

## Literature review: The effect of environmental arrangement on malaria incidence in dry tropical climate areas in NTT

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### Abstract

"Indonesia Bebas Malaria 2030" is the Indonesian government's target proclaimed by the Indonesian Ministry of Health at this time. This set target is inversely proportional to several discoveries found in eastern Indonesia, especially East Nusa Tenggara. For example, in 2022 in Sikka Regency, there will be an increase in malaria cases reaching 55 people. Based on research conducted in Africa, it is known that the treatment of malaria can not only be overcome by medication but by improving the physical environment such as housing and the surrounding environment. Therefore, an article search was carried out in several reputable journals for the past ten years to determine the influence of external and internal environmental settings on the incidence of malaria, especially in the East Nusa Tenggara region. From the search that has been done, it is known that environmental factors provide and biological factors are the factors that most influence the thermal characteristics of the incidence of malaria in NTT.

**Keywords:** Malaria; Physical Environment; East Nusa Tenggara; Dry Tropical Climate; Sikka Regency

### 1. Introduction

Climate is one of the factors that is considered to have an influence on the spread of several diseases in Indonesia, such as malaria. As a country with a tropical climate, Indonesia is known as one of the regions with the highest proliferation of malaria. In the Koppen climate classification, the tropical climate in Indonesia is divided into 3 (three) climate types, namely tropical rain forest climate (Af), Monsson (Am) and Tropical Dry/savanna (Aw). Of the three climate types, East Nusa Tenggara, especially Sikka Regency, is an area that falls into the dry tropical climate type and has the highest cases of malaria spread in 2022 [1].

Several studies that have been carried out regarding the proliferation of malaria indicate that there are several factors that result in the high spread of malaria in an area. These factors include environmental factors [2], [3]. Based on research by Rumbiak et al., environmental conditions are one of the factors in the proliferation of malaria in Indonesia [4]. It is also known that sources of diseases such as malaria will develop in a suitable environment and increase their proliferation [5]. According to Bhara [6] and Rokhayati et al. [7] there are several variables in environmental factors that can be of concern in the proliferation of malaria. These environmental factors include rural areas, open access to each house, the distance between houses and livestock pens, and the distance between houses that are close to mosquito breeding sites. Apart from that, the existence of sewers or dump sites is another factor in the environment that influences the incidence of malaria [8].

Based on the results of Sura coverage at the end of 2022, it is known that there are 55 cases of malaria being treated in Sikka Regency, East Nusa Tenggara, where according to information obtained from the Ministry of Health of the

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Republic of Indonesia in 2023, the eastern region of Indonesia such as East Nusa Tenggara is still given special attention to the spread of this disease [9].

From the statements mentioned above, this literature study was carried out to determine the influence of environmental order on the incidence of malaria, especially in the East Nusa Tenggara region which has a dry tropical climate.

## 2. Research Method

The method used in this research is a literature study taken from several research articles regarding the incidence of malaria, especially in the East Nusa Tenggara region. The articles taken are several articles totaling 15 articles that have been published in the last ten years using the Google search engine using the keywords malaria incidence in East Nusa Tenggara with an emphasis on the environmental factors that most influence the incidence of malaria.

## 3. Results and Discussion

Several important points that need to be reviewed regarding malaria in NTT are as follows, can be seen in Table 1 below.

**Table 1** Literature review results from several national articles

No	Researcher/Year	Method	Conclusion
1	Mau [10]	SPSS Pearson correlation test	17v. There is a significant relationship between P.falciparum infection and rainfall, where r gradually increases at the end and beginning of the rainy season.
2	Jella and Masriadi [11]	explanatory riset	Knowledge of the physical environment has a direct influence on the incidence of malaria and attitudes have no direct influence on the physical environment; 2. Knowledge, attitudes and physical environment have a direct influence on the incidence of malaria; 3. Knowledge and attitudes have an influence on the incidence of malaria passing through the physical environment.
3	Susilowati [12]	This research is an observational study and pre-experimental study tested with chisquare and advanced correction tests.	The results of this study show that clinical diarrhea is mainly found in toddlers, vomiting in teenagers, and back pain in adults. There are more women sufferers than men
4	Nur and Lestin [13]	observational analytics with a Cross Sectional Study design	The results of the study showed that activities outside the home at night (p value 0.000), the presence of livestock pens (p value 0.000) and the habit of hanging clothes (p value 0.000) were related to the incidence of malaria.
5	Adnyana [14]	Literature search	There is a relationship and influence of physical environmental factors regarding house construction, biological environment, availability of fauna around settlements on the incidence of malaria in an area
6	Sir et al. [15]	Analytical study with a cross-sectional design. A total of 180 samples were taken from a population of 327 people. Samples were taken by probability sampling using the Stratified Random Sampling technique	The incidence of malaria is related to education, income, knowledge, attitudes, actions and use of mosquito nets. Meanwhile, work has nothing to do with the incidence of malaria
7	Willa and Kazwaini [16]	Using a cross sectional design	The spread of malaria cases is within a radius of 0 to 1,000 meters from residential areas and is spread

			evenly in remote villages. The breeding habitat consists of buffalo footprints, puddles of water, rice fields, rivers, buffalo wallows, ditches and ditches, with a water pH of 7 to 9 and the highest salt content of 1 ppm. The breeding habitat is more in turbid water and exposed to direct sunlight.
8	Muhammad et al. [17]	(1) use of human landing collection techniques, (2) catching mosquitoes that land inside the house and in the cow pen, and (3) use of light traps	Based on the average hourly density, <i>Anopheles</i> spp. in Lifuleo Village it is exophagic and exophilic, that is, it prefers to bite outside the house rather than inside the house and prefers to rest outside the house.
9	Kazwaini and Mading [18]	The research was conducted in 12 locations on Sumba Island, three locations in each district on Sumba Island, namely East Sumba Regency, Central Sumba Regency, West Sumba Regency and Southwest Sumba Regency. Data collection was carried out 4 times at each location within 2 years (2009 and 2012) between July and November.	Type of breeding habitat for <i>Anopheles</i> spp. found on Sumba Island with the highest density of larvae in puddles and buffalo footprints. In this type of habitat there is no vegetation or predators so the larvae can live free from the threat of predators.
10	Lestari and Salamah [19]	binary logistic regression analysis	Stilt houses, thatch roofs, tin roofs, and cracked plastered cement floors are factors that significantly influence malaria in pregnant women with each risk value of 6.447; 6,290; 3,356; 2,778. The chance that a pregnant woman will contract malaria if she lives in a house on stilts, uses a thatched roof, and has a plastered cement floor is 0.91.
11	Mardiana and Perwitasari [20]	Per Month in the last ten years. The research design was retrospective. To find out if there is a tendency to increase or decrease the incidence of malaria according to rainfall, temperature and humidity, a graph is made by displaying a linear line to see the trend of each data in the two districts.	Rainfall has no direct effect on malaria incidence. The tendency to increase malaria incidence is indirectly influenced by temperature and humidity, but can directly influence the number of malaria parasites and mosquitoes as vectors.
12	Sutarto and Chania [5]	Literature search	Environmental factors, behavior, health services and genetics are determinants that are closely related to the population's risk of contracting malaria. The source of malaria comes from environmental conditions that are suitable for the life of <i>Anopheles</i> mosquitoes, so that as the mosquito population increases, the risk of contracting malaria increases.
13	Taopan [21]	Observational analytics with case control design	The results of statistical tests show that 8 variables are related to the incidence of malaria ( $p < 0.05$ ), namely type of work, attitude, use of mosquito nets at night, use of mosquito repellent, habit of sleeping outside the house at night, habit of doing activities outside the house at night. days, the presence of puddles of water that serve as breeding places, the efforts of health workers, variables that are not related to the incidence of malaria ( $p > 0.05$ ), namely

			age, gender, level of education, knowledge, existence of health service facilities.
14	Lestari [22]	The research design uses a cross sectional study.	Low use of mosquito nets, low use of anti-mosquito medication and the habit of going out at night are risk factors for high malaria incidence
15	Mulyono et al [23]	Analytical Studies	The presence of medium livestock (goats, sheep, pigs) and large livestock (cows, buffalo, horses) as well as the location where medium and large livestock are kept have an influence on malaria cases in NTT Province.
16	Tamrin et al [24]	Observational research using a case control design	Breeding place factors and air humidity are strongly related to the incidence of malaria in Clubagolit District

Based on the literature review above, it can be said that there are several factors that influence the incidence of malaria in NTT. Factors that influence the incidence of malaria include the influence of the physical environment such as temperature, air humidity, altitude, wind speed, rain, sunlight which have a greater influence on mosquito breeding. This is not much different from previous research by Susanti and Wantini [25] in Lampung and Babba et al. [26] in Jayapura who found that the physical environment is a factor that influences the proliferation of malaria in tropical climates. Physical conditions and the environment around the house are important determinant factors for the occurrence of malaria, especially in the East Nusa Tenggara region [27]. From research conducted by Pamela [28] and Triwahyuni and Ladyani [29], it is known that the physical conditions of the house such as ventilation, ceilings and walls have a significant relationship to the incidence of malaria that occurs in an environment.

Based on the literature review that has been carried out, it is known that in the West Sumba region there is an interrelated relationship between house construction (traditional houses), biological environment, availability of fauna around settlements and the incidence of malaria in an area. The condition of permanent and semi-permanent houses with bamboo walls (halar) can also have an influence on the incidence of malaria in these residences. The density of house walls can have a significant influence on the incidence of malaria. House walls that are not tight or have many gaps can affect the risk of transmitting malaria from outside the house through Anopheles mosquito bites. Several factors that need to be considered are the penetration of Anopheles mosquitoes as vectors of malaria, looking for places to feed, especially at night. If the walls of the house are not tight or have many gaps, mosquitoes can easily enter the house and bite the residents inside, causing malaria transmission. Dense and strong house walls can function as a barrier for mosquitoes to enter the house. Using dense building materials and using wire mesh on windows and ventilation can also help prevent the entry of Anopheles mosquitoes. This can be seen from the density of the bamboo walls applied, which is not the same as the density using brick walls.



**Figure 1** One of the residences with loose walls in Sikka Regency (source: Personal Documentation, 2023)

Apart from that, research conducted by Mulyono et al. found that there is a close relationship between livestock keeping and the location where it is kept and the incidence of malaria, especially in medium and small livestock [23]. The location of animal cages close to human settlements or in environments with environmental conditions that support the

breeding of Anopheles mosquitoes can influence the spread of malaria. If the animal's enclosure is in an area with a lot of standing water, such as a pond, swamp, or slow-flowing river, this can be an ideal breeding ground for Anopheles mosquitoes. This can increase the risk of malaria transmission to the surrounding population.

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#### 4. Conclusion

Based on the discussion above, it can be concluded that physical environmental factors can influence the incidence of malaria, where thermal characteristics such as temperature, humidity, wind and light are factors that influence the incidence of malaria in NTT. Apart from that, the density of the walls also influences the incidence of malaria, because the openings in the walls are not provided with another barrier layer. So, in efforts to control malaria, a holistic approach is needed that involves improving the environment, educating the public, using insecticide-treated bed nets, and controlling mosquito vectors to achieve optimal results, especially in areas prone to malaria incidents.

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#### Compliance with ethical standards

##### *Disclosure of conflict of interest*

No conflict of interest to be disclosed.

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