Aedes* eggs were found (Figure 7). *Gampong* Lam Ujong is located on the outskirts of the city, and the population is not very dense. The houses in this *gampong* are relatively well-organized, and the vegetation is not too dense.

Figure 7. Distribution of ovitraps in *Gampong* Lam Ujong, Baitussalam subdistrict (: negative for *Aedes* eggs ; : positive for *Aedes* eggs).

In rural or suburban areas, low population density and well-spaced houses make mosquito control management easier. Reliable water drainage systems and safe waste disposal can help reduce concerns about the rising incidence of dengue by limiting breeding sites. Improved transportation networks can connect smaller rural areas, thereby increasing the effective population size. Low population mobility in an area also reduces the risk of dengue spread by *Aedes* [21]. However, areas where dengue cases have not yet been found should remain vigilant and continue preventive efforts through mapping and monitoring activities. Better identification of the key risk characteristics for dengue in an area will enhance surveillance and support the development of the most appropriate intervention strategies.

4. Conclusion

The results showed that there were 4 *gampong* with *Aedes* eggs distribution in Baitussalam Subdistrict, Aceh Besar, namely *Gampong* Blang Krueng, *Gampong* Baet, *Gampong* Kajhu, and *Gampong* Cadek, while in *Gampong* Lam Ujong, no ovitraps positive for *Aedes* eggs. Ovitraps are an effective method for mapping *Aedes* spp. in efforts to control dengue.

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