Various Mosquitoes Species and Control Efforts in Villages With Malaria Problem at Menoreh Hill Central Java

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**Abstract**—Menoreh Hill is located in Central Java and divide two provinces and three districts namely Purworejo and Magelang District of Central Java Province and Kulonprogo District of Yogyakarta Province. The height of this area is about 1000 m asl. In this area, Malaria is one of problematic diseases. Nevertheless, Magelang district got the National Malaria Elimination Certificate in 2014, while Purworejo and Kulonprogo are still in malaria pre elimination phase. The aims of this research are to describe various species of mosquitoes and mosquitoes control efforts specially genus Anopheles. The Data were collected from entomological survey using a technique based on WHO guidelines. Catching the mosquitoes was done twice, each was done all night in two different villages—which both located in Menoreh and had malaria problem. The research was done in July-October 2018. The mosquitoes that had been caught were then identified and checked for their parousity to estimate the average age of the mosquitoes. Focus Group Discussion was done to get the information about mosquitoes control that had been done in the community. The result of this research: genus of mosquitoes found in menoreh hill were Anopheles, with species An. maculatus, An. balabacensis, An. aconitus, An. vagus, An. flavirostris, An. barbirostris, An. minimus, An. kochi, An. limosus. The mosquitoes that had been found were mosquito species such as An. maculatus, An. balabacensis, An. vagus, An. flavirostris, An. barbirostris, An. minimus, An. kochi, An. limosus. The combination of several ways to control mosquitoes had been done by people in menoreh hill.

**Keywords:** mosquito, species, malaria, Menoreh Hill

I. **INTRODUCTION**

Menoreh Hills is located in Central Java which divide two province and three district namely Purworejo and Magelang District of Central Java Province and Kulonprogo District of Yogyakarta Province. The height of this area reached about 1000 m asl. Malaria is one of problematic diseases in this area. Magelang district had been got National Malaria Elimination Certificate in 2014 while Purworejo and Kulonprogo are in pra malaria elimination phase. The number of malaria cases at first December 2018 in Magelang was 5 malaria import cases, while in Kulonprogo was 28 malaria cases (14.29% indigenous) and in Purworejo was 190 malaria cases. Those were dominated by indigenous case. Malaria transmission influenced by the host, agent and environment. Mosquitoes are the definitive host for malaria, human is the intermediate host, and Plasmodium is the agent of malaria. Suitable environment for the life-cycle of Anopheles vector would affect the malaria transmission [1]. Identification and elimination of malaria foci combined with targeted vector control must be done to eliminate malaria [2]. Research in endemic area in Purworejo show shows that humidity, precipitation, migration and previous malaria cases had have a significant relationship with malaria [3]. Analysis spacial Special analysis from a research in 3 village in Menoreh Hills found that malaria cases were more common in a low density population, as malaria patients were living near the mosquitoes breeding places like river, spring and puddle [4]. The result of malaria vector survey in Kaliwader Village, Bener Subdistrict, Purworejo s District at Menoreh Hills, in 2000 found various species such as An. maculatus, An. balabacensis, An. vagus,
An. barbirostris, An. aconitus, An. kochi and An. flavirostris, in Sidomulyo Village. A survey in Bener Subdistrict, Purworejo District, found An. balabacensis, An. vagus and An. kochi. All species were found indoor and outdoor and had both exofagic and exofilic tendency [5]. To eliminate malaria, one of the things needed is surveillance vector. Surveillance vector could be done by larval survey and mosquitoes survey. Larval survey is easier, cheaper and do not need more resources, therefore larval survey is possible to be done by health worker in Public Health Centre or District Health Office. Mosquitoes data is needed to complete malaria vector data. Vector control of malaria that has been done by community would affect the vector malaria existence and chance of malaria transmission. The aims of this research are to describe various species of mosquitoes and mosquitoes control efforts specially genus Anopheles in Menoreh Hills.

II METHOD

A. Adult Mosquitoes Survey

This paper uses part of research data from “Development Role of Cross Program, Cross Sectors and Communities in Supporting Malaria Elimination at District in Menoreh Hill Area”. Ethical approval from the Health Research Ethics Committee of the National Institute of Health Research and Development Number LB. 02.01/KE.056/2018 Jakarta was obtained on February 15th 2018. The Data collected from entomological survey using a technique based on WHO guidelines and Ministry of Health Republic of Indonesia [6][7]. Catching the mosquitoes was done twice, each was done all night in two different villages which both located in Menoreh and had malaria problem. The research was done in July-October 2018. There were six mosquitoes collector who collected mosquitoes using manual aspirator from 06.00 pm until 06.00 am. Each mosquitoes collector caught mosquitoes in the houses. Three of six collectors caught mosquitoes indoor with human landing technique in 40 minutes. After that they caught mosquitoes resting in the wall in 10 minutes every hours. The others collected mosquitoes outdoor with human landing technique in 40 minutes and caught mosquitoes resting in the cattle for around 10 minutes. Each collector had 10 minutes break. Number of mosquitoes that had been caught every hour were sent to post and then were identified based on the identification key [8], and calculated the relative mosquitoes density by using a formula[7]:

\[
\text{Man Hour Density (number of mosquitoes/person/hour)} = \frac{\text{number of mosquitoes caught}}{\text{number of collector} \times \text{catching time}}
\]

By using dissecting microscope with 40x objective lens and check for parousity by dissecting abdomen and observed in compound microscope with 100x magnification. Parousity number use to estimate the average of mosquitoes’ age by using formula [9].

\[
\text{Age of mosquitoes in population (days)} = \frac{1}{-\log e^p}
\]

While \(e\) = natural logaritma
p = opportunities daily life of mosquitoes, with formula

\[
P = \frac{A}{\text{B}}
\]

A= gonotrophic cycle (use estimated in three days)[10].
B= parousity (percent of number of parous mosquitoes per number of mosquitoes examined).

B. Focus Group Discussion[11]

Focus Group Discussion was done to get information about mosquitoes control that had been done in the community. There were 3 to 4 group FGD in each villages whose members were health cadre, village officials, village malaria community health workers (“Juru Malaria Desa”), public figure, youth group. The Focus Group Discussion was about malaria and one of the question that will be discussed in this paper is about malaria control especially mosquitoes control.

II. RESULTS

Mosquitoes that were found in this survey can be seen in Table 1-3.
Table 1 showed that various species of mosquitoes found were biting indoor and outdoor, resting indoor and resting in the cattle in Kulonprogo. Species Anopheles vector—found biting indoor were An. *maculatus* MHD 0.05/people/hour, *An. balabacensis* MHD 0.01 people/hour and *An. aconitus* MHD 0.05/people/hour. Anopheles vector found biting outdoor were *An. balabacensis* MHD 0.026 people/hour, *An. vagus* MHD 0.115/people/hour and *An. maculatus* MHD 0.031/people/hour. Anopheles vector found resting indoor were *An. vagus* MHD 0.084/people/hour. Anopheles vector found in the cattle were *An. maculatus* MHD 0.771/people/hour, *An. vagus* MHD 12.91/people/hour, *An. balabacensis* MHD 0.041/people/hour. Based on the parousity and assumption of gonotrophic cycle, *Anopheles balabacensis* that were found outdoor had estimated age in population—which were about 13-14 days, *An. aconitus* that were found biting indoor and *An. balabacensis* that were found resting in cattle had estimated age in population which were more than 28 days.

| Species                  | Man Hour Density/MHD (/people/hour) | % parous | Opportunities daily life | Age of mosquitoes in population (days)* |
|--------------------------|-------------------------------------|----------|--------------------------|----------------------------------------|
| **biting indoor**        |                                     |          |                          |                                        |
| *An. maculatus*          | 0.005                               | 0        | 0                        | <0.2                                   |
| *An. balabacensis*       | 0.01                                | 0        | 0                        | <0.2                                   |
| *An. aconitus*           | 0.005                               | 100      | 1                        | ~ (more than 28 days)                  |
| *An. barbirostris*       | 0.005                               | 0        | 0                        | <0.2                                   |
| *Cx. vishnui*            | 0.01                                | 0        | 0                        | <0.2                                   |
| *Cx. quenquefasciatus*   | 0.005                               | 0        | 0                        | <0.2                                   |
| *Ar. subalbatus*         | 0.005                               | 0        | 0                        | <0.2                                   |
| **biting outdoor**       |                                     |          |                          |                                        |
| *An. balabacensis*       | 0.026                               | 80       | 0.93                     | 13.44                                  |
| *An. maculatus*          | 0.031                               | 50       | 0.79                     | 4.3                                    |
| *An. limosus*            | 0.005                               | 0        | 0                        | <0.2                                   |
| *An. barbirostris*       | 0.025                               | 0        | 0                        | <0.2                                   |
| *An. flavirostris*       | 0.015                               | 0        | 0                        | <0.2                                   |
| *Cx. bitumenorhynchus*   | 0.005                               | 0        | 0                        | <0.2                                   |
| *Cx. vishnui*            | 0.01                                | 0        | 0                        | <0.2                                   |
| *Ar. subalbatus*         | 0.026                               | 0        | 0                        | <0.2                                   |
| **Resting indoor**       |                                     |          |                          |                                        |
| *An. vagus*              | 0.084                               | 0        | 0                        | <0.2                                   |
| *An. flavirostris*       | 0.021                               | 0        | 0                        | <0.2                                   |
| *An. barbirostris*       | 0.021                               | 0        | 0                        | <0.2                                   |
| *Cx. quenquefasciatus*   | 0.146                               | 14.29    | 0.52                     | 1.5                                    |
| *Cx. vishnui*            | 0.209                               | 0        | 0                        | <0.2                                   |
| **Resting in the cattle**|                                     |          |                          |                                        |
| *An. maculatus*          | 0.771                               | 54.05    | 0.81                     | 4.87                                   |
| *An. vagus*              | 12.91                               | 16.94    | 0.55                     | 1.69                                   |
| *An. minimus*            | 0.063                               | 0        | 0                        | <0.2                                   |
| *An. barbirostris*       | 0.229                               | 9.09     | 0.45                     | 1.25                                   |
| *An. balabacensis*       | 0.041                               | 100      | 1                        | ~ (more than 28 days)                  |
| *An. kochi*              | 0.229                               | 18.18    | 0.56                     | 1.75                                   |
| *An. aconitus*           | 0.146                               | 42.86    | 0.75                     | 3.55                                   |
| *Cx. quenquefasciatus*   | 0.125                               | 0        | 0                        | <0.2                                   |
| *Cx. vishnui*            | 1.334                               | 0        | 0                        | <0.2                                   |
| *Ar. subalbatus*         | 0.084                               | 0        | 0                        | <0.2                                   |
| *Ar. theobald*           | 0.021                               | 0        | 0                        | <0.2                                   |
| *Ar. kesseli*            | 0.041                               | 0        | 0                        | <0.2                                   |
| *An. flavirostris*       | 0.104                               | 0        | 0                        | <0.2                                   |
| *Ar. Aureolineatus*      | 0.063                               | 0        | 0                        | <0.2                                   |

*) counting with assumption of gonotrophic cycle in three days.
Table II. The Variety of Mosquitoes Species from Biting Indoor, Biting Outdoor, Resting Indoor and Resting in the Cattle in Purworejo

| Species                | Man Hour Density/MHD (/people/hour) | % parous | Opportunities daily life | Age of mosquitoes in population* |
|------------------------|-------------------------------------|----------|--------------------------|----------------------------------|
| **biting indoor**      |                                     |          |                          |                                  |
| An. Balabacensis       | 0.015                               | 0        | 0                        | <0.2                             |
| An. Vagus              | 0.005                               | 0        | 0                        | <0.2                             |
| An. Flavirostris       | 0.016                               | 0        | 0                        | <0.2                             |
| Cx. quinquefasciatus   | 0.105                               | 10       | 0.46                     | 1.30                             |
| Cx. vishnui            | 0.083                               | 0        | 0                        | <0.2                             |
| Ar. Kesseli            | 0.005                               | 0        | 0                        | <0.2                             |
| **biting outdoor**     |                                     |          |                          |                                  |
| An. Balabacensis       | 0.058                               | 18.18    | 0.56                     | 1.75                             |
| An. Barbirostris       | 0.005                               | 0        | 0                        | <0.2                             |
| An. Minimus            | 0.005                               | 0        | 0                        | <0.2                             |
| An. Vagus              | 0.051                               | 20       | 0.58                     | 1.86                             |
| An. Maculatus          | 0.015                               | 0        | 0                        | <0.2                             |
| Cx. quinquefasciatus   | 0.068                               | 13.33    | 2.37                     | 1.47                             |
| Cx. vishnui            | 0.306                               | 0        | 0                        | <0.2                             |
| Cx. Citiens            | 0.01                               | 0        | 0                        | <0.2                             |
| Cx. Gelidus            | 0.01                               | 0        | 0                        | <0.2                             |
| Ar. Subalbatus         | 0.021                               | 0        | 0                        | <0.2                             |
| Ae. Poecillus          | 0.005                               | 0        | 0                        | <0.2                             |
| **Resting indoor**     |                                     |          |                          |                                  |
| An. Maculatus          | 0.041                               | 0        | 0                        | <0.2                             |
| Cx. quinquefasciatus   | 0.146                               | 0        | 0                        | <0.2                             |
| Cx. vishnui            | 0.105                               | 0        | 0                        | <0.2                             |
| Cx. Fasicocephala      | 0.021                               | 0        | 0                        | <0.2                             |
| An. Vagus              | 0.063                               | 0        | 0                        | <0.2                             |
| **Resting in the cattle** |                                     |          |                          |                                  |
| An. Barbirostris       | 0.041                               | 0        | 0                        | <0.2                             |
| An. Minimus            | 0.291                               | 0        | 0                        | <0.2                             |
| An. Vagus              | 0.584                               | 21.43    | 0.60                     | 1.92                             |
| An. Maculatus          | 0.146                               | 0        | 0                        | <0.2                             |
| An. Flavirostris       | 0.041                               | 40       | 0.74                     | 3.27                             |
| Cx. quinquefasciatus   | 0.271                               | 15.38    | 0.54                     | 1.58                             |
| Cx. vishnui            | 0.605                               | 3.45     | 0.33                     | 0.85                             |
| Cx. Gelidus            | 0.396                               | 5.26     | 0.97                     | 1.00                             |
| Cx. tritaeniorhyncus   | 0.021                               | 0        | 0                        | <0.2                             |
| Ar. subalbatus         | 0.209                               | 0        | 0                        | <0.2                             |
| Ar. malayi             | 0.021                               | 0        | 0                        | <0.2                             |
| Ar. kesseli            | 0.084                               | 0        | 0                        | <0.2                             |
| Uranotaenia campestris | 0.041                               | 0        | 0                        | <0.2                             |

* counting with assumption of gonotrophic cycle in three days

Table 2 showed that various species of mosquitoes were found biting indoor and outdoor, resting indoor and resting in the cattle in Purworejo. Species Anopheles vector found biting indoor were An. balabacensis MHD 0.01 people/hour and An. vagus MHD 0.05 /people/hour. While Anopheles found biting outdoor were An. balabacensis MHD 0.058 /people/hour, An. vagus MHD 0.051 /people/hour, and An. maculatus MHD 0.015 /people/hour. Anopheles vector found resting indoor were An. maculatus MHD 0.041 /people/hour, An. vagus MHD 0.063 /people/hour. Anopheles vector found in the cattle were An. vagus MHD 0.584 /people/hour. An. maculatus MHD 0.146 /people/hour. Estimated age of mosquitoes in population was not more than 4 days.
Table 3. The variety of mosquitoes species from biting indoor, biting outdoor, resting indoor and resting in the cattle in Magelang

| Species                        | Man Hour Density/MHD (/people/hour) | % parous | Age of mosquitoes in population* |
|--------------------------------|-------------------------------------|----------|----------------------------------|
| **biting indoor**              |                                     |          |                                  |
| Cx. vishnui                    | 0.21                                | 0        | <0.2                             |
| Cx. quinquefasciatus           | 1.313                               | 0.28     | 0.76                             |
| An. maculatus                  | 0.02                                | 0        | <0.2                             |
| Ar. malayi                     | 0.005                               | 0        | <0.2                             |
| Ar. subalbatus                 | 0.005                               | 0        | <0.2                             |
| An. aegypti                    | 4.929                               | 0.31     | 0.85                             |
| Cx. gelidus                    | 0.166                               | 0        | <0.2                             |
| **biting outdoor**             |                                     |          |                                  |
| An. barbipalpis                | 0.168                               | 0.50     | 1.41                             |
| An. minimus                    | 0.188                               | 0.61     | 1.98                             |
| An. vaga                       | 15.561                              | 0.34     | 0.92                             |
| An. maculatus                  | 0.395                               | 0.68     | 2.6                              |
| An. kochi                      | 0.208                               | 0.67     | 2.5                              |
| An. aconitus                   | 1.271                               | 0.63     | 2.13                             |
| An. fluvostris                 | 3.105                               | 0.48     | 1.36                             |
| An. limous                     | 0.041                               | 0        | <0.2                             |
| Cx. vishnui                    | 13.168                              | 0.38     | 1.00                             |
| Cx. vishnui                    | 1.314                               | 0.40     | 1.06                             |
| Cx. gelidus                    | 0.438                               | 0.36     | 0.98                             |
| Cx. hutchinoni                 | 0.021                               | 0        | <0.2                             |
| Cx. tritaerhyncus              | 0.041                               | 0        | <0.2                             |
| Ar. subalbatus                 | 0.021                               | 0        | <0.2                             |
| Ar. kucingenis                 | 0.021                               | 0        | <0.2                             |
| Ar. malayi                     | 0.043                               | 0.49     | 1.38                             |
| Ae. albopictus                 | 0.021                               | 0        | <0.2                             |
| Ae. aegypti                    | 0.021                               | 0        | <0.2                             |

*) counting with assumption of gonotrophic cycle in three days

Table 3 showed that mosquitoes biting indoor was only Cx quinquefasciatus, various other species of mosquitoes found biting outdoor, resting indoor and resting in the cattle in Magelang. Anopheles vector species that was found biting outdoor was An. vaga MHD 0.125 /people/hour, An. maculatus MHD 0.005/people/hour. Anopheles vector found resting indoor were An. maculatus MHD 0.021/people/hour. Anopheles vector found in the cattle were An. vaga MHD 15.3561 /people/hour, An. maculatus MHD 0.395 /people/hour, An. aconitus MHD 1.271/people/hour. The estimated age of mosquitoes in population was not more than 3 days.

Focus Discussion one of the points in discussion were about vector control. The group of Focus Group Discussion (FGD) in Kulonprogo consisted of health cadre group, village malaria community health workers (Juru Malaria Desa), and village officials group. Group of FGD in Purworejo were health cadre group, village officials group, public figure and youth group. Meanwhile, the group of FGD in Magelang consisted of village officials group, health cadre group, public figure, and village malaria community health workers (Juru Malaria Desa). The results of FGD which emphasize on the vector control were shown in Table 4.

Table IV. Resume of Focus Group Discussion about vector control of malaria in Kulonprogo, Purworejo and Magelang

| Kulonprogo | Purworejo | Magelang |
|------------|-----------|----------|
| a. cleaning environment individually or together | a. The existence of a village health forum | a. cleaning environment individually or together. |
| b. Malaria control socialization | b. The existence of village malaria community health workers (JMD) | b. Indoor Residual Spraying |
| c. Distribution of temephos | c. cleaning environment individually or together. | c. Impregnated Insecticide Thretening Bed Nets (ITN) |
| d. using Impregnated Insecticide Thretening Bed Nets (ITN) | d. Indoor Residual Spraying | d. The existence of village malaria community health workers (JMD) |
| e. Indoor Residual Spraying | e. Impregnated Insecticide Thretening Bed Nets (ITN) | e. Malaria control socialization |
| f. Repelen distribution | f. Distribution of temephos | f. Giving larvae-eating fish |
| g. Training of village malaria community health workers (JMD) | | |
| h. Involvement of health cadre | | |
| i. The existence of the village malaria prevention post | | |
Table 4 showed that Impregnated Threatening Nets (ITN), Indoors Residual Spraying (IRS), lavaciding, household insecticides, using larvae-eating fish in Kulonprogo and community service were the mosquitoes control that been done.

IV. DISCUSSION

Malaria in Menoreh Hills could be eliminated by cross district collaboration. Survey in three district in Menoreh Hills found various mosquitoes species, namely An. maculatus, An. balabacensis, An. aconitus, An. vagus, An. flavirostris, An. limosus, An. harbirostris, An. minimus, An. kochi, An. limosus; Culex with species Cx. vishnui, Cx. quenquefasciatus, Cx. bitaeniorhyncus, Cx. citiens, Cx. gelidus, Cx. fuscocephala, Cx. hutchinsoni; Armigeres with species Ar. subalbatus, Ar. kesseli, Ar. aureolineatus, Ar. theobald, Ar. aureolineatus, Ar. malayi, Ar. kucingsis and Aedes with species : Ae. aegypti, Ae. albopictus and Uranotaenia campestris. The variety of mosquitoes species that had been caught indicated that the survey areas have a risk for another disease transmission such as Dengue Haemorrhagic Fever, Chikungunya, Japanese Encephalitis or lymphatic filariasis [12].

Species of Anopheles that were examined as vector of malaria were An. balabacensis, An. maculatus and An. aconitus [7]. Anopheles vagus was potential as a malaria vector in Kokap by ELISA Test [13]. In this survey, An. balabacensis, An. maculatus, Anopheles vagus and Anopheles maculatus were found in all survey location except An. aconitus which was found only in Purworejo District. From this survey, it can be concluded that in the survey location was was receptive for malaria. Anopheles balabacensis in Kulonprogo have reached enough age to transmit malaria. The process from plasmodium in gametocyte phase from human that who was suffering from malaria entered mosquitoes body until it became sporozoite of plasmodium phase (the sporogony process) which needed about 8-15 days according the species type of plasmodium and temperature [14][15]. In this survey the parousity of An. aconitus biting indoor and An. balabacensis resting in the cattle were 100% parous. When calculating the age of mosquitoes in population we did not find any, so we estimated using 99% parous and the result can be used to estimate a mosquito in population which is 298 days more than 9 months. Literatures show that in nature mosquitoes can survive for longer than 3 weeks and in the laboratory they can live for more than 4 weeksb [16]. The longevity of mosquitoes was affected by environment factor like temperature, relative humidity wind, vegetation and host [9].

Anopheles balabacensis in Kulonprogo and Purworejo found biting indoor and outdoor, and was also found in cattle in Kulonprogo, while in Magelang this species was not found. This species in Banjarnegara District was often found in malaria outbreak [17]. Anopheles balabacensis had a tendency to anthropophilic, breed in water like water springs, even found in footprint or vehicle foot print in plantation area with lush and uniform plants. Research from Umi Widyastuti, et all. in Tegiri and Gunungregi Village, Kokap Sub District, Kulonprogo District found that An. maculatus as dominant vector was suceptible to P. vivax with sporozoite rate 3.7% [18]. In this research we did not examine the sporozoite rate, An. maculatus in this survey was found in all survey location. Anopheles aconitus was found in Kulonprogo and Magelang because there was no habitat for An. Aconitus which was terrace paddy fields in the survey location in Purworejo. From mosquitoes vector we get description that survey location had risk for malaria transmission especially in Kulonprogo. The village communities in the survey locations in the three districts have made efforts to control mosquitoes by cleaning environment individually or together. The weakness of this effort is that they cleaned the environment around houses which tend to be the breeding places of DHF vector, even though they consider such efforts to be a malaria vector control. This was because they did not have enough knowledge about where the breeding places of Anopheles SP are. However, this kind of activity is good, it only needed to be expanded to clean the Anopheles mosquitoes breeding places like in along river, water springs, hoard puddles, hoard unused fish ponds, and to reduce twigs / midribs so that the sunlight could penetrate through those places . Research in Enugu Southeast Nigeria concluded that there is a need for audience specific communication and attitudinal change to ensure the uptake improvement [19]. Malaria control socialization in Kulonprogo and Magelang were delivered as one of malaria vector control efforts. In Kulonprogo and Magelang, Socializations have always been done in every time and opportunity but they have never been mentioned as one of malaria vector control efforts.

Informant of FGD in Kulonprogo and Purworejo also said that distribution of temephos was also one of malaria vector control efforts. However in Magelang ITN was used in all three locations as one of malaria vector control efforts. All villages there even have received ITN from the government. The use of ITN is one way to combat-malaria. In Malawi the use of ITN on children under 5 years old has increased in the last five years [20]. A study in Haiti showed that there was no evidence that mass ITN campaigns reduce clinical malaria. This was caused by a kind of Anopheles vector behavior in this area.

Indoor Residual Spraying (IRS) was also one of malaria vector control efforts in survey location. They realized that the IRS was carried out under certain conditions. Additionally the informant suggested that coordination is needed whenever IRS was done in the border area, so IRS will be done by both districts including the adjacent area. According to their logic the mosquitoes will move to area that is not treated using IRS. Indoor Residual Spraying would reduce malaria incidence in unstable malaria setting, but some limited data from meta analysis research conclude that ITN give better protection in unstable malaria setting [21]. In research area IRS was conducted when there were indications of local malaria transmission. The distribution of repelen in Kulonprogo was used as a way to control malaria vector. Although as a program policy to control malaria, the
used repellent is weak. Thus a deeper study regarding this matter is needed [22]. The existence of village malaria community health workers (JMD) in three location is considered as an attempt to control vectors. In Kulonprogo the involvement and existence of the village malaria prevention post play a role in controlling malaria vectors On the other hand the role in controlling malaria vectors in Purworejo is the existence of village health forum while in Magelang giving larvae eating fish especially in water springs. This research is in line with research from Solikhah in Kulonprogo that people play active role in malaria vector control effort even though they do not know well about vector of malaria [23]. Innovative control tool to ensure that vector control strategy are tailored to local circumstances [24]. This research conclude that towards malaria elimination and to maintain malaria elimination status in Menoreh Hill, *Anopheles balabacensis* in dry season in Kulonprogo has reached the age to transmit malaria. Impregnated Threatening Nets (ITN), Indoor Residual Spraying (IRS), larvaciding, household insecticides and community service were mosquitoes control that been done.

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