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The Effects of Physical Environment on Density and Anopheles Species in Maribu Village, West Sentani District in 2017

Renold M. Mofu[a], Nawang Wulan[b], Marlin M Jarona[c], Bruce Mehue[d], Arwam Hermanus[e], Jems KR Maay[f*], [a,b,c,d,e,f]Health Environment School, Nursing Program, Health Polytechnic of Jayapura, Jalan Padang Bulan 2, Hedam, District Heram, Jayapura City, Papua, Indonesia, Email: [f*]jemskrmaay@yahoo.co.id

In Indonesia in 2014, the Annual Parasite Incident (API) was 24/1000 with the population with malaria mortality reaching 1.3%. In Papua Province the API in 2013 was 63.69 / 1000 population; in Jayapura Regency in 2016 it was 57.29 / 1000 population; in the Dosay health centre in 2016 it was 1,455 cases and in Maribu village it was 349 cases. There are about 80 species of Anopheles, while there are 24 species declared as malaria vectors. The Provinces of Papua and West Papua (Tanah Papua) based on an Entomology Survey conducted from 2006 to 2014 by the Papua Biomedical Research and Development Centre found Anopheles species are as follows: An. farauti, An. punctulatus, An. koliensis, An. bancroft, An. kochi, An. tessellatus. This illustrates that the Land of Papua is still a malaria-endemic area whose development has continued to occur because it has a bionomic and vector potential. The purpose of this determination is to study the effect of physical environmental factors on the density and species of Anopheles. This type of research is analytic observational with a cross-sectional study design. Catching mosquitoes is done in 3 neighbouring accounts (RT), where each RT takes 1 point (house). Statistical analysis is achieved with a Pearson test. The analysis showed that the density of Anopheles was as low at 3.4 fish/person/hour and the highest was 4.8 fish/person/hour. The Anopheles species is An. koliensi, Ani and An. punctulatus. There is a relationship between air humidity, temperature and wind speed with the density of the Anopheles vector where (r = 0.957, r = 0.616, r = -0.811). This study suggests that: environmental modifications and manipulations need to be increased, greater coverage of the use of

mosquito nets, improved community behaviour and comprehensive and longitudinal research on risk factors for malaria events.

Key words: *Risk factors, malaria incidence.*

Introduction

Anopheles mosquito is an important genus in the Anophelinae subfamily because Anopheles is the only type of mosquito that can transmit malaria to humans. Good malaria is caused by Plasmodium falciparum, Plasmodium vivax, Plasmodium malaria, and Plasmodium ovale and these are all transmitted by Anopheles mosquitoes whose species vary from one region to another. According to Takken and Knols (1990), Anopheles mosquitoes are mosquitoes' vector of malaria. In the world there are approximately 400 species that have been recognised, 60 of which have the ability to transmit malaria and 30 - 40 are hosts of Plasmodium parasites which are the cause of malaria in malaria-endemic areas. In Indonesia alone, there are 24 species of Anopheles mosquitoes that are capable of transmitting malaria.

In Indonesia, Anopheles mosquitoes have become a vector of malaria transmitters such as Anopheles sundaicus, Anopheles aconites, Anopheles barbarous and Anopheles subpictus. There are about 80 species of Anopheles, while there are 24 species with different habitats to those stated as malaria vectors. In the province of Papua, species declared as malaria vectors are Anopheles farauti, Anopheles koliensi, and Anopheles punctulatus. An Anopheles vector density survey was conducted by Mofu R. et al. (2013) in the working area of the Hamadi Community Health Center, Jayapura City with an average vector density level of 2.1 birds/person/hour with captured Anopheles species were Anopheles farauti, Anopheles koliensis, and Anopheles punctuates.

The high number of malaria morbidity is influenced by the physical condition of the house, environmental sanitation, community behaviour, biological environment, physical environment, chemical environment and vector density and the type of vector or Anopheles species. The spread of malaria is generally influenced by various things such as environmental changes, vectors, socio-culture, drug resistance and access to health services. Malaria is an infectious disease caused by parasites that live and multiply in human red blood cells and is an infectious disease caused by a Protozoa infection on the genus Plasmodium which is at high risk of death with a relatively rapid transmission process. This disease is naturally transmitted through female Anopheles mosquito bites and is one of the public health problems that can cause death especially in high-risk groups namely infants, toddlers, pregnant women, and childbirth and can cause low birth weight (LBW), reduce productivity work and reduce learning achievement of school children.

Malaria is an infectious disease that can cause a decrease in the immune system in patients, can cause anaemia and can indirectly increase the severity of patients with other diseases. Malaria is a parasitic disease that is widespread throughout the world although it is generally found in areas located between 640 North Latitudes (the city of Archangel in Russia) and 320 South Latitudes (Cordoba, Argentina) with an altitude of 400 meters below sea level (dead sea) and 2,800 meters above sea level (Cochabamba, Bolivia). Malaria is almost found in all parts of the world, especially in countries with tropical and sub-tropical countries. The population at risk of malaria is around 2.3 billion people or 41% of the world's population in 90 countries. Each year the number of cases is 300 - 500 million cases and results in 1.4 - 2.6 million deaths, mainly in African countries.

The World Health Organization (WHO) estimates that there are 270 million cases of malaria, which causes about 1 million people to experience deaths each year, especially in children. In 2013 there were an estimated 216 million cases of malaria, with 655 deaths. About 86% of deaths from malaria are children under 5 years. The malaria situation in Indonesia is not much different from other countries. Tropical climatic conditions and the development processes that continue to develop resulting in changes in the environment, thus creating a very favourable situation for the presence of Anopheles mosquitoes.

In 2011, there were 1,100,000 clinical malaria cases in Indonesia and in 2012 it increased to 1,800,000 cases with Annual Parasite Incidents (API). In the past year (2013-2014), mortality rates were 24 per 1000 of the population due to malaria (1.3%). Generally, malaria sufferers are found in remote areas, rural areas, transmigration areas, population refugee areas and most of the economically weak groups. Based on Basic Health Research (Riskesdas, 2013) malaria prevalence decreased in Indonesia, namely 1.39% in 2009 to 0.6% in 2013. Provinces with API above the National average are NTB, Maluku, North Maluku, Central Kalimantan, Babylon and Riau Islands.

Method

This type of research is observational analytic, where the researcher intends to conduct an analysis of the effect of the physical environment on the density and species of Anopheles. The design or design of this study is a cross-sectional study, which is an epidemiological study design that studies the relationship between exposure and disease or cause and effect, at one time or at the same time. The population in this study were all Anopheles mosquitoes in Maribu Village. The sample in this study was Anopheles sp mosquitoes that were caught during the mosquito capture survey in Maribu Village.

Research Instruments and Data Collection Methods

The instruments used in this study were a set of tools used for measuring and catching mosquitoes in people's homes. The tools used in this study consisted of:

1. Measurement of the physical environment using a Thermo hygrometer (four in one) and anemometer.
2. Mosquito density. This was determined by catching mosquitoes perched on the catching body at night at 18:00 - 24:00 with the HLC (human landing collection) method carried out in the community home. Each house was carried out by two arrests, inside and outside the house. Every hour, catching mosquitoes for 50 minutes divided into 40 minutes catching with bait people inside and outside the house and 10 minutes on the walls inside and outside the house (cage wall) and rest or collection of catches of 10 minutes. Catching mosquitoes is done by using a flashlight, aspirator and a paper cup. Mosquitoes were carried out in three (3) Neighbourhood Associations namely RT 001, 002 and 003. This was done with a consideration of the Anopheles mosquito fly distance of 1.5 - 2 km (a map of the mosquito catching location is attached).
3. Identification of Anopheles sp by using the Indo-Australian (Eastern Indonesian) Anopheles species identification key from Wepster, J. B., Swellengrebel, N. H., (1945), dissecting microscope, chloroform, Petri dish and insect tweezers.

Research results

1. Univariate Analysis
   a. Physical environment

Table 2: Recapitulation of Temperature, Humidity and Wind Speed Distribution During the Research in Maribu Village, Jayapura Regency, 2017

Variable		N	Median (min-max)	Mean, ± SD
Temperature	(^{0}C)	12	26,70 (26,0-27,4)	26,68±0,41
Humidity	(%)	12	79,10 (77,4-80,6)	79,06±1,13
Wind velocity	(m/s)	12	2,10 (1,8-2,9)	2,28±0,41
Anopheles density		12	3,90 (3,4-4,8)	4,00±0,50

Source: Primary Data, 2017

The average air temperature at the time of the study (mean, ± SD) was 26.68 ± 0.41 with a median of 26.70 and a minimum/maximum of 26.0 / 27.4 with a normal air temperature distribution p = 0.924> 0.05. The average humidity at the time of the study (mean, ± SD) was

79.06 ± 1.13 with a median of 79.10 and a minimum/maximum of 77.4 / 80.6 with a normal air humidity distribution p = 0.389> 0.05. The average wind speed at the time of the study (mean, ± SD) was 2.28 ± 0.41 with a median of 2.10 and a minimum/maximum of 1.8 / 2.9 with a normal wind speed distribution p = 0.074 < 0.05. The average Anopheles density at the time of the study (mean, ± SD) was 4.00 ± 0.50 with a median of 3.90 and a minimum/maximum of 3.4 / 4.8 with a normal Anopheles density distribution p = 0.153 <0.05

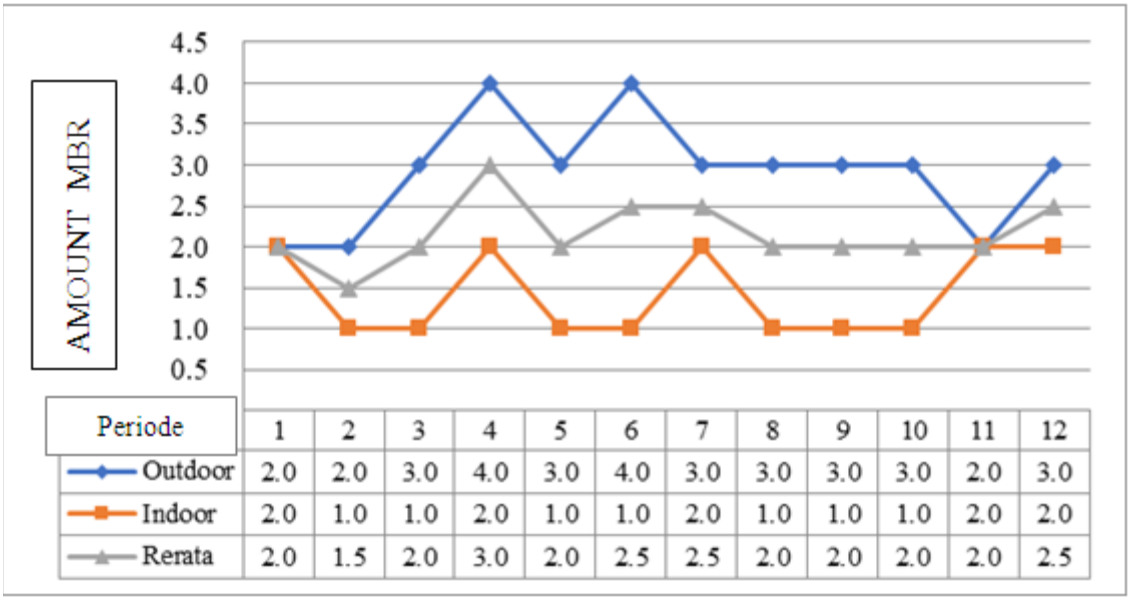
b. Anopheles mosquito density

The results of the research showed that Anopheles mosquito density was as low as 3.4 fish/person/hour and the highest was 4.8 fish/person/hour with an average of 4.8 fish/person/hour. Anopheles density based on MBR and MHD calculations, as follows:

1) Man Bitting Rate (MBR)

Man Bitting Rate is the number of Anopheles caught divided by the number of catchers per night. The lowest MBR average is 2.0 tails/night and the highest is 4.0 tails/night, more can be seen in the following figure (Figure 8).

Figure 8. Graph of Man Bitting Rate (MBR) Outside and Inside the House Per night in Maribu Village, 2017

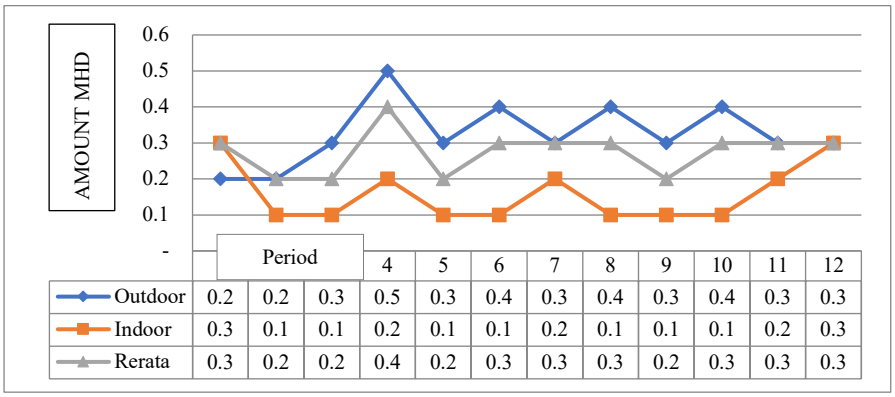


Periode	1	2	3	4	5	6	7	8	9	10	11	12
Outdoor	2.0	2.0	3.0	4.0	3.0	4.0	3.0	3.0	3.0	3.0	2.0	3.0
Indoor	2.0	1.0	1.0	2.0	1.0	1.0	2.0	1.0	1.0	1.0	2.0	2.0
Rerata	2.0	1.5	2.0	3.0	2.0	2.5	2.5	2.0	2.0	2.0	2.0	2.5

2) Man Hour Density (MHD)

Man Hour Density (MHD) is the number of Anopheles caught divided by the number of catchers multiplied by the length of arrest times multiplied by the number of arrest periods. The lowest average of MHD is 0.1 fish/person/hour and the highest is 0.5 fish/person/hour, can be seen in the following figure:

Figure 9. Graph of Man Hour Density (MHD) Outside and Inside the House Based on Arrest Hours in Maribu Village, 2017



Period	1	2	3	4	5	6	7	8	9	10	11	12
Outdoor	0.2	0.2	0.3	0.5	0.3	0.4	0.3	0.4	0.3	0.4	0.3	0.3
Indoor	0.3	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.2	0.3
Rerata	0.3	0.2	0.2	0.4	0.2	0.3	0.3	0.3	0.2	0.3	0.3	0.3

c. Anopheles species

The mosquito density survey was carried out at three (3) locations namely RT. 01.02 and 03, with arrest hours from 18.00 - 06.00 in Maribu village. The survey was conducted on July 2017, the number of Anopheles caught was 303. The most Anopheles species caught is An. *koliensi* of 152 tails (50.2%) and the lowest was An. *punctulatus* of 66 animals (21.8%). More details can be seen in the following table (Table 3).

Table 3: Distribution of Anopheles Species in Maribu Village, Jayapura Regency at the July 2017 Arrest

Anopheles species	**F**	**%**
An. koliensis	152	50,2
An. farauti	85	28,1
An. punctulatus	66	21,8
Jumlah	303	100

Source: Primary Data, 2017

2. Bivariate Analysis

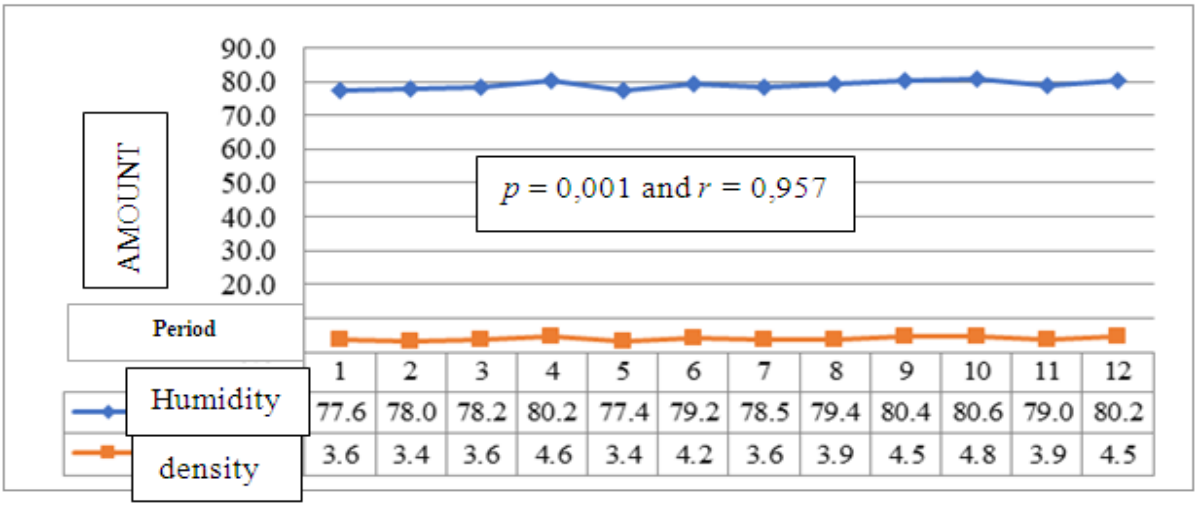
Data were analysed using Pearson statistical analysis (parametric) to determine whether the variables (numerical variables) studied were risk factors related to vector density in Maribu Village, Jayapura Regency.

a. Air Humidity with Vector Density

The correlation between air humidity and vector density shows the value of p = 0.001 and r = 0.957. This shows that there is a strong positive correlation of 0.957 between the humidity of the air with the density of the Anopheles vector and the relationship is significantly different at the 5% error level.

The highest density of Anopheles (4.8 heads/person/ hour) occurred at 80.6% air humidity and the lowest was 3.4 heads/person/ hour at 78.0% and 77.4% air humidity, in full can be seen in the following figure (Figure 10).

Figure 10. Graph of Anopheles Density Based on Air Humidity in Maribu Village, 2017



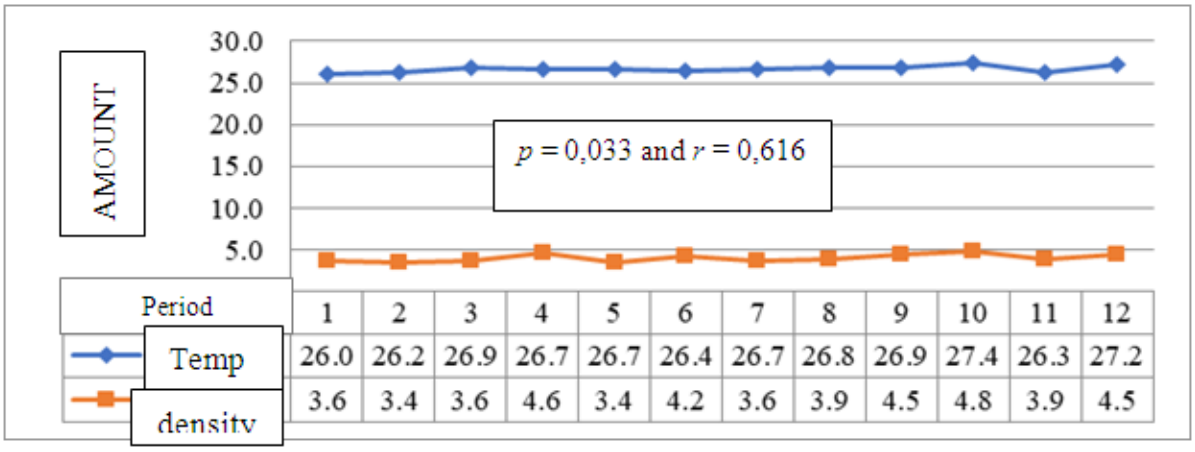
Period	1	2	3	4	5	6	7	8	9	10	11	12
Humidity	77.6	78.0	78.2	80.2	77.4	79.2	78.5	79.4	80.4	80.6	79.0	80.2
density	3.6	3.4	3.6	4.6	3.4	4.2	3.6	3.9	4.5	4.8	3.9	4.5

b. Air Temperature with Vector Density

The results of the correlation between air temperature with vector density showed p = 0.033 and r = 0.616. This shows that there is a strong positive correlation of 0.616 between air temperature and Anopheles vector density and the relationship is significantly different at the 5% error level.

The density of mosquitoes increased 4.8 heads/person/hour at an average temperature of 27.4ºC and as low as 3.4 individuals/person/ hour at temperatures of 26.2 ºC and 26.7 ºC, is explained in the following figure (Figure 11).

Figure 11. Anopheles Density Graph Based on Air Temperature in Maribu Village, 2017



Period	1	2	3	4	5	6	7	8	9	10	11	12
Temp	26.0	26.2	26.9	26.7	26.7	26.4	26.7	26.8	26.9	27.4	26.3	27.2
density	3.6	3.4	3.6	4.6	3.4	4.2	3.6	3.9	4.5	4.8	3.9	4.5

c. Wind Speed with Vector Density

The correlation between wind speed and Anopheles vector density shows the value of p = 0.001 and r = -0.811. This shows that there is a strong negative correlation of 0.811 between wind speed and vector density of Anopheles and the relationship is significantly different at the error level of 5%.

The highest mosquito density was 4.8 individuals/hour/hour at a wind speed of 1.8 m/s and the lowest was 3.4 individuals/person/hour at wind speeds of 2.4 and 2.8 m/s. The higher the wind speed, the lower the vector density and vice versa, the lower the wind speed, the higher the vector density, he explained in the following figure (Figure 12).

Figure 12. Anopheles Density Graph Based on Wind Speed in Maribu Village, 2017

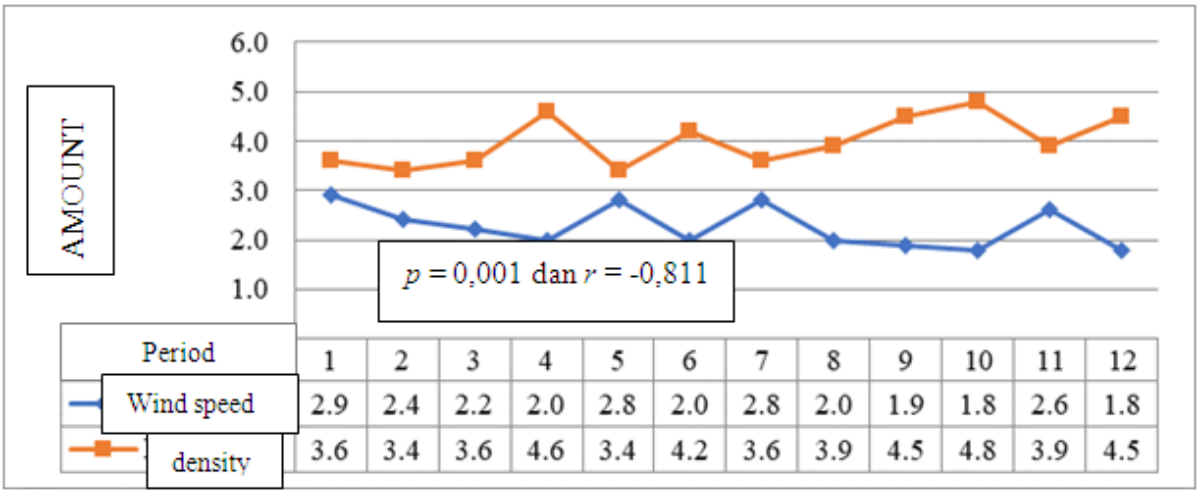


Table 4: Pearson Analysis Results of the Relationship between Risk Factor Variables and Vector Density in Maribu Village, Jayapura Regency, 2017

Variable		Mosquito Density
Humidity*	*r* *p* n	0,957 0,001 12
Air temperature*	*r* *p* n	0,616 0,033 12
Wind velocity*	*r* *p* n	-0,811 0,001 12

Description: * Pearson Test

Conclusion

Anopheles density is as low as 3.4 fish/person/hour and the highest is 4.8 fish/person/hour Anopheles synthesis is An. *koliensi,* An. *farauti* and An. *punctulatus*, there is a strong positive correlation of 0.957 between air humidity and Anopheles vector density, there is a strong positive correlation of 0.616 between air temperature and Anopheles vector density and there is a strong negative correlation of 0.811 between wind speed and density Anopheles vector.

Physical environmental control is carried out in the form of environmental modification and manipulation to eliminate Anopheles vector habitat such as draining sewage water, piling up

puddles and cleaning bushes and biological control by spreading predatory fish in puddles and livestock as cattle barriers which are carried out intensively and integrated. Increasing the use of insecticide-treated bed nets, especially for high-risk groups (pregnant women and children). Counselling about malaria and its transmission needs to be done for parents and school children to continue to improve the behaviour (knowledge, attitudes, and actions) of the community in an effort to reduce contact between humans and mosquitoes. Comprehensive and longitudinal research on bionomics and malaria spread in Maribu Village needs to be done to determine habitat and patterns of malaria transmission so that efforts to prevent and eradicate vectors can be carried out appropriately, effectively and efficiently.

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