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Breeding places characteristic of anopheles mosquito in bagelen subdistrict, Purworejo

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Abstract. Purworejo is one of malaria endemic area with Annual Parasite Incidence was 0.94%. The purpose of this study was to describe Anopheles mosquito breeding place based on environmental factors in Bagelen Subdistrict, Purworejo Regency. This was an observational research. The population and samples was all malaria patients in the whole endemic area of Bagelen sub-district (70 respondents in 6 villages). Data analysis using spatial analysis and distribution frequencies. The breeding place of Anopheles mosquito was taken at ± 200 m radii from patient's home, then measured the environmental factors. The results showed that from 70 cases of malaria, there were 29 of 39 points of Anopheles mosquito's breeding place positive of Anopheles mosquito larvae. Types of breeding sites were water path (20.51%), crevice (30.77%), water puddle (30.77%), and cement mortar pond (17.95%). The breeding places of Anopheles mosquito were mostly found in Durensari Village (33.33%). The average temperature at the positive breeding place of Anopheles mosquito larvae was 26.74°C, the average humidity was 79.41%, the average of water pH was 7.63. As many as 60.98% of the breeding places were found in plant vegetation (bamboo trees), twigs of tree, teak trees, palm trees, and taro trees. The highest densities of larvae (8.2 larvae/detention) found in cement mortar pond with the temperature of the water was 26°C, the humidity was 82%, pH 9.2, and taro plant vegetation. It is suggested to the community to aware places that have the potential to become larvae habitats like ponds of cement mortar around the house.

1. Introduction

Malaria become global public health problem with approximately 40% of world's population live in area that have some risk of malaria infection. [1] This disease transmitted by the bite of Anopheles mosquito which is infected by parasite belonging to the genus Plasmodium. [2]–[4] The incidence of malaria in the world reach 300-500 million cases / year with more than 1.1 million deaths, that mostly occur in children aged less than five years old and pregnant women. According to hospital statistics, CFR due to malaria from all age groups decreased from 2004 to 2006, from 10.6% to 1.34%. However, in 2006 to 2009 the CFR is tend to increase more than doubled.[5]

In Central Java Province there are ten regencies/cities including endemic malaria, including Cilacap, Banyumas, Purbalingga, Banjarnegara, Kebumen, Purworejo, Magelang, Pekalongan and Jepara. In 2000, cases of malaria in Purworejo Regency reached 33.543 cases (API 43.7 %). Then tended to decline in subsequent years. But in the last four years, API malaria in Purworejo tended to increase is 0.62 % (2012), 0.74 % (2013), 0.74 % (2014), and 0.94 % (2015), the figures were obtained from Health Office of Purworejo Regency. Although these figures have met the target (API <1), there are still some villages with malaria focus areas, one of them in Bagelen subdistrict.[5]

Bagelen Subdistrict divided into two Community Health Center's working area, including Dadirejo Bagelen and Bagelen Community Health Centers. For five consecutive years, API in Dadirejo Bagelen Community Health Center always ranked first in Purworejo Regency, reached 18.64 % in 2015. While the API in Bagelen Community Health Centers not meet the target of API in Purworejo Regency, which in 2015 reached 4.69 %.[5] There are 17 villages in the Bagelen Subdistrict, six of them are malaria endemic villages. The details of the six malaria endemic villages are Semono (10.8 %) and Durensari (11.73 %) Village have HCI status, Somorejo

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(1.2 %), Hargorojo (1.26 %), and Sokoagung (0.65 %) Villages have MCI status, then Semagung Village have LCI status.

There are several factors that influence the incidence of malaria in endemic areas in the Bagelen Subdistrict. One of them is the large number of potential breeding sites and Anopheles Mosquito's breeding sites. Considering several factors such as geographical condition of Bagelen Subdistrict which was mostly consist of land non rice field, environmental management has not been considered, and environmental factors also are contributing related tho the existance of mosquito's breeding sites which can eventually have an impact on increasing the density of larvae in Bagelen Subdistrict.

2. Research Methods

The type of research is an observational descriptive study in Bagelen Subdistrict, Purworejo, Indonesia. The study population was divided into two, the area population for spatial analysis including entire area in the Bagelen Subdistrict and all malaria patients in endemic areas (6 villages) as many as 70 respondents. Malaria patients are people in Bagelen Subdistrict which were recorded in the Dadirejo Bagelen Health Center, Bagelen Health Center, and Purworejo District Health Office based on microscopic examination in January 2016-May 2017 where the data was obtained from secondary data from Dadirejo Bagelen Health Center, Bagelen Health Center, and District Health Service Purworejo. Measurements of the coordinates of the houses of malaria patients were measured using GPS-based applications, namely Mobile Topographer. Sampling technique uses the sampling area and all of population (6 villages and 70 respondents). Samples for spatial analysis were all endemic villages (LCI, MCI, and HCI) malaria in Bagelen Subdistrict, including Semono, Durensari, Somorejo, Sokoagung, Hargorojo, and Semagung Villages. The variables were the existence of breeding place, larvae density, breeding temperature, rainfall index, humidity, the present of plant vegetation, pH, and history of travelling. The existence of breeding places was a breeding ground for mosquitoes found around the respondent's house within a radius of ≤ 200 m, usually housed in puddles such as rice fields, irrigation, traces of vehicle tires, etc. whose edges are overgrown with grass / shade plants. The findings were then recorded on the observational sheet regarding the type of breeding site and then measured using GPS to determine the coordinates. Larval density is a comparison between Anopheles mosquito larvae found in breeding sites with the number of cidukan carried out, which is 10 times the injection. Cidukan carried out at the breeding site found in large puddles and allows for do the snatching, then the larvae obtained are taken using a dropper pipette to be inserted into the bottle, and identified related to the genus of larvae. Then calculated the number of Anopheles larvae obtained to be included in the formula for calculating larval density. For breeding sites in the form of puddles such as puddles, grooves on the ground, etc. which are not possible to do the snatching, the mosquito larvae are immediately taken using a pipette and inserted into the bottle, to identify the genus. Then counted the number of Anopheles mosquito larvae found. Bottles containing larvae are labeled according to the type of water, time of collection (date, month, year), and coordinates with by categories such as 0 tails: yellow dots, 1-15 tails: orange dots, 16-30 tails: purple dots, 31-45 tails: gray dots. breeding temperature is a measure of the temperature of water which is the breeding ground for Anopheles mosquitoes found within a radius of ≤ 200 m from the respondent's house. Temperature is measured using a dipped water thermometer at the breeding site. The measurement results are recorded in the observation sheet. Rainfall index Is the amount of rainwater falling on the surface of the land in Bagelen Subdistrict during the research conducted, based on the results of measurements and records carried out by the Public Works Agency and the Purworejo District Spatial Planning. Humidity is the amount of water contained in the air around the breeding site of the Anopheles mosquito found within a radius of ≤ 200 m from the respondent's house using a hygrometer. The presence of plant vegetation is plant vegetation species found around the Anopheles mosquito breeding site within a radius of ≤ 200 m from the respondent's house. Identification of the presence of plant vegetation is done by visual observation, which then results are recorded in the observation sheet. pH Is the acidity of the breeding place of the Anopheles mosquito found around the respondent's house in a radius of ≤ 200 m. Measurements were made using a pH meter dipped in the breeding site, then the results of the measurements were recorded in the observational sheet. History of travelling is It is the activity of respondents to travel to an area within 4 weeks before being infected with malaria by interviewing using a questionnaire. Analysis of data using spatial analysis and descriptive statistics.

3. Results and discussions

The results showed that the the majority of the respondents are in the age group 5-17 years, as many as 27 respondents (38.57%). While in the 18-31 year age group, there are only 4 respondents (5.71%) are positive

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malaria in that period. The results also found that malaria mostly suffered by male (52.86%), graduated from elementary school (38.57%), and most of them work as gardener/farmers/ forester (35.71%). (Table 1)

Table.1 Characteristic of Respondents by Sex, Age, Education Level, and Occupation (n=70)

Characteristics of Respondents	f	Percentage (%)
1. Sex		
a. Male	37	52.8
b. Female	33	47.2
2. Age		
a. 5-17 years	27	38.6
b. 18-31 years	4	5.8
c. 32-44 years	17	24.3
d. 45-57 years	12	17.1
e. 58-79 years	5	7.1
f. 71-83 years	5	7.1
3. Education level		
a. No school	14	20.0
b. Elementary school	27	38.6
c. Junior high school	21	30.0
d. Senior high school	8	11.4
4. Occupation		
a. Do not work	12	17.2
b. Student	25	35.7
c. Gardener/farmer/forester	25	35.7
d. Labors	5	7.1
e. Seller	1	1.4
f. Government employee	2	2.9

The age group with the highest malaria distribution is dominated by the age group of 5-17 years, that is as many as 38.57%. This results are similar to those reported by Clarke et al, the results showed that the estimated prevalence of malaria among children age 5-18 years is 41%.[7] Another study conducted by Wanji et al reported the prevalence of malaria among children age 4-16 years is 40%.[8]

Malaria cases in school age children in Bagelen Subdistrict due to the transmission of infection from parents or relatives who live in one house. It is evident that of the 70 malaria cases in the Bagelen Subdistrict spread over into 65 points with 14 cases were found in several similar homes. Based on data from Purworejo Regency Health Office, time lapse pain among children with parents or relatives who live in similar house between 2-18 days.

Related to the distribution of malaria cases in the Bagelen Subdistrict by sex, showed that the majority of people with malaria on the January 2016 – May 2017 period, the number of male and female's patient are almost equally. From the result of research conducted by Sultana in Kenya obtained result that there is no significant relationship between the sex of respondent with the malaria incidence.[9] This results differs from that of Jenkins et al and Kepha et al who revealed that female was more susceptible to malaria than male.[10], [11]. The underlying hypotheses in this incidence may due to the sex difference include testosterone and estrogen specific modulation of antiplasmodial immune.[12]

From the results above, we can conclude that most of the respondents have low level of education. According to Braakmann's study, there is a positive correlation between education and healthy living behavior. Individuals with a low level of education tend to conduct behaviors that are at risk for health due to lack of good knowledge related to health.[13] Nearly 35.7% of the respondents are working as coconut palm farmer/gardener and student. The activities of coconut palm farmers risk exposure to malaria transmission. At the time of palm collection either in the morning or evening, the farmers are always in contact with mosquitoes resting places such as bushes and plantations. Various types of tree plantations will create the level of relative humidity required by some of the forest breeding malaria vectors. Oil palm plantations are associated with malaria.[14]

Spread of malaria cases in the Bagelen Subdistrict on January 2016-May 2017 period, mostly found in the Durensari Village, which reached 34.25% (25 cases). While in the Hargorojo village found only a few cases,

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which is about 4.11% of the total cases. The spread of the malaria cases is uneven, there were 70 cases in total by the distribution of 65 points and 14 cases are found in the same house. Distribution of malaria cases the period January 2016-May 2017 can be seen in Figure 1.1.

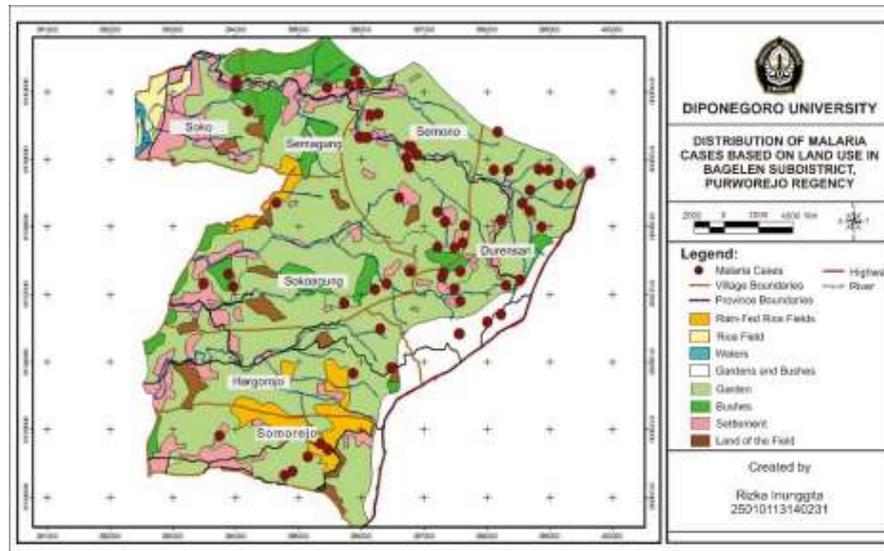


Figure 1.1. Distribution of Malaria Cases Based on Land Use in Bagelen Subdistrict, Purworejo Regency

Based on data from Purworejo Regency Health Office, cases of malaria on January 2016-May 2017 period with *Plasmodium vivax* is the most found in patients, which is about 77.41%. Then for cases of malaria with *Plasmodium falciparum* species found 18.57%. Meanwhile, for the case of malaria with *Plasmodium mix* only found 4.29%.

The results of observation in this study shows that of all cases of malaria in Bagelen Subdistrict, from all of 70 cases, as many as 39 (55.70%) were found *Anopheles* mosquito's breeding places around the home of the patients. There are 4 types of breeding places that found in around patient's home, consist of water path (20.51%), crevice (30.77%), water puddle (30.77%), and cement mortar pond (17.95%). As we can see on the figure 1.2

Physical environmental factors such as water temperature, humidity, and rain fall were support the existence of *Anopheles* mosquitos breeding places. From the observation on 39 points of breeding places were found, overall water temperature obtained of all breeding places ranged between 25-28 °C. Thus it can be said that all breeding paces were found have the optimum temperature for *Anopheles* larvae. This is in line with the study conducted by Johnson et al who revealed the largest abundance of long-lived mosquitoes between 20–30°C temperature range.[15]

Based on the result of humidity measurement performed on the environmental humidity around 39 points of breeding places, obtained between 74-86%. From the result of these measurements can be said that all breeding places were found have environmental humidity that supports the breeding places *Anopheles* mosquitoes. The previous study found that *Anopheles* optimum relative humidity range was 60-75%.[16] The next physical environmental factor that contributes to the existence of breeding places and survival of *Anopheles* larvae is rainfall. The minimum rainfall required for the breeding of mosquitoes is less than 1.5 mm/day.[17] With relatively low rainfall such as this, resulted not found *Anopheles* breeding places at every point of malaria cases in Bagelen Subdistrict, Purworejo Regency. But on the other hand, mild rainfall causes the rivers become dry resulting water basins on the river bank or in the crack rocks. These circumstances led to the emergence of potential habitats of *Anopheles*.

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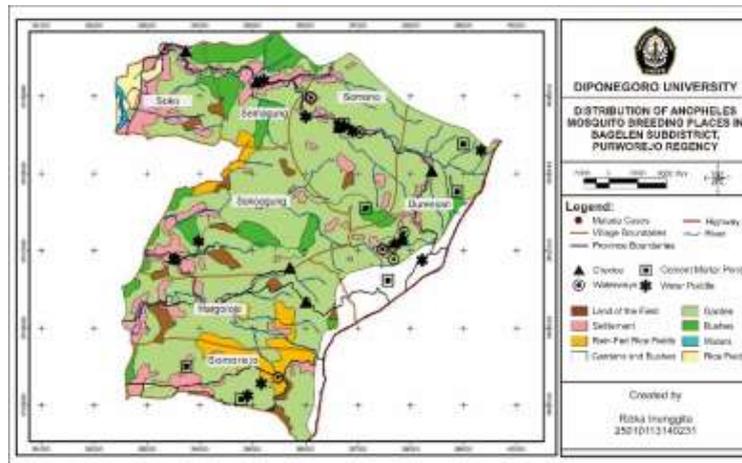


Figure 1.2. Distribution of Anopheles Mosquito Breeding Places in Bagelen Subdistrict, Purworejo Regency

Biological environmental factors referred in this study is vegetation around the breeding places were found in Bagelen Subdistrict. The result of the study, indicate that the bamboo trees are most widely vegetation were found around Anopheles breeding places. The bamboo leaf which drops around the breeding places can be used as a shelter for Anopheles larvae from predator attack and sunlight exposure. These results are similar to those reported by Dejenie et al who stated that the vegetation of plants, serve as a place to hide Anopheles mosquitoes from predator.[18] The existence to these vegetation support the life mosquitoes, among others as place to laying eggs, shelter, and larvae Anopheles mosquito's foraging.

The chemical environmental factor that measured in this study were pH levels. The result of pH measurement in the all of breeding places ranged between 6.4-9.2. According to Geller et al, the optimum pH of *Anopheles gambiae* rangend between 4.0-7.8 in laboratory condition.[19] The highest density of Anopheles larvae found in the breeding places form cement mortar pond having pH of 9.2. According to research conducted in Ghana found that some kind of Anopheles larvae can survived limit between at pH above 7. [19] In contrary with the results of the study conducted by Adebote et al who reported *Anopheles sp* prefers at low pH.[20]

4. Conclusions

1. The majority of respondents who tested malaria positive are male (52.86%), livelihood as coconut palm farmers (35.71%) and students (35.71%), had elementary education (39.73%), and in the 5-17 age group.
2. The spread of malaria cases in January 2016-May 2017 were not evenly distributed in every endemic village in Bagelen Subdistrict.
3. There are 4 types of breeding places were found in Bagelen Subdistrict, including waterways (20.51%), crevice (30.77%), water puddle (30.77%), and cement mortar pond (17.95%) as many as 39 points or about 55.71% of total malaria cases which found in Bagelen Subdistrict, Purworejo Regency on January 2016-May 2017 period.
4. The average temperature was 26.88 °C, with relative humidity 79.69%, rainfall intensity 2-20 mm/day, 60.97% found bamboo vegetation, and the level of pH range to 6,4,9,2.

5. Suggestions

1. The people of Bagelen Subdistrict are encouraged to always use long sleeved clothing and long pants when doing outdoor activities at 06.00 p.m. to 06.00 a.m.

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2. The society of Bagelen Subdistrict are encourage to make efforts to prevent malaria, especially for coconut palm farmers to reduce contact with *Anopheles* mosquitoes.
3. The people are encourage to always pay attention to the surrounding environment, bury or clean up places that have potential to become larvae habitats such as cement mortar ponds around the house.

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