



Geographic Distribution of DHF Cases and Larvae Free Index In Situbondo Regency, 2019-2021

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ABSTRACT

For the last 3 years of dengue cases in Situbondo Regency, there were 475 patients recorded from January to December 2021 (incident rate, IR = 68.904/100,000) and 4 death cases (case fatality rate, CFR = 0.8%). The average percentage of Larvae Free Index Situbondo scores is still below the Environmental Health Quality Standards for an area of at least 95%. This study aims to describe the mapping of Larvae Free Index and dengue cases in Situbondo district in 2021. The type of this research is descriptive. The object of this research is the value of Larvae Free Index and cases of DHF. The data obtained is secondary data from Larvae Free Index and DHF cases in Situbondo Regency for 3 years starting from 2019-2021. The data is displayed using QGIS mapping using points and polygons. Health information and the potential for dengue fever in the area can be identified using geographic mapping, this information can be used to decide policies in breaking the chain of disease. The number of dengue cases in Situbondo Regency increased from 2019-2021. Larvae Free Index value of each village is better than the previous year. The spread of dengue cases is very high due to the mobility of residents who carry out activities outside the area of residence, resulting in transmission of dengue through mosquito bites. To prevent the spread of dengue cases, people are expected to use mosquito-repellent lotion when traveling.

INTRODUCTION

Dengue Hemorrhagic Fever, also known as DHF, is an endemic disease caused by dengue virus infection and transmitted by the *Aedes aegypti* mosquito.¹ Dengue fever is currently a major global health problem. DHF has always been an endemic disease and a major problem to date.² The case of DHF is very closely related to the presence of the *Aedes sp.* The cycle of the *Aedes sp.* has four stages, namely egg, larva, pupa and adult. The breeding ground for egg, larva, and pupa stages is in calm and clear water. Puddles of water in containers or water storage containers can make *Aedes sp.*³

The highest sufferers in Kediri district in 2016 were mostly in the Pare District and Kunjang District, Ngasem District, showed that *Aedes sp.* from the 4 districts were resistant to Temephos and adult mosquitoes were resistant to the chemical insecticide malathion.⁴ Larvae *Aedes sp.* Larvae *Aedes sp.* were resistant to Temefos at a concentration of 0.04 mg/lit,⁵ further confirmed by Haidah which was associated with the distribution of *Aedes sp.* in the 11 sub-districts studied.⁶

Resilience status of the region of the 11 subdivisions of resistance status, only one region is susceptible to detecting the presence of the *Aedes sp.* which is proven to be resistant to organophosphate pesticides. Detection of pesticide resistance in *Aedes sp.* showed a 250 bp band in the mosquito gene indicating that VGSC is a pesticide-resistant gene, Indonesia uses organophosphate pesticides.⁷ Kediri has been using Organophosphate insecticides for quite a long time, the results of Marlik's research showed that *Aedes sp.* is resistant to malathion.⁸

DHF is influenced by several factors, namely the host, agent and environment, or an epidemiological triangle. The host factor is human as the main host of the dengue virus, such as population mobility, population density, residential sanitation hygiene, education, occupation, age, race, and nutritional immunity. The agent factor is the virus that causes DHF. Rainfall that periodically causes puddles of water in the media can be a convenient breeding ground for mosquitoes.⁹

Most cases of dengue fever are detected in the rainy season when there are lots of puddles in rainwater containers that are breeding grounds for mosquitoes. Until now, the number of

districts infected with dengue fever in Indonesia is 477 districts or 92.8% of all districts in Indonesia. This number is likely to increase from 2010 to 2019.¹⁰

The increase in the Larvae Free Index value has an impact on the total DHF at the Perak Health Center. DHF cases increased during the rainy season when Larvae Free Index began to decrease, indicating that the presence of larvae was increasing.¹¹ explained that the lower the Larvae Free Index value will affect the high incidence of DHF.¹² Mosquito Nests and 3M Plus in Baba Village, Baba District, Kediri Regency are considered less eradicated.¹³ A contributing factor to the prevalence of dengue fever is the habit of *Aedes* breeding in clear and clean water in the household environment. The preferred place for *Aedes aegypti* mosquitoes is the indoor environment, especially the bathroom.¹⁴ The failure of eradicating mosquito nests is the result of a lack of information and understanding on how to prevent DHF correctly according to government recommendations. The purpose of this study is to describe the geographical distribution of Larvae Free Index and DHF cases in Situbondo Regency in 2019-2021 because DHF cases are still increasing every year.

MATERIAL AND METHOD

This research uses the descriptive research method. The population in this study was the community with dengue fever cases in the Situbondo district, East Java, Indonesia, in 2019-2021. Sample comes from the total population, with a sample of 20 (twenty) Health Centers. Variables include patients with DHF and ABJ cases were obtained from the health office of Situbondo. This research was approved by the Ethics Committee of the Surabaya Health Polytechnic Number EA/1138/KEPK-Poltekkes_Sby/V/2022.

This study describes, map, and interpret Larvae Free Index and DHF in the Situbondo district using the Quantum GIS application. Standard percentage for Larvae Free Index is $\geq 95\%$ and any percentage below the standard ($\leq 95\%$) is considered not meeting the Larvae Free Index requirement.¹⁵

RESULTS

Dengue Haemorrhagic Fever Cases

The incidence rate of DHF in Situbondo Regency in 2019 was 65.6 per 100,000

population with a total of 448 cases. The health center with the highest incidence of DHF in Situbondo Regency in 2019 occurred at the Mlandingan Health Center with 46 cases. Meanwhile, the lowest number of DHF cases were in Jatibanteng Health Center (0 cases).

The incidence rate of DHF in Situbondo Regency in 2020 is 48.3 per 100,000 population with a total of 331 cases. The health center with the highest incidence of dengue fever in Situbondo Regency in 2020 occurred at the Jangkar Health Center which reached 58 cases. Meanwhile, the lowest DHF cases were at the Widoropayung Health Center as many as 3 cases.

The incidence rate of DHF in Situbondo Regency in 2021 is 68.9 per 100,000 population with a total of 475 cases. The health center with the highest incidence of DHF in Situbondo Re-

gency in 2021 occurred at the Panji Health Center which reached 48 cases. Meanwhile, the lowest DHF cases were at the Widoropayung Health Center as many as 5 cases.

For 3 years (2019-2021) the number of DHF cases experienced ups and downs (fluctuative). The cases decreased in 2020 then the number of DHF increased in 2021. However, in terms of mortality, the number of deaths caused by DHF is the highest in 2020 compared to 2019 and 2021.

In 2019 there were no deaths due to cases of dengue fever, it is likely that in 2019 with the rise of COVID-19, the person who died was declared dead from COVID-19 instead of DHF. The number of cases and mortality in each health center throughout the years can be seen in the following Table 1.

Table 1. DHF Cases in Situbondo Regency 2019-2021

Health Center	2019		2020		2021	
	Cases	Mortality	Cases	Mortality	Cases	Mortality
Sumbermalang	34	0	13	0	8	0
Jatibanteng	0	0	6	0	9	0
Banyuglugur	15	0	5	0	11	0
Besuki	21	0	9	0	28	0
Widoropayung	21	0	3	0	5	0
Suboh	46	0	15	0	19	1
Mlandingan	26	0	10	1	15	0
Bungatan	7	0	6	0	9	0
Kendit	28	0	5	0	9	0
Panarukan	12	0	8	0	36	0
Situbondo	23	0	16	0	47	1
Mangaran	45	0	7	0	33	0
Panji	31	0	16	0	48	0
Klampokan	3	0	11	1	28	0
Kapongan	21	0	22	1	33	1
Arjasa	27	0	34	0	37	0
Jangkar	35	0	58	0	38	0
Asembagus	33	0	49	1	23	1
Banyuputih	7	0	31	2	31	0
Wonorejo	13	0	7	0	8	0
Incidence Rate of DHF	65/100.000		48,3/100.000		68,9/100.000	

Source: Situbondo Health Office Annual Report, 2019-2021

The Value of the Larvae Free Index

The following Larvae Free Index values for 2019-2021 data are obtained from the annual report of the Situbondo District Health Office.

It can be seen from Table 2 that the average Larvae Free Index score for 3 years (2019-2021) is 91%. According to the Minister of Health Regulation Number 50 of 2017 these results are still below the standard larvae-free index of $\geq 95\%$. Out of 20 (twenty) health centers, only 4 health centers met the larvae-free index requirements in 2019 - 2020 with a percentage of 20%, while in 2021 there are 6 health centers with a percentage of 30%. However, there are several health centers which never met the standard score requirements, namely Sumbermalang, Banyuglugur, Besuki, Mlandingan, Bungatan, Situbondo, Mangaran, Panji, Kapongan, Arjasa, Asembagus and Banyuputih.

Table 2. The Average Area under Health Center in Situbondo Regency with Larva Free Index from 2019-2021

Health Center	Larvae Free Index in Areas Below Health Center (%)		
	2019	2020	2021
Sumbermalang	90	91	90
Jatibanteng	95	95	94
Banyuglugur	85	84	89
Besuki	87	85	89
Widoropayung	82	71	95
Suboh	95	97	98
Mlandingan	92	80	93
Bungatan	80	91	93
Kendit	90	83	96
Panarukan	96	96	96
Situbondo	83	84	88
Mangaran	91	94	92
Panji	91	92	92
Klampokan	89	94	96
Kapongan	91	91	94
Arjasa	90	92	93
Jangkar	91	92	95
Asembagus	89	88	88
Banyuputih	92	91	88
Wonorejo	97	98	97
Percentage of Areas with Larvae-Free Index $\geq 95\%$ in Situbondo Regency	20%	20%	30%

Source: Larvae Free Index Annual Report Situbondo Health Office, 2019-2021

Distribution Map of DHF and Larvae Free Index Cases in Situbondo Regency in 2019-2021

All figure showed images distribution of cases of DHF and Larvae Free Index at the Situbondo District Health Center from 2019 to 2021. The green area on the 2019 map shows that villages that meet the Larvae Free Index requirements are fewer than in 2020 and 2021. The number of DHF cases has changed up and down so that in 2019 there were 448 cases and no one died then dengue cases in 2020 decreased by 331 patients and 5 people died while in 2021 it increased by 475 patients and 4 people died.

DISCUSSION

Cases of DHF and Larvae Free Index in Health Center in Situbondo Regency

In 2021 in the Situbondo area, there were 475 cases of dengue fever with 4 deaths, which increased compared to the number of cases in 2020. On the contrary, the number of dengue cases was 331 people in 2020, yet the number of deaths was 5 people, which was slightly more than 2021 case. Sequentially backward years, the number of dengue cases in 2019 was 448 people but there were no deaths.

In 2019-2021 villages that are included in the work area of 20 health centers in the Situbondo district, were categorized as not fulfilling the requirements as it did not meet the average Larvae Free Index value. The highest DHF cases were in 2019 at the Suboh Health Center, in 2020 at the Anchor Health Center, and in 2021 at the Panji Health Center. The total number of Larvae Free Index scores that do not meet the requirements of the Health Center working area in 2019 is 100 villages, in 2020 there are 92 villages, and in 2021 as many as 79 villages. Dengue fever cases from 2019-2021 have decreased, this shows that for 3 (three) years there has been a change for the better. Every year villages that do not meet the larva-free index standards undergo necessary changes to meet the health regulatory requirements of the larva-free index.

The effect of the high value of Larvae Free Index is due to not being monitored with a maximum of the larva monitoring officer program.¹⁶ Half of the larvae monitoring officers sometimes only prioritize the quantity of work

and not paying attention to the quality of work, with this the influencing factor is the lack of facilities for larva inspection which affects the work of the officers against the mismatch of goals and expected results.¹⁷

There are several risk factors that can affect DHF, one of which is the house (type of container inside and outside the house, distance between houses, height from the water surface, climate and house arrangement), social environment, and biological environment. The spread of mosquitoes between one house and another is the distance between houses so that mosquitoes can easily spread to the next house and so on.¹⁸ Places that affect mosquitoes laying eggs outside or inside the house are due to puddles of water in various containers such as the type of water reservoir, the location of the water reservoir, the color of the container, the depth of the water and the origin of the water.¹⁹

Mosquito *Aedes sp* DHF vectors can live at an altitude of 0 to 500 meters above sea level, but the *Aedes sp.* at an altitude of 1000 meters above sea level can survive.²⁰ *Aedes* can survive and breed up to an altitude of \pm 1,000 m above sea level. For an altitude higher than \pm 1,000 meters above sea level, the temperature is too low for mosquitoes to breed.²¹

Situbondo Regency has implemented the eradication of mosquito nests program, however due to the large number of larvae in the area, the Larvae Free Index Value has yet meet the requirements, because *Aedes* may have been resistant to chemical compounds to eradicate larvae. This theory is related to Demes research on *Aedes aegypti* in Kediri, which showed *Aedes aegypti* have been resistant to the chemical temephos with a concentration of 0.01 mg/l, 0.02 mg/l, 0.03 mg/l, 0.04 mg/l.²¹ Larvae *Aedes aegypti* originating from the Depok, Sleman area can be found to have an average mortality of 97% still susceptible to temephos.²²

Geographical Distribution of DHF and Larvae Free Index Cases in the Situbondo Regency in 2019-2021

In 2021, the highest dengue case in East Java was Situbondo Regency. In this study, the function of the geographic distribution map of DHF and Larvae Free Index cases is as a media presenter in displaying the location of the

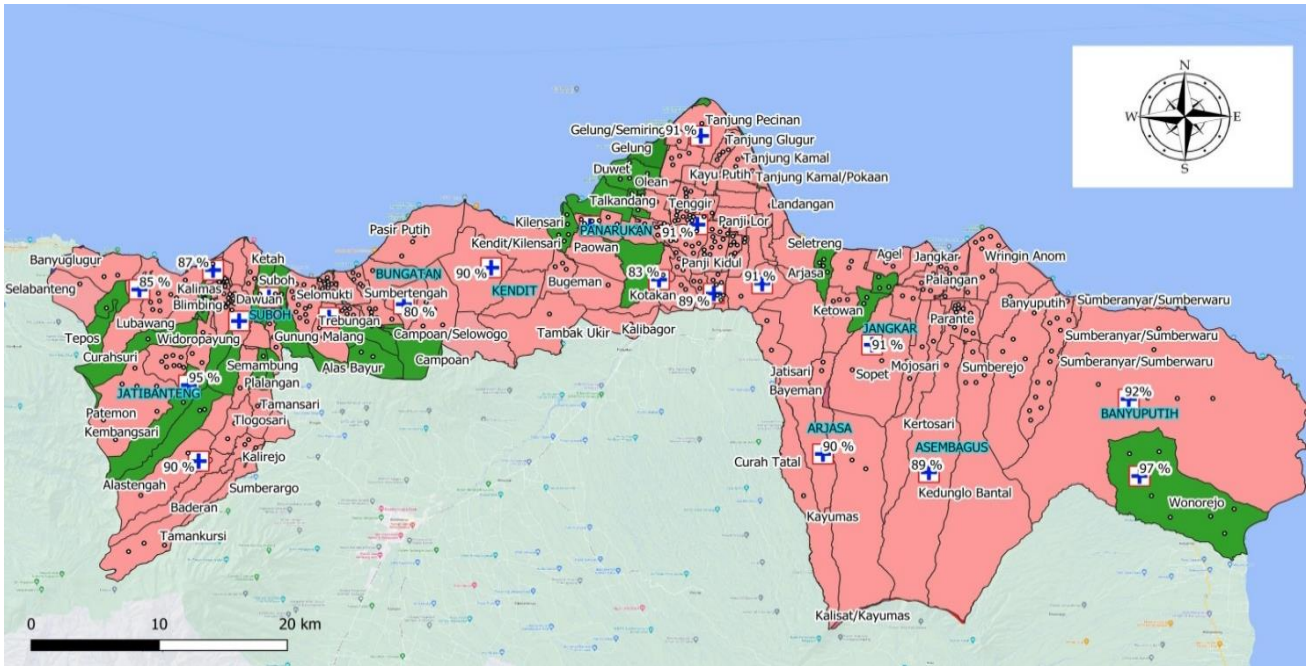
distribution of DHF and Larvae Free Index cases in the Situbondo Regency in 2019-2021. The green area indicates that the working area of the Health Center has an Larvae Free Index value that meets the requirements of >95%, while the pink area indicates that the area is categorized as not meeting the requirements of <95%.

The Larvae Free Index value increases every year based on data from 2019 to 2021. This is in line with changes in the green area on the map whose distribution is getting wider. In addition, cases of DHF experienced ups and downs (fluctuative).

Regions whose Larvae Free Index scores do not meet the requirements for 3 years (2019-2021) are 72 villages, namely Plalangan, Tlogosari, Baderan, Kalirejo, Tamansari, Alas Tengah, Sumberargo, Jatibanteng, Banyuglugur, Kalianget, Selobanteng, Kalisari, Besuki, Coastal, Langkap, Kalimas, Mlandingan Kulon, Selomukti, Trebungan, Sumber Anyar, Bletok, Bungatan, Patemon, Selowogo, Kendit, Paowan, Olean, Talkandang, Kotakan, Kalibagor, Tanjung Glugur, Mangaran, Tanjung Kamal, Tanjung Pacinan, Ardirejo, Semiring, Trebungan, Bulk Jeru, Mimbaan, Eucalyptus, Panji Lor, Tenggir, Tokelan, Klampokan, Juglangan, Panji Kidul, Battal, Gebangan, Kandang, Kesambi Rampak, Landangan, Pokaan, Wonokoyo, Bayeman, Kayumas, Jatisari, Kembangsari, Agel, Asembagus, Gudang, Wringin Anom, Trigonco, Perante, Awar-Awar, Kedunglo, Pillow, Kertosari, Mojosari, Banyuputih, Sumberejo, and Sumberanyar.

In 2021 the number of villages that meet the requirements for the Larvae Free Index score in Situbondo Regency is more compared to 2019. It can be seen that the village areas that meet the requirements for the 2021 Larvae Free Index value have changed quite well, 57 villages that meet the requirements and 79 villages do not meet the requirements. Meanwhile in 2019, only 29 villages eligible and 107 villages did not meet the requirements.

In figure 1, 2, and 3 it can be seen that the distribution of DHF cases in the working areas of smaller health centers (Panji Health Center, Besuki Health Center, and Jangkar Health Center) is more compared to the wider Health Center working area.

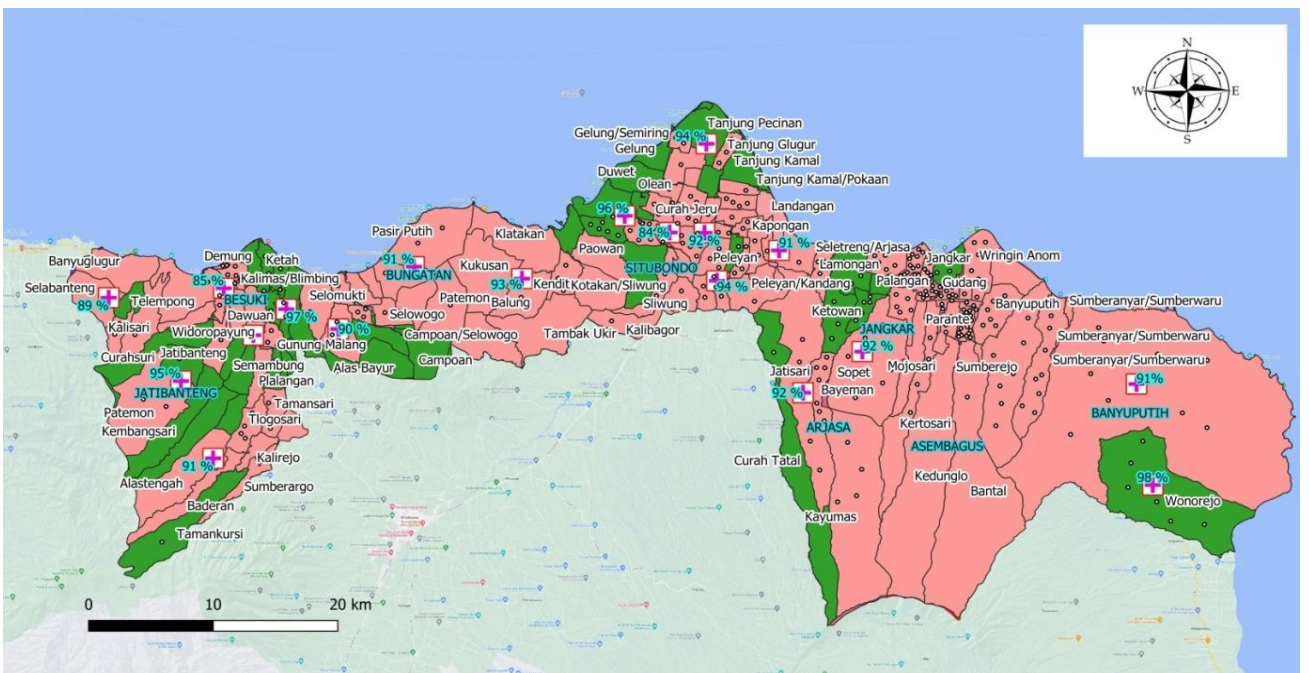


Note

- : Cases
- ⊕ : Health Center
- : Larvae Free Index ($< 95\%$)
- : Larvae Free Index ($> 95\%$)

Source: DHF and Larvae Free Index Annual Report Situbondo Health Office, 2019

Figure 1. Distribution Map of DHF and Larvae Free Index Cases in the Situbondo Regency in 2019

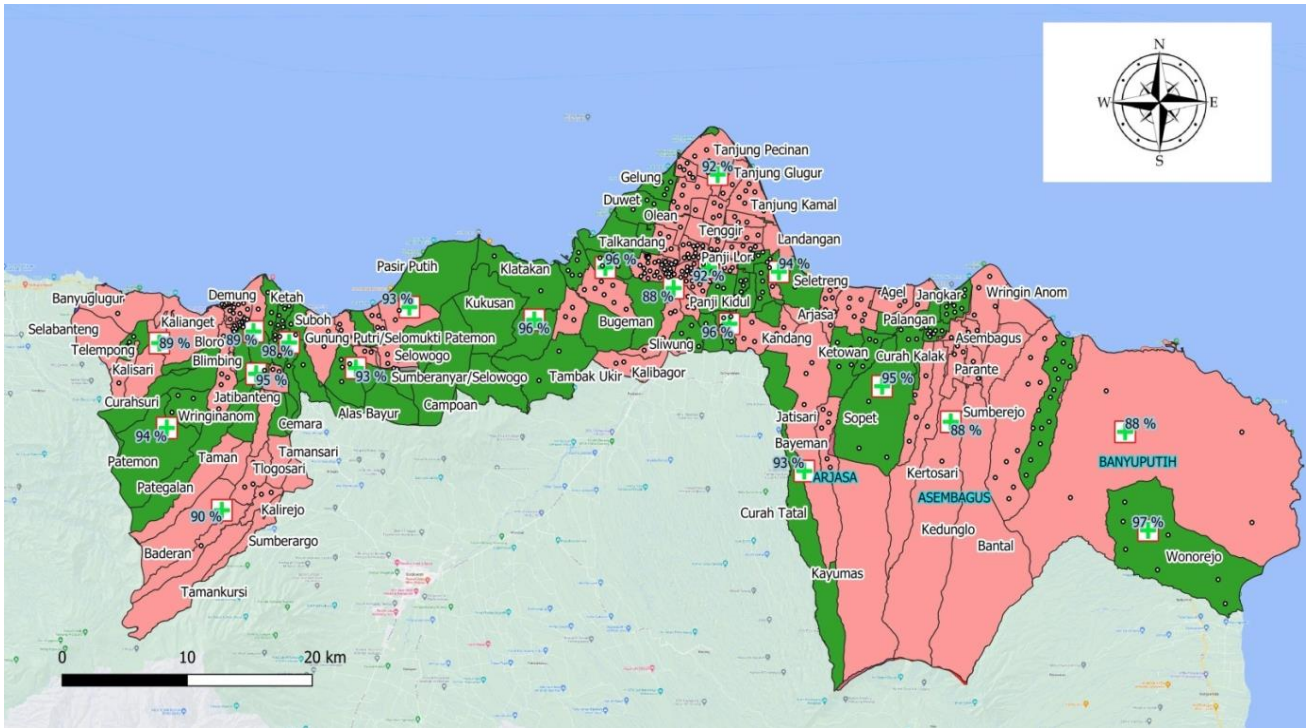


Note

- : Cases
- ⊕ : Health Center
- : Larvae Free Index ($< 95\%$)
- : Larvae Free Index ($> 95\%$)

Source: DHF and Larvae Free Index Annual Report Situbondo Health Office, 2020

Figure 2. Distribution Map of DHF and Larvae Free Index Cases in the Situbondo Regency in 2020



- Note
- : Cases
 - ⊕ : Health Center
 - : Larvae Free Index (< 95%)
 - : Larvae Free Index (> 95%)

Source: DHF and Larvae Free Index Annual Report Situbondo Health Office, 2021

Figure 3. Distribution Map of DHF and Larvae Free Index Cases in the Situbondo Regency in 2021

That population density does not affect the number of dengue cases.²³ Contrary to other studies, there is a very influential relationship between population density and the number of dengue cases.²⁴ In Karang Malang District, Sragen Regency, it shows that spatially there is a relationship between population density and DHF.²⁵ Bivariate analysis obtained a value of 0.001. It means that there is a statistically significant relationship between population density and the incidence of dengue cases.

The spread of dengue cases is very high due to the mobility of the population of Situbondo Regency who carries out activities outside the area where they live so the transmission of dengue cases occurs through bites from mosquitoes of the *Aedes* (*Ae. aegypti* or *Ae. albopictus*) infected with the dengue virus and then biting healthy humans. The existence of a place for mosquitoes to breed can lead to dengue cases, such as an area of the house where there are unused bottles so that it becomes a breeding ground for mosquitoes. So the occurrence of a

large number of cases of DHF is due to high mobility.²⁵

To prevent the occurrence of dengue cases in the Situbondo Regency area, every Situbondo resident is expected to use mosquito repellent lotion when doing activities outside the home to not get bitten by mosquitoes, as a step to prevent transmission of dengue cases. It is recommended for the people of Situbondo Regency to use mosquito repellent lotion when traveling outside the home to avoid mosquito bites and apply eradication of mosquito nests to reduce the number of areas that do not meet the Larvae Free Index requirements, thus the incidence of dengue cases for the upcoming year is reduced.

CONCLUSION AND RECOMMENDATION

DHF cases in Situbondo Regency in 2019 were 448 cases, in 2020 as many as 331 cases, and in 2021 as many as 475 cases. The most cases of dengue fever in 2019 were at the Mlandingan Health Center, the most dengue cases in 2020 at

the Anchors Health Center, and the most dengue cases in 2021 at the Panji Health Center. The average percentage of Larvae Free Index scores for 3 years (2019-2021) is 91% and there are several areas of health centers whose Larvae Free Index scores for 3 years have never met the requirements, namely Sumbermalang, Banyuglugur, Besuki, Mlandingan, Bungatan, Situbondo, Mangaran, Panji, Kapongan, Arjasa, Asembagus and Banyuputih. The highest dengue cases from 2019, the most common areas are in the work area of the Panji Health Center where the Larvae Free Index score does not meet the requirements. The highest DHF case from 2020 is the area that occurs a lot, namely in the work area of the Anchor Health Center with a Larvae Free Index value that does not meet the requirements. The highest dengue cases from 2021 in the most common areas, namely in the work area of the Panji Public Health Center with Larvae Free Index value that does not meet the requirements.

The results of this study can be used as a source of information in the form of map images for agencies related to the spread of DHF cases and the Larvae Free Index area in order to make it easier to find out information on DHF case data so that the implementation of the DHF case-control program is maximal, by using mosquito repellent lotion when doing activities outside the residence.

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AUTHOR CONTRIBUTIONS

DN and HNM compiled and planned the research; HNM conducted research in the field; HNM, M, and RLA analyzed the data; HNM and DN discussing the results; HNM and M writing papers; HNM and DN compiling the article. DN = Demes Nurmayanti; HNM = Hanifah Nailul Mukarromah; M = Marlik; RLA = Ruslan La Ane.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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