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Responding to Malaria Outbreak in East Lombok, Indonesia

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〔抄　録〕

本稿は，2005 年にマラリア・アウトブレイクの発生したインドネシア東ロンボク島で実施したマラリア血液検査データとマラリアに関する住民意識と行動の社会疫学調査（CBDESS, 2006）のデータを解析し，マラリア・アウトブレイクの因果関係を実証的に明らかにしようとするものである。

2005 年の東ロンボク島アウトブレイクは，NTB 州政府報告によると，1443 名の罹患者と 14 名の死亡が公式確認され，その 75.2% は熱帯熱マラリアであった。マラリア蔓延の発生源は，Korleko 地区の石灰工場の労働者だと推測されている。同島では，マラリア・アウトブレイクはこれまでも頻発していたが，2005 年の場合は，ほとんどコントロールが利かず，いくつかの地区では，医療体制の崩壊に襲われた。さらに，この石灰工場の多くの労働者は，地方からの出稼ぎ労働者であったために，マラリア発生源として帰郷し，このことが従来は全くのマラリアフリーだった山間僻地における新たなマラリア感染拡大の原因となった。

本研究では，マラリア感染率（AMI）を被説明変数とし，98 の社会学的変数を説明変数として用いて，マラリア感染拡大の地域間比較分析をする。その分析結果によると，マラリア感染は経済貧困と教育問題，とくにマラリア教育の不足が顕著な要因であることが分かった。マラリア対策に関連して，抗マラリア薬の耐性問題や媒介生物のハマダラ蚊駆除の困難性のほかに，マラリア教育に関する社会的解決の重要性についても議論を深めている。

キーワード　マラリア・アウトブレイク，インドネシア・ロンボク島，社会疫学調査

1. INTRODUCTION

Malaria is one of the most common causes of morbidity and mortality in many parts of WNT. The annual malaria incidence rate (AMI) in 2005 is 20.5 per 1000 population. Sev-

eral areas even have larger incidence, i.e. more than 50 per 1000 population, which are consider as endemic areas. This incidence in 2005 is slightly changed from that in 2000. Moreover, monthly variation of incidence is obvious in these endemic areas in which the incidence is increasing during the beginning of rainy season, usually on September, and reaches the peak on December. Besides the incidence variation, the province also faced several occasion of outbreaks within the last five years. Nevertheless, the outbreak in 2005, which is illustrated at the beginning of this paper, was the most difficult to control.

In responding to this outbreak, a study called collecting baseline data epidemiological/ sociological survey part 1 funded by Japan Society for the Promotion of Science (JSPS) and Bukkyo University was conducted to assess sociological aspect of community in an epidemic. This study was a collaboration study between Bukkyo University, Medical Faculty, University of Mataram and Provincial and District Health Offices. At the same time, Medical Faculty, University of Mataram also developed a surveillance program through village malaria worker. The surveillance was targeted to describe malaria incidence and the prevalence of drug-resistant malaria.

2. POPULATION AND AREA CHARACTERISTICS

East Lombok District covers a total area of about 3,498.5 square kilometres. The land in the district is only less than half of the total area width (1,605.5 square kilometers) with 220 kilometer coastline. In general, it is considered tropical area with the highest rainfall of 281 mm in December and the lowest of 2 mm in August. Mean annual rainfall is 1,218.50 mm. Its population density is the highest in WNT which showed rapid increased from 370.92/km^2 in 1995 to 598.16/km^2 in 2000. Annual income per capita is about USD 300 which mainly came from agricultural sector.[26] Demographic data shows low educational status in which 80% of the population attends elementary school or none educated.

The study was conducted in four endemic villages in East Lombok in which the 2005 epidemic occurred, i.e. Sukaraja, Pijot and Tanjung luar villages in Keruak sub-district as well as Batu Nampar village in Jerowaru sub-district. Pijot village is approximately 6.8 km^2 densely inhabited by 6017 people. Tanjung Luar village is a smaller village, approximately 2.36 km^2, but has nearly twofold as many inhabitants as Pijot village 12,383 people. Batu Nampar village is approximately 9.24 Km^2 with 2,486 people.[26] The two villages of Keruak district, Pijot and Tanjung Luar, have high Annual Malaria Incidence (AMI): 100.8 per thousand in Pijot, and 65.5 per thousand in Tanjung Luar, while the AMI in the other two villages are considered moderate, i.e. 40.6 per thousand in Batu Nampar.[27][28]

3. STUDY DESIGN

A comparative, cross-sectional study will be made using primary data obtained from a survey to explore the demographic and geographic characteristics, as well as factors influencing malaria occurrence and control in the community. Comparison will be made based on level of endemicity, i.e. high and moderate endemicity.

The CBDESS I analysis will consist of malaria trends, socio-demographic, economic, cultural, and religious characteristics, community involvement in previous programs and community knowledge and behavior related to malaria transmission in the study area.

The socio-economic data will include population demographics: number, age, sex, level of education, occupation, health indexes, social activity, income, expenditure, ownership, and migrant laborers activity. Knowledge of malaria is determined based on three constructs, i.e. recognized malaria symptoms, prevention and treatment. Composite frequency of the three constructs is then used to divide the knowledge into three categories, including good (know malaria symptoms, prevention and treatment), moderate (know at least two constructs), or poor (know only one construct or none).

Malaria, in general, manifests as fever which is resulted from simultaneous rupturing of red blood cells following large-scale parasite multiplication. Chills and sweating are often accompanied by a fever. Other symptoms may be headache and joint pains. Fever accompanied by periodic chills and sweating is the classic symptom of malaria. Respondents will be asked to mention any malaria symptoms they know. Knowing three of those symptoms is cutoff point for knowledge of malaria symptom.

Prevention, as the second construct, involves a wide range of prevention method, including human behavior modification, environmental management and vector control. Certain habits or behaviors make human become more vulnerable, i.e. travelling to endemic areas, outdoor activities during mosquito's biting time at night, wearing without any cloth to protect against mosquitoes and so forth. Modifying these behaviors has been effective in preventing malaria. Furthermore, managing the environment by creating an unfavorable milieu for anopheles mosquito is another important means of prevention. This may include environmental modification, environmental manipulation, and human habitual modification. To combine vector control method such as biological predator with chemical control, it is believed to provide a paramount malaria control. Knowing two of the three malaria prevention methods is used as the cutoff point.

Knowing the treatment of malaria is the last construct of malaria knowledge. Whenever respondent can mention at least one malaria medication, then he or she is considered to have a good knowledge of malaria treatment.

Local custom, culture and religion of the community will be observed to reveal the pos-

sibility of developing new approach to implement the preventive measures in the community. Key persons who have potential ability to influence community toward better malaria behavior will be identified. Community events will also be identified as a baseline to develop community malaria events.

This study will use two stage stratified random sampling with endemicity as cluster. In precision rate 1%, confidence level 99% and proportion 0.0172, the minimal samples are 936. Respondents for the interview are the head of the household or the family member, whenever the head of the household is not available.

At the same time, the malaria surveillance program was developed by utilizing village malaria workers in the community. They were specifically trained to identify malaria cases and perform rapid diagnostic test (RDT) examination. The village malaria workers are community health center (Puskesmas) staffs, mainly nurses, who live in study areas or neighboring areas. Among positive malaria cases, blood sample was taken to be examined for drug-resistant plasmodium.

4. RESPONDENT'S CHARACTERISTICS

4–1. Demographic characteristics

A total of 992 (99.2%) respondents from four villages participated in the study, including 192 (19.4%) from Pijot, 300 (30.2%) from Tanjung Luar, 200 (20.2%) from Batu Nampar, and 300 (30.2%) from Sukaraja villages. The majority of respondents are male (60.1%), Muslim (99.8%) and in productive age, i.e. between 20 and 59 years old (88.8%). There are 1.4% and 9.8% of respondents below 20 years old and over 60 years old, consecutively. Comprehensive description of respondent's demographic characteristics within each village can be found in Table 1.

The majority of respondents are Sasakneese. Bugis is the second dominant ethnic in the study areas, particularly in Tanjung Luar village which is a fisherman village. It is widely known that Bugis ethnic, originally comes from Sulawesi, favors to fish and lives in many coastal regions in Indonesia.

The government targeted that junior high school is the minimal basic education. From the study, the vast majority of respondent's educations are elementary school or no formal education (83.7%). A considerable number of respondents never attended any formal education or didn't graduated from elementary school (31.7% and 20.6%, consecutively). There are even very few respondents (1.2%) that proceed to higher education (college or university degree).

The majority of respondents are employed (70.5%). The followings are the three most common occupation, including farmer (37.2%), fisherman (31%), and labor or farm labor (27.2%).

Approximately 99.6% of respondents are married. There are 35.5% of respondent that have been married more than once. Furthermore, a small proportion of respondent (2.3%) even married more than 4 times. Most of them (69.5%) have been living with more than one household (Table 1).

Table 1　Demographic characteristic in areas with high and moderate endemicity

DEMOGRAPHIC CHARACTERISTICS	HIGH ENDEMICITY		MODERATE ENDEMICITY	
	PIJOT N(%)	TANJUNG LUAR N(%)	BATU NAMPAR N(%)	SUKARAJA N(%)
Sex				
• Male	85 (44.3)	208 (69.3)	120 (60.0)	183 (61)
• Female	107 (55.7)	92 (30.7)	80 (40.0)	117 (39)
Age (years)				
• ＜20	3 (1.6)	0 (0.0)	3 (1.5)	8 (2.7)
• 20–29	47 (24.5)	47 (15.7)	43 (21.5)	80 (26.7)
• 30–39	52 (27.1)	108 (36.0)	60 (30.0)	90 (30.0)
• 40–49	31 (16.1)	81 (27.0)	42 (21.0)	62 (20.7)
• 50–59	20 (10.4)	39 (13.0)	36 (18.0)	43 (14.3)
• ≥60	39 (20.3)	25 (8.3)	16 (8.0)	17 (5.7)
Religious				
• Islam	192 (100)	300 (100)	200 (100)	298 (99.3)
• Christianity	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.3)
• Buddha	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.3)
Ethnicity				
• Sasak	183 (95.3)	218 (72.7)	184 (92.0)	299 (99.7)
• Sumbawa	1 (0.5)	4 (1.3)	1 (0.5)	0 (0.0)
• Bima	0 (0.0)	0 (0.0)	2 (1.0)	0 (0.0)
• Bugis	0 (0.0)	35 (11.7)	9 (4.5)	0 (0.0)
• Java	2 (1.0)	4 (1.3)	1 (0.5)	0 (0.0)
• Others	6 (3.1)	39 (13.0)	3 (1.5)	1 (0.3)
Educational status				
• No formal education	58 (30.2)	58 (19.3)	80 (40.0)	118 (39.3)
• Attending elementary school	29 (15.1)	88 (29.3)	42 (21.0)	45 (15.0)
• Elementary school	67 (34.9)	104 (34.7)	50 (25.0)	91 (30.3)
• Junior high school	25 (13.0)	34 (4.3)	18 (9.0)	22 (7.3)
• Senior high school	11 (5.7)	13 (4.3)	7 (3.5)	20 (6.7)
• College	1 (0.5)	0 (0.0)	1 (0.5)	1 (0.3)
• University	1 (0.5)	3 (1.0)	2 (1.0)	3 (1.0)
Occupation				
• Government employee	1 (0.5)	1 (0.3)	3 (1.5)	7 (2.3)
• Village staff	2 (1.0)	0 (0.0)	1 (0.5)	2 (0.7)
• Teacher	0 (0.0)	3 (1.0)	0 (0.0)	0 (0.0)
• Temporary government employee	0 (0.0)	1 (0.3)	1 (0.5)	2 (0.7)
• Private employee	0 (0.0)	2 (0.7)	4 (2.0)	2 (0.7)
• Fisherman	20 (10.4)	148 (49.3)	48 (24.0)	1 (0.3)
• Farmer	45 (23.4)	3 (1.0)	70 (35.0)	142 (47.3)
• Labor/farm labor	41 (21.4)	46 (15.3)	40 (20.0)	63 (21.0)
• Unemployed	83 (43.2)	96 (32.0)	33 (16.5)	81 (27.0)
Marital status				
• Married	192 (100)	298 (99.3)	199 (99.5)	299 (99.7)
• Single	0 (0.0)	2 (0.7)	0 (0.0)	1 (0.3)
• Divorced	0 (0.0)	0 (0.0)	1 (0.5)	0 (0.0)
Number of children				
• ≤2	79 (41.1)	115 (38.3)	103 (51.5)	177 (59.0)
• 3	74 (38.5)	122 (40.7)	56 (28.0)	87 (29.0)
• ≥4	39 (20.3)	63 (21.0)	41 (20.5)	36 (12.0)

Table 2　Respondent's economic characteristics

HIGH ENDEMICITY	MODERATE ENDEMICITY		ECONOMIC CHARACTERISTCS	
	PIJOT N(%)	TANJUNG LUAR N(%)	BATU NAMPAR N(%)	SUKARAJA N(%)
Income (1,000 IDR)				
• ＜500	116 (60.4)	91 (30.3)	123 (61.5)	202 (67.3)
• 500–1,000	67 (34.9)	138 (46.0)	68 (34.0)	88 (29.3)
• 1,000–2,000	8 (4.2)	65 (21.7)	9 (4.5)	9 (3.0)
• ＞2,000	1 (0.5)	6 (2.0)	0 (0.0)	1 (0.3)
Ownerships				
• House	167 (87.0)	287 (95.7)	182 (91.0)	284 (94.7)
• Land	62 (32.3)	23 (7.7)	97 (48.5)	216 (72.0)
• Livestock	86 (44.8)	78 (26.0)	130 (65.0)	132 (44.0)
• Electricity	78 (40.6)	200 (66.7)	94 (47.0)	153 (51.0)
• Television	45 (23.4)	158 (52.7)	36 (18.0)	58 (19.3)
• Radio	57 (29.7)	68 (22.7)	53 (26.5)	89 (29.7)
• Computer	3 (1.6)	5 (1.7)	0 (0.0)	5 (1.7)
• Refrigerator	2 (1.0)	13 (4.3)	7 (3.5)	7 (2.3)
• Phone/handphone	27 (14.1)	30 (10.0)	16 (8.0)	32 (10.7)
• Transportation				
◦ Cidomo*	3 (1.6)	4 (1.3)	2 (1.0)	12 (4.0)
◦ Bicycle	4 (2.1)	8 (2.7)	12 (6.0)	15 (5.0)
◦ Motorcycle	38 (19.8)	29 (9.7)	42 (21.0)	52 (17.3)
◦ Car/truck	3 (1.6)	3 (1.0)	2 (1.0)	2 (0.7)
◦ Boat	14 (7.3)	162 (52.0)	26 (13.0)	2 (0.7)
Household expenditure per month				
• Daily needs (1,000 IDR)				
◦ ＜100	25 (13.0)	41 (13.7)	85 (42.5)	283 (94.3)
◦ 100–500	135 (70.3)	169 (56.3)	107 (53.5)	16 (5.3)
◦ 500–1,000	32 (16.7)	73 (24.3)	8 (4.0)	1 (0.3)
◦ ＞1,000	0 (0.0)	17 (5.7)	0 (0.0)	0 (0.0)
• Health				
◦ ＜100	166 (86.5)	192 (64.0)	194 (97.0)	251 (83.7)
◦ 100–500	24 (12.5)	103 (34.3)	6 (3.0)	46 (15.3)
◦ 500–1,000	1 (0.5)	5 (1.7)	0 (0.0)	2 (0.7)
◦ ＞1,000	1 (0.5)	0 (0.0)	0 (0.0)	1 (0.3)
• Education				
◦ ＜100	142 (74.0)	168 (56.0)	172 (86.0)	251 (83.7)
◦ 100–500	45 (23.4)	113 (37.7)	25 (12.5)	46 (15.3)
◦ 500–1,000	5 (2.6)	16 (5.3)	2 (1.0)	2 (0.7)
◦ ＞1,000	0 (0.0)	3 (1.0)	1 (0.5)	1 (0.3)
• Transportation				
◦ ＜100	159 (82.8)	213 (71.0)	173 (86.5)	237 (79.3)
◦ 100–500	33 (17.2)	84 (28.0)	26 (13.0)	58 (19.3)
◦ 500–1,000	0 (0.0)	2 (0.7)	1 (0.5)	3 (1.0)
◦ ＞1,000	0 (0.0)	1 (0.3)	0 (0.0)	1 (0.3)

In terms of the number of children, most respondents (82%) have three or less children. The number of children ranges from 1 to 13 children and about 18% of respondent has 4 or more children. Approximately 33% of respondents have working children, mostly 1 (35.4%) and 2 (29.9%) children (Table 1).

4–2. Economic characteristics

More than half of respondent (53.6%) has monthly income less than 500,000 IDR which is, to certain extend, could be lower or the same as the minimum regional payment of the

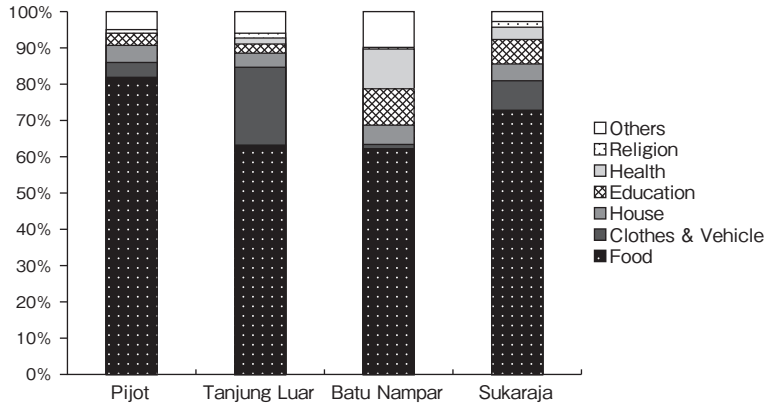

Figure 1　Household expenditure priority in four endemic villages

province in 2005 (475,000 IDR). With such a low monthly income, nevertheless, the vast majority of respondent (92.7%) managed to occupy their own house. There were few respondents who lived with their parents (5.6%) or rent a house (0.5%). Moreover, there were 40.1% of respondent that own farm land. The highest proportion of land ownership can be found in Sukaraja village (72%), where their main occupation is farming. In village where most respondents worked as fisherman such as Tanjung Luar village, land ownership was subsequently the lowest among others (7.7%). Detailed description of respondent's economic characteristics can be found in Table 2.

In accordance with low monthly income, respondent's household expenditure followed. Most of the expenses are addressed to fulfilled daily needs which account for approximately 69.6% of monthly expenditure. Among different villages, this expenditure priority is varied. The highest expense for daily needs can be found in Pijot village (Figure 1). Compare to other expenses, household disbursement for health is considerably low (0.8%). This may reflect a very low willingness to pay for medical care within the four villages which may hamper overall community health status. In terms of exact amount of expense, most respondents (73.9%) stated that they provide approximately less than 100,000 IDR per month for health which is the same amount of expenditure for education and transportation. As stated in many studies, low income may result in lesser access to medical care which can affected the final attainment of health status.

5. FACTORS CONTRIBUTING TO THE OUTBREAK OCCASION

As stated in chapter two, malaria transmission related to the characteristic of 1) host, 2) agent, 3) vector, and 4) the environment. Changes in each factor may enhance or reduce the disease's transmission. The following explanation describes the characteristics of host, agent and environment which account for the outbreak occasion in East Lombok.

Host and environment characteristics are described from the socio-anthropological perspective.

5–1. Host vulnerability characteristics

Generally speaking, immunity determines ones vulnerability to acquire certain infection. In general population, the following individuals including children, pregnant women, elderly and immunocompromised individuals have immunity problem which made them prone to malaria and requires specific protection. This biological susceptibility is not explored in this study. The variable host vulnerability characteristics in this study include knowledge of malaria, vulnerable behaviors and people mobilization.

There are 60.2% of respondent that have poor knowledge of malaria. The number of respondents with poor knowledge is slightly higher in high endemic area than moderate endemic area (68.7% and 51.8%, consecutively). Compared to other villages, Furthermore, Batu Nampar has the smallest proportion of respondents with poor knowledge (28.5%) (Figure 2). Statistical analysis showed a significant association between knowledge and the level of endemicity ($p < 0.001$), i.e. higher knowledge resulted in lower AMI, but this correlation is very weak (Spearman's rho = −0.167). Knowledge attainment is also found to be related to educational status. The higher the educational status is the better knowledge of malaria; however, the correlation is also very weak ($p = 0.001$, Spearman's rho = 0.104). Health personnel also stated that community knowledge and behavior are frequently associated with malaria. They stressed that a low level of education and awareness of malaria prevention is associated with poor knowledge of malaria and preventive measurements.

Knowledge acquisition can also be influenced by experience, i.e. having had malaria should provide a better understanding of the disease. However, it is not the case in this study. Experiencing malaria is not necessarily followed with improved knowledge of the

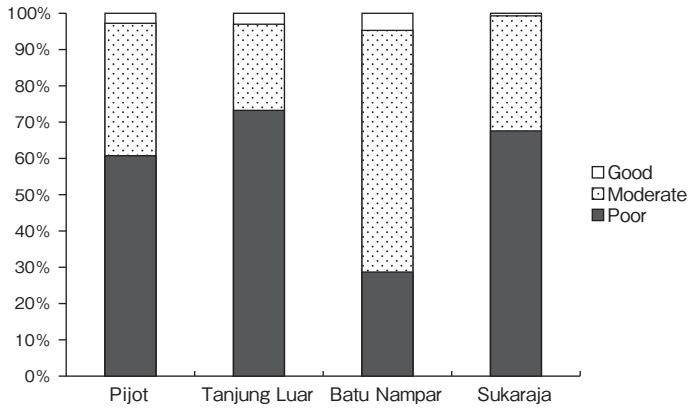

Figure 2　Knowledge of malaria in four endemic villages

disease. Statistical analysis showed a negative correlation which mean that having malaria did not resulted with improved knowledge ($p < 0.001$, Spearman rho = −0.141). This correlation, however, is very weak. There is a possibility that the experience is not truly malaria since the study did not provide any medical information of respondent's previous illness. Experience of malaria was gathered merely from asking respondents whether they ever had malaria before. Moreover, since respondent's knowledge was generally poor, there is a possibility that they are referring to other diseases which share the same symptoms as malaria.

In spite of the knowledge, Puskesmas is the major care provider visited by most respondents (79.9%) whenever they experience malaria symptoms. Other care providers include medical doctor (7.7%), health cadre (3.3%) and hospital (1.0%). A considerable proportion of respondents still utilizes traditional healer (4.3%) to treat for malaria. This condition is generally the same in all villages (Table 3). Moreover, the treatment of malaria is generally provided by health personnel in Puskesmas (76.5%), private practitioner (8.8%) and hospital (1.8%). However, there are some respondents who still take medication from traditional healer (4.0%) or by self-prescription (4.5%).

Although most respondents have poor knowledge of malaria, utilization of anti-mosquito devices is common in all villages. Approximately 77.3% of respondents utilize various anti-mosquito tools. Among different tools, mosquito's coil (59.9%) and bed net (13.6%) are commonly used in all villages (Figure 3). moreover, there is no statistically significant difference of anti-mosquito utilization between high and moderate endemic areas ($p = 0.102$).

With regard to bed net, there are 40.4% of respondents that own bed net. Most of them only have one bed net (73.5%). Among respondent that own bed net, most of them (76.4%) mentioned that they are used to using it every night. There is merely a small proportion of respondent (5.3%) that never use the net (Table 4). Net ownership is a statistically significant factor relates to malaria occasion. Not having bed net relates to higher AMI ($p < 0.001$), however the correlation is very weak (Spearman rho = 0.172).

Studies have been shown that outdoor activities during mosquito's biting time may put

Table 3　Provider visited for malaria symptoms in four malaria endemic villages

CARE PROVIDER	HIGH ENDEMICITY		MODERATE ENDEMICITY	
	PIJOT N(%)	TANJUNG LUAR N(%)	BATU NAMPAR N(%)	SUKARAJA N(%)
• Puskesmas	144 (75.0)	225 (75.0)	165 (82.5)	259 (86.3)
• Health cadre	16 (8.3)	3 (1.0)	10 (5.0)	4 (1.3)
• General practitioner	15 (7.8)	54 (18.0)	4 (2.0)	3 (1.0)
• Hospital	3 (1.6)	5 (1.7)	1 (0.5)	1 (0.3)
• Traditional healer	6 (3.1)	8 (2.7)	16 (8.0)	13 (4.3)
• Others	6 (3.1)	4 (1.3)	1 (0.5)	0 (0.0)
• None	2 (1.0)	1 (0.3)	3 (1.5)	13 (4.3)

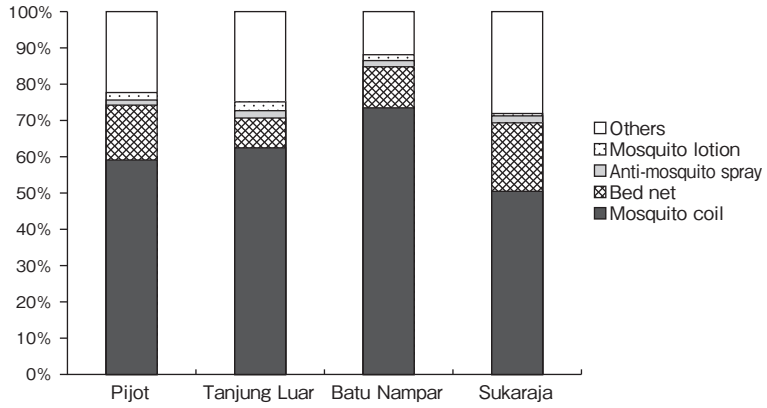

Figure 3 The utilization anti-mosquito tools in four endemic villages

Table 4 Ownership and utilization of bed net among different endemic villages

	HIGH ENDEMICITY		MODERATE ENDEMICITY	
	PIJOT N(%)	TANJUNG LUAR N(%)	BATU NAMPAR N(%)	SUKARAJA N(%)
Own bed net	88 (45.8)	68 (23.0)	99 (49.5)	145 (48.3)
Frequency of utilization				
• Every night	61 (69.3)	52 (76.5)	74 (74.7)	118 (81.9)
• During malaria season	17 (19.3)	12 (17.6)	20 (20.2)	12 (8.3)
• Never	5 (5.7)	3 (4.4)	5 (5.1)	8 (5.6)
• others	5 (5.7)	1 (1.5)	0 (0.0)	6 (4.2)

individuals more susceptible to acquire malaria. Approximately 51.2% of respondents often sleep in open spaces. This activity is more frequent in Tanjung Luar village compare to others (Table 4). Outdoor night activities are also commonly found in four endemic villages. There are 46.6% of respondents who routinely or frequently have outdoor night activities, while some others (27.2%) are only seldom. The difference between high and moderate endemic area, however, is not statistically significance, both in terms of outdoor night activity and sleeping in open spaces ($p = 0.721$ and $p = 0.607$, consecutively).

In terms of outdoor night activities, the followings are common activities in all villages including working (44.5%), night watch (13.0%) and others (32.6%) such as visiting relatives or friends, and sight-seeing. The dominant outdoor activities are different among the villages. In Tanjung Luar, working is the dominant night activities since most of them work as fisherman which commonly departs for fishing at dusk. In the remaining villages, other activities, such as visiting relatives or friends and sight-seeing, are the most dominant night activity (Table 5).

Beside the factors mentioned above, malaria transmission can also be facilitated through people mobilization. Community movement, in-and-out migration from endemic area, may help transmit malaria. Since many parts of East Lombok are endemic of malaria, mobilization among villages or sub-districts can easily enhance malaria transmis-

Table 5　The susceptible behaviors related to malaria transmission in four endemic villages

	HIGH ENDEMICITY		MODERATE ENDEMICITY	
	PIJOT N(%)	TANJUNG LUAR N(%)	BATU NAMPAR N(%)	SUKARAJA N(%)
Outdoor night activities				
• Working	15 (14)	187 (71.9)	59 (42.8)	71 (29.5)
• Night watch	18 (16.8)	22 (8.5)	22 (15.9)	35 (14.5)
• Praying	8 (7.5)	13 (5.0)	3 (2.2)	16 (6.6)
• Attending sermon	9 (8.4	7 (2.7)	4 (2.9)	14 (5.8)
• Others	57 (53.3)	31 (11.9)	50 (36.2)	105 (43.6)
Frequency				
• Routine	21 (10.9)	189 (63.0)	66 (33.0)	32 (10.7)
• Often	33 (17.2)	24 (8.0)	27 (13.5)	70 (23.3)
• Sheldom	54 (28.1)	45 (15.0)	42 (21.0)	129 (43.0)
• never	84 (43.8)	42 (14.0)	65 (32.5)	69 (23.0)
Sleeping in open spaces	73 (38.0)	183 (61.0)	106 (53.0)	146 (48.7)

sion. The frequency of traveling among respondents is low. Approximately there are 28.3% of respondents that often travel to another sub-district. However, the epidemic in 2005 is mostly facilitated by community mobilization according to malaria worker in the district health office and Puskesmas. It is mentioned that the epidemic was firstly brought by limestone mining worker in Ijo Balit sub-village, Korleko village. The workers come from different places, particularly the surrounding villages. Once being sick, they shall return back to their villages bringing the disease along with them. This mobilization spread malaria and caused an epidemic occasion in 2005.

5. 2. Malaria prone environment

The study areas are coastal areas with harsh environment. Clean water access is a major concern in these areas. The community is forced to generate water tap which is a potential breeding place for *Anopheles* mosquito. This water tap is used both for household needs, such as drinking, cooking, washing and shower, and farming, particularly during rainy season. Moreover, there are also a lot of low land areas which is frequently flooded by water during rainy season or high tides which create more mosquitos' breeding sites.

Beside these natural borne factors, abandon shrimp or fish ponds and salt ponds can easily be found in these areas. They act as mosquito's breeding site for the whole year. When the ponds are filled with shrimp, it is difficult to control the mosquito's larvae since shrimp doesn't eat the larvae. Moreover, if fish were added into the ponds, it will take the shrimp.

The climate change also plays important role in the 2005 epidemic. The transition from dry to wet season was shifted which makes control efforts became ineffective. Wet season usually started on September with increasing rainfall in the next coming months. However, the dry season was prolonged.

In terms of control efforts, various measurements have been applied to fight against malaria, including malaria surveillance, active case finding, bed net distribution, environmental management, insecticide application, and biological vector control. However, the resources available to perform these control efforts are limited. For instance, the number of impregnated bed nets (ITN) which is limited. In some Puskesmas, ITN was distributed widely to the community but in others it is insufficient, as the case in Keruak and Labuan Haji sub-districts. ITN in these two facilities were used to in-patient and not distributed to the community due to shortage of supply. Environmental management as one of control efforts can only conducted three times per year. It includes cleaning lagoons and rivers from algae which often used by malaria mosquito's vector. The alteration of seasonal transition made this effort became ineffective since it was not conducted at proper time. Moreover, there was no additional budget to perform another environmental management.

Community acceptance of the control efforts remains a challenge. Control efforts related to sickness and illness, not only for malaria, is perceived to be governmental responsibility, in this case district health office and Puskesmas. The environmental management, for instance, is not perceived as a community need. Most of them consider clearing the lagoon will not be beneficial for them. It is always required external motivation and intervention which requires considerably large amount of budget to keep the environment free from malaria mosquitoes. Another example is the application of fish as the biological vector control in lagoons. Many villagers frequently go fishing or even catch the fish with a casting net that disrupted the minimal number of fish required to control mosquito's larvae.

5. 3. SOCIAL OPPORTUNITY TO FIGHT AGAINST MALARIA

Despite factors mentioned above, socially there is a good opportunity to fight against malaria in all villages. In terms of participation in community activities, the vast majority of respondents (82.5%) took part in various activities. Religious activities are the most common community gathering activities. Approximately 75.2% of respondents mentioned that they frequently attend a sermon in the village. A sermon can be delivered at various occasions including during Friday praying, regular pray in the mosque, homily, etc. among various religious occasion, the following activities are common, including praying together at the mosque (64.9%), Friday sermon (67.6%), and *pengajian* (homily) (34.3%).

There are fewer respondents that mentioned to participate in community social activities, such as village meeting (5.7%), social work (15.9%), PKK (1.5%), and *arisan* (0.5%). PKK is a women group association with vertical hierarchy starting from the national level to village level. *Arisan* is a community social gathering in which they collect a small amount of money for the member and distributed randomly every month. Overall

picture of respondents' participation in community activities can be found in Table 6.

Table 6　Respondents' participation in community activities in four endemic villages

	HIGH ENDEMICITY		MODERATE ENDEMICITY	
	PIJOT N(%)	TANJUNG LUAR N(%)	BATU NAMPAR N(%)	SUKARAJA N(%)
Participation in community activities	134 (69.8)	229 (76.3)	181 (90.5)	274 (91.3)
• Attending a sermon	73 (54.5)	144 (62.9)	166 (91.7)	232 (84.7)
• Village meeting	15 (11.2)	17 (7.4)	4 (2.2)	11 (4.0)
• PKK	6 (4.5)	4 (1.7)	1 (0.6)	1 (0.4)
• Social work	39 (29.1)	58 (25.3)	7 (3.9)	26 (9.5)
• Arisan	0 (0.0)	2 (0.9)	1 (0.6)	1 (0.4)
• Others	1 (0.7)	4 (1.7)	2 (1.1)	3 (1.1)

Table 7　Health topics and Friday sermon in four endemic villages

	HIGH ENDEMICITY		MODERATE ENDEMICITY	
	PIJOT N(%)	TANJUNG LUAR N(%)	BATU NAMPAR N(%)	SUKARAJA N(%)
Health topics delivered during Friday sermon	88(45.8)	193(64.3)	144(72.0)	221(73.3)
• Cleanness	67(76.1)	146(75.6)	142(98.6)	206(93.2)
• Psychological & psychiatric illness	4(4.5)	26(13.5)	0(0.0)	5(2.3)
• Preventive measurement	13(14.8)	16(8.3)	1(0.7)	6(2.7)
• Treatment of disease	2(2.3)	1(0.5)	0(0.0)	2(0.9)
• Others	2(2.3)	4(2.1)	1(0.7)	2(0.9)

From the table above, the highest participation on community activities can be found in Sukaraja and Batu Nampar villages. In all villages, sermon as one of common religious activities is frequently attended by the community. It could be a potential channel in which health program and community empowerment activities could be delivered. Moreover, if environmental management program could be included as one of the social work of the community, it may increase effectiveness and acceptance of community members.

Looking at the content of the sermon, health topics are commonly delivered. Approximately 65.1% of respondents mentioned that health topics are commonly given during Friday sermon. This further opens the possibility to deliver health program or community empowerment activities through religious gathering. The topics may include cleanness (56.6%), psychological and psychiatric illness (3.5%), preventive measurement (3.6%), and treatment of diseases (0.5%). General picture of this occasion is the same in all villages (Table 7).

Besides the potential channel of social activities, social tied is also an important factor that determines how strong the social boundary is. One way to look at this social tied is by observing the social support provided by community members. There are about 16.1% of respondents that mentioned to receive community support. Most of the support is in

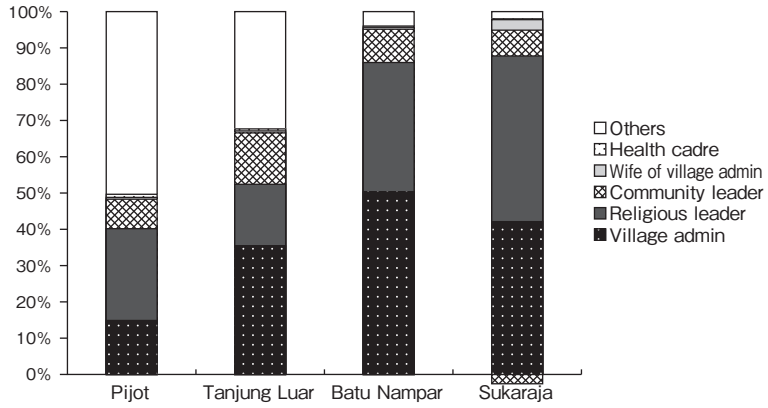

Figure 4　Influential persons in four endemic villages

term of moral or social support (81.8%).

As a channeller, the following key persons are the most potential informant in the community, including formal authorities (36.1), i.e. head of the village, sub-village or hamlet, and religious leader (31.4%), and respected community leader (10.2%). Generally, the picture is the same in all four villages (Figure 4). However, a considerable number of respondents in Pijot and Tanjung Luar mentioned other person to be most influential for them (50.5% and 32.7%, consecutively). These individual may be their relatives or other family members or even other respectful community members.

CONCLUSION

Host social characteristic and environmental change as well as the availability of health care or health program to fight against malaria are important factors associated with the occurrence of malaria epidemic in 2005. In order to develop future prevention program, it is important to consider community demographic and social characteristics as well as the embedded culture.

Socially, there is a strong possibility to develop control program which have strong acceptance and effectiveness. The first step should involve formal authorities, religious leader and community leaders which shall act as important channelers. The next step is to deliver the program through religious activities and included in the community social work. Of course there are several other determinants in building social network and social structure to fight against malaria which are not explored in this study and required further research.

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〔付記〕

本研究に対して，佛教大学より平成 19 年度特別研究費および平成 20 年度総合研究所特別研究『ポスト京都議定書における低炭素循環型社会形成に関する研究』から研究助成を受けた。

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