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Analysis of malaria incidence based on widespread rainfall factor in Ogan Komering Ulu District, South Sumatera Province, Indonesia

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ABSTRACT

The objective of the study was the analysis of malaria incidence based on widespread rainfall factor in Ogan Komering Ulu District, South Sumatera Province. The research sites were conducted in Ogan Komering Ulu District, South Sumatera Province. The dataused in the study was from the Department of Health and was the monthly report of the discovery and treatment of malaria in 2013-2015. The maps of rainfall foronly 2 KM from the settlements become an area of study. The distance determination was carried out using the approach of buffering, upon consideration of the flight range of Anopheles spp which only reached to fly no more than 2 km from the where it origin. The approach used the spatial analysis using geographic approach, and the data that had been through the stages of data processing were analyzed using univariate data analysis to looked at the distribution of malaria cases by type of area rainfall. The rresearch showed that an average incidence of malaria per 1000 population in 2013 to 2015 occurred in every district fluctuations. The fluctuations occurred due to an accumulation of various factors such as mosquitoes, parasites, environmental and human amended from time to time. The highest incidence of malaria spatially occurred in the Subdistrict of Lubuk Batang in the period of 2 (two) years. The characteristics of the region provided an indication of the vulnerability of the spread of malaria, with an area of 53.645 m^2 and a total population of 32.146 inhabitants. The region also was the area of the extensive rainfall> 3500 mm per year which would support the transmission of malaria. Theother factors that played a role were the lack of public awareness on malaria prevention familiarize behavior. The spread of malaria incidence in spatial ecology approach confirmed that OganKomering Ulu District in the medium category of the endemicity of malaria. The approach using the geographic information system (GIS) facilitated the monitoring of malaria and planning program for more accurate control efforts.

Key words : *Malaria incidence, Widespread, Rainfall, Ogankomeringulu district, South sumatera province*

Introduction

Malaria is a public health problem that is most serious in the world. In 2010, an estimated 219 million malaria cases (estimated to be between 154-289 million) occur worldwide, and 660,000 (estimated between 490.000-836.000) people died, most of them are children (WHO, 2015). Malaria incidence in the population of Indonesia in 2013 in five (5) provinces with the highest incidence of Papua (9.8%), East Nusa Tenggara (6.8%), West Papua (6.7%), Central Sulawesi (5.1 %) and Maluku (3.8%). Of the 33 provinces in Indonesia, 15 provinces have malaria prevalence above the national average, mostly in eastern

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Indonesia. (The Ministry of Health RI, 2013).

South Sumatra Province in 2012, Annual Malaria Incidence (AMI) of 6.80 ‰, in 2013 amounted to 6.85 ‰ and 2014 amounted to 5.39 ‰, Data Annual Parasite Incidence (API) in 2012 amounted to 0.62 ‰, in 2013 of 0.47 ‰, in 2014 of 0.36 ‰. (South SumateraProvince Health Department, 2014). Reports of epidemiological surveillance of malaria in 2012-2014 in Ogan KomeringUlu undergone significant changes. Annual Malaria Incidence (AMI) in 2012 amounted 10‰, in 2013 amounted 11‰, in 2014 amounted 14‰ (OganKomeringUluHealth Department, 2014). Efforts to reduce morbidity and mortality conducted through the malaria eradication program whose activities include the following early diagnosis, rapid and precise treatment, surveillance and vector control, all of which aimed to break the chain of transmission of malaria (The Ministry of Health RI, 2013).

In general, The rainfall will facilitate the development of mosquitoes and malaria epidemics. The size of the effect depends on the type and torrential rain, vector species and types of breeding places. Rain interspersed heat will increase the likelihood of an Anopheles mosquito breeding (Arsin, 2002; Sunarsi *et al.,* 2009; Suwito *et al.,* 2010; Pratama *et al.,* 2015; WHO, 2015). To evaluate the control and elimination of malaria strategies, techniques Geographic Information System (GIS) has been adopted to visualize and assess the risk of malaria distribution in space and time malaria in Mali, West Africa (Coulibaly *et al.,* 2013), in Yunnan, China (Bi, 2013). Geography Information System (GIS) with spatial and temporal modeling method have been increasingly used f disease-based mosquito in terms of supervision and risk management, and it can also help to understand the distribution of disease in space and time (Hakre *et al.,* 2004; Gray and Bradley, 2005; Hui *et al.,* 2009; Bi, 2013; Coulibaly *et al.,* 2013). The functional capabilities of Geographic Information Systems (GIS) of the data obtained and stored, recorded and spatial displayed in accordance with the definition of Geographic Information System (GIS) that combined with all the elements necessary for problem-solving and analysis (Clarke *et al.,* 1996; Bailey, 2001; Hakre *et al.,* 2004; Hui *et al.,* 2013).

Materials and Methods

The place of the research was conducted in Ogan Ogan Ulu, South Sumatra Province which the geographicalwas in a position between 103 ° 40'-104 ° 33'BT and 3 ° 45'-4 ° 55 'LS or sits astride Central Crossing Trans Sumatra, which connected Lampung province with Bengkulu province. The area had a wet tropical climate and temperatures varied between 22-31 °C. The research was a descriptive epidemiological study using a quantitative approach. The study design was ecological studies that used data from the entire population to compare the frequency of different diseases in a population at the same period and the same group in different areas (Rothman, 2008; Webb and Bain, 2011). The population in this study were all the incidences of malaria in the region of districts in the county OKU recorded in health centers in the system of recording and reporting of malaria in 2013-2015.

Study Area

The research sites were conducted in Ogan KomeringUlu District, South Sumatera Province which geographically located between 103° 40 'East Longitude to 104° 33' East Longitude and 3° 45 'South Latitude to 4 ° 55' South Latitude or on the Trans-Sumatra Trans-Pacific Highway, which connected Lampung Province with Bengkulu Province. The area had a tropical, and wet climate with temperatures varied between 22 -31°C.

Collection Data

The data from the Department of Health was the monthly report of the discovery and treatment of malaria in 2013-2015. The maps of rainfall were taken from the administration of Planning and Regional Development and Public Works Department. The data presented in the form of maps used for a spatial approach in malaria cases was the analysis of malaria endemic areas and the endemicity of malaria cases with potential mosquito breeding territories which was then stacked upbased on the data collected from secondary data.

Data Analysis Research

In this study, the districts which became an area of study was only the area in 2 KM from the settlements. The distance determination was carried out using the approach of buffering, upon consideration of the flight range of Anopheles sppwhich only reached to fly no more than 2 km from the where it origin (Gandahusada, 2006). The approach was conducted withthe spatial analysis using geographic approach, and software. Data that had been through

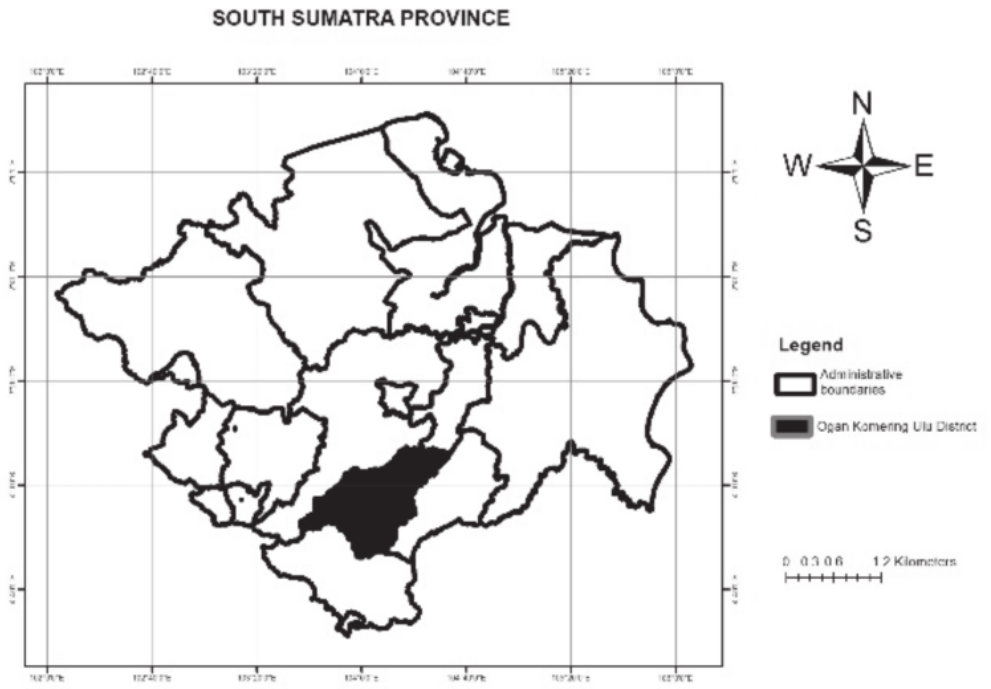

Fig. 1 .Study area in District of Ogan Komering Ulu, South Sumatera.

the stages of data processing were analyzed using univariate data analysis that looked at the distribution of malaria cases by type of area rainfall. The mapping was carried out based on the distribution of cases by region with a predetermined level of endemicity in the classification of each variable. Furthermore, the area was mapped by overlaying the endemic areas with potential mosquito breeding areas by using spatial analysis. The analysis of experimental data on malaria cases was done using the indicator malaria incidence. The analysis of data using the extraction method was to take some of the features before becoming a full information. The overlay method was performed to address information by the purpose of research.

Result and Discussion

Annual Malaria Incidence

OganKomeringUluDistrict is a regency in South Sumatra Province which has 12 districtsand have malaria endemic areas. Endemistas malaria could be figured out from Annual Malaria Incidence (AMI) indicator figure which categorized as very low, low, medium, and high if AMI were <5 ‰, 5-10 ‰, 10-50 ‰, and> 50 ‰, respectively. From this study, the rates of AMI in 2013, 2014, and 2015 were calculated to 11 ‰, 14 ‰, and 8 ‰, respectively. The spatial distributions of AMI bysubdistricts were shown in Fig 2.

The physical environmental factors indirectly affected the dynamics of malaria transmission, so that by monitoring physical environmental factors would be obtained a description of the population dynamics, distribution and location of the incidence of malaria. The physical environmental factors could be projected in space scale regularly to predicting of malaria incidence and could be done in anticipation.

The research showed that an average incidence of malaria per 1000 population in 2013 to 2015 occurred in every district fluctuations. The fluctuations occurred due to an accumulation of various factors such as mosquitoes, parasites, environmental and human amended from time to time. The Increasing of incidence of malaria was influenced not only the physical environmental factors but also the

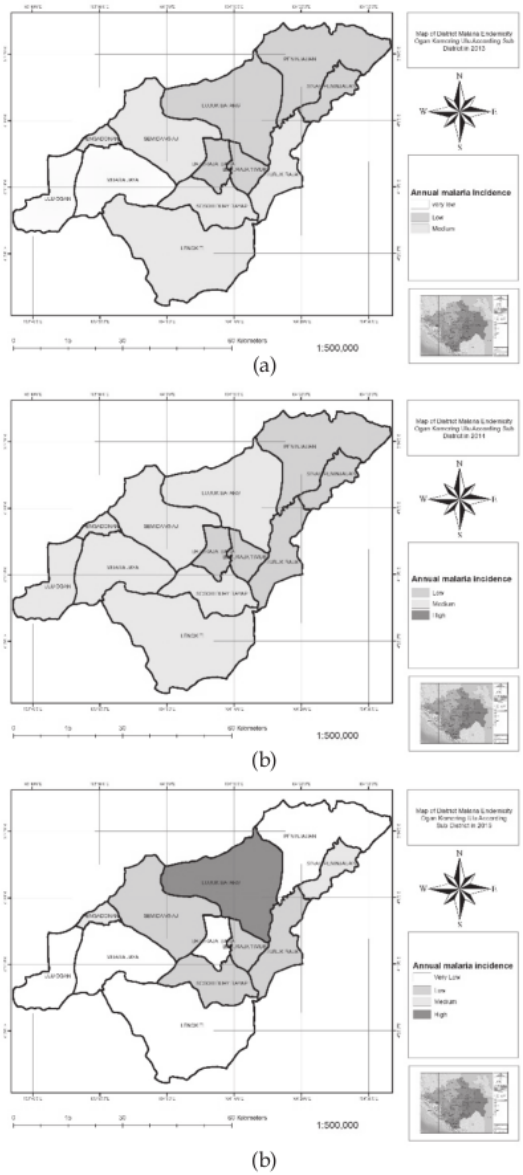

Fig. 2. Annual Malaria Incidencesin Year,(a) 2013, (b) 2014 and (c) 2015.

changes in behavior (Sujari *et al.*, 2007; Sunarsih *et al.*, 2009; Pratama, 2015).

The highest incidences of malaria spatially occurred in the District LubukBatang in the period of two years.The characteristics of the region provided an indication of the vulnerability of the spread of malaria, with an area of 53.645 m^2, a total population of 32.146 inhabitants, and thearea had the extensive rainfall> 3500 mm per year. These factors would support the transmission of malaria. Furthermore, the other factors that played a role were the lack of public awareness on malaria prevention familiarize behavior.

The distribution pattern of malaria based on factors rainfall

In this study, the approach of GIS (geographic information system) was used to analyze the spatial distribution of malaria by the sub-district. The data of rainfall extent collected from the Department of Public Works and Regional Planning Board was a map of the spatial plan and regional plan (RTRW) in 2012-2032. The results of this study confirmed that malaria was a disease that could easily spread or transmitted, in which in some cases have specific characteristics resulting from the combination of many variables. The physical environmental factors influenced and consistent relationship associated with the transmission of malaria.

The incidence of malaria would arise by the vectors of malaria. The malaria vectors would be extended if their breeding places and vector breeding sites were supported by the physical environment that allowed the sites to become a breeding place and resting place. Fig. 3 showed that the extent of the risk factors of rainfall would bring the malaria vector breeding places. Fig. 5 showed that the extensive Precipitation was rainfall> 3500 mm / year spread 85%. The factors of rainfall would increase the amount of stagnant water which previously had little or nothing in the dry season. These conditions facilitated the breeding of mosquitoes so that the

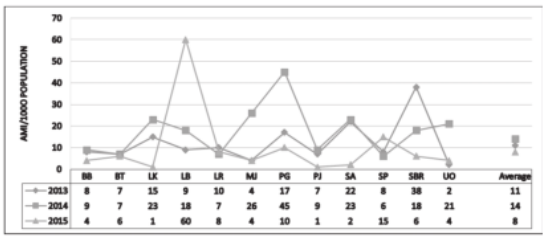

Fig. 3. Average AMI/1000 population from 2013 to 2015

density mosquito would be higher.

The results of this study showed that the number of extents> 3500 mm / year rainfall had an influence on the incidence of malaria. It could be seen from almost all of the districts in the research site become

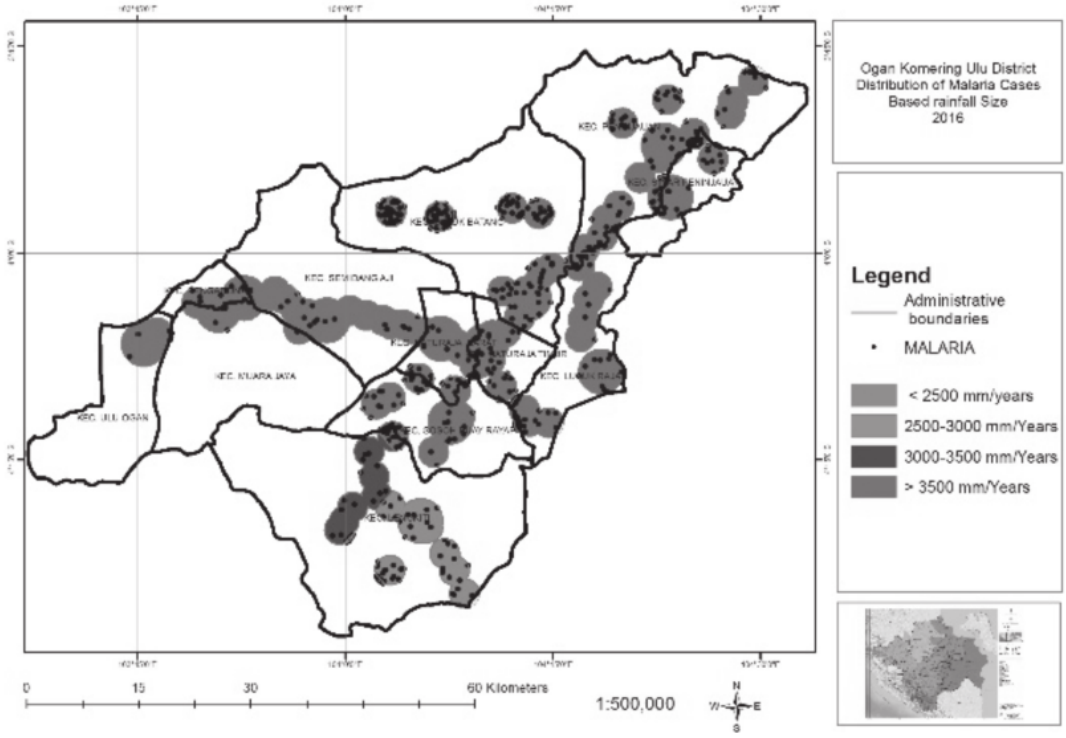

Fig. 4. The spatial pattern of malaria incidence by rainfall factors

the incidence of malaria risk zone.The stagnant water would be the main mosquito breeding and the development of puddlein the lowlands or below 500 m above sea level due to essential for the development of mosquito larvae.The research on the extent of rainfall supported the breeding places of malaria vectors because the half life cycle of the malaria mosquito was spent in the stagnant water or water that flowed from egg to adult mosquitoes. Furthermore, without water, there would be no mosquitoes (Arsin, 2002; Gandahusada, 2006; Mordecai*et al*., 2013).

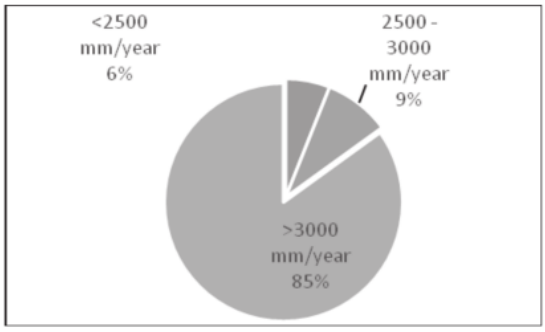

Fig. 5. Percentagesof extensive rainfall

The study on the influences of rainfall on malaria transmission had been studied and found that the larval habitats of Anopheles spp increased in the moist areas where would improve the survival of mosquitoes (Aron andPatz, 2001; Stoops *et al.*, 2008; Stoops *et al*., 2009; Suwito*et al.*, 2010). This study was supported by the meticulous research by Eisele*et al.* (2007) in Haiti which concluded that the rainy season was more favorable for malaria transmission.

The results of this study were also similar to the study conducted in Kwazulu Natal province of South Africa which showed that the malaria burden increased with the increasing of rainfall level in the range of 32 -110 mm, and showed the decreasing level with the reduction in the monthly rainfall. In particular, the transmission was maximized for rainfall in the range of 95 -125 mm. This occurs was only for a period of six months in Kwazulu-Natal. It was

shown that the burden of malaria decreased each time the amount of rainfall exceeds a certain threshold value (Okuneyeand Gumel, 2016). There would be a decrease, and an increase in cases of malaria with fluctuations in rainfall remained calculations mm. The opinion of Epstein revealed that an increase in air humidity and rainfall was directly proportional to the increase in the density of the malaria mosquito (Robert *et al.,* 1998; Lindblade *et al.,* 2000; Jury and Kanemba, 2007; Sujari *et al.,* 2007; Impoinvil *et al.,* 2007; Mordecai *et al.,* 2013).

Conclusion

The spread of malaria incidence in spatial ecology approach confirmed that Ogan Komering Uluwas in the medium category of the endemicity of malaria where theendemicity occurred in the working area of the Subdistrict of LubukBatang and endemicity of the lowest in the region of the Subdistrict of Lengkiti. The approach using geographic information system (GIS) facilitated the monitoring of malaria and plan the program for more accurate control efforts.

References

Arsin, A.A. 2002. *Malaria in Indonesia,epidemiology aspect.*MasagenaPress.Jakarta.

Aron, J.L., and Patz, J.A. 2001. *Ecosystem Change and Public Health: A Global Perspective*. Baltimore: The Johns Hopkins University Press.

Mordecai, A.Nunes, J.P.,Freitas, F.B., Sousa, C.A.,Novob, M.T.,Lourenço, P.M., Lima, J.C., Seixas, J. and Almeida, A.P.G.2014. Satellite-derived estimation of environmental suitability for malaria vector development in Portugal.*Remote Sensing of Environment.* 145:116-130.

Bailey, T.C. 2001. Spatial Statistical Methods In Health.*Cad. Saúde Pública, Rio de Janeiro.*17(5):1083-1098.

Bi, Y. 2013. *Impact of Socio-Ecological Variability on the Transmission of Malaria in Yunnan Province, China.*Ph.D. thesis. School of Public Health and Social Work. Queensland University of Technology. Australia.

Clarke, K., Mclafferty, S. and Tempalski, B. 1996. On epidemiology and geographic information systems: A review and discussion of future directions. *Emerging Infectious Diseases*. 2(2): 85-92.

Coulibaly, D., Rebaudet, S., Travassos, M., Tolo, Y., Laurens, M., Kone, A.K. 2013. Spatio-temporal analysis of malaria within a transmission season in Bandiagara, Mali. *Malaria Journal*. *12*(82): 9 pp.

Eisele, T.P., Keating, J., Bennett, A., Londono, B., Johnson, D., Lafontant, C., and Krogstad, D.J. 2007. Prevalence of Plasmodium falciparum Infection in Rainy Season, Artibonite Valley, Haiti, 2006. *Emerging Infectious Diseases*. 13(10): 1494 – 1496.

Gandahusada, S. 2006. *Medical Parasitology*. Faculty of Medicine, University of Indonesia. Jakarta.

Gray, E.M. and Bradley, T.J. 2005. Physiology of desiccation resistance in Anopheles gambiae and Anopheles arabiensis. *Am. J. Trop. Med. Hyg.* 73: 553-559.

Hakre, S.,Masuoka, P.,Vanzie, E. and Roberts, D.R. 2004.Spatial correlations of mapped malaria rates with environmental factors in Belize, Central America.*International Journal of Health Geographics.*3(6): 12 pp.

Hui, F.M., Xu, B., Chen, Z.W., Cheng, X., Liang, L., Huang, H.B., *et al.* 2009. Spatio-Temporal Distribution of Malaria in Yunnan Province, China. *Am. J. Trop. Med. Hyg.* 81(3): 503–509.

Impoinvil, D.E., Cardenas, G.A., Gihture, J.I., Mbogo, C.M. and Beier, J.C. 2007. Constant temperature and time period effects on Anopheles gambiae egg hatching. *J. Am.Mosq. Control Assoc*. 23: 124–130.

Jury M.R. and Kanemba, A.D. 2007. A climate-based model for malaria prediction in southeastern Africa. *South African Journal of Science.*103: 57 – 62.

OganKomeringUlu District of Health Department. 2014. Profile ofOganKomeringUlu District of Health Department. Baturaja.OganKomeringUlu District.

Okuneye, K. and Gumel, A.B. 2016. Analysis of a temperature- and rainfall-dependent model for malaria transmission dynamics. *Mathematical Biosciences.* xxx (2016) xxx–xxx. 20 pp.

Lindblade, K.A., Walker, E.D., Onapa, A.W., Katungu, J. and Wilson, M.L, 2000. Land use change alters malaria transmission parameters by modifying temperature in a highland area of Uganda. *Tropical Medicine and International Health. 5*(4): 263-274.

Mordecai, E.A., Paaijmans, K.P., Johnson, L.R., Balzer, C., Ben-Horin, T., de Moor, E.,McNally, A., Anwar, S., Ryan, S.J., Smith, T.C., and Lafferty, K.D. 2013. Optimal temperature for malaria transmission is dramatically lower than previously predicted. *Ecol. Lett.* 16, 22e30.

Pratama, G.Y. 2015. Nyamuk *Anopheles sp* dan Faktor yang Mempengaruhi di Kecamatan Rajabasa, Lampung Selatan. *J Majority*. 4(1): 20 – 207.

Robert, V., Awono-Ambene H.P. and Phioulouse, J.1998. Ecology of larval mosquitoes, with special reference to Anopheles arabiensis(Diptera: Culcidae) in market-garden wells in urban Dakar, Senegal. *J. Med. Entomol*. 35: 948-955.

Rothman, K.J. 2008. *Modern Epidemiology. 3rd Edition*. Lippincott Williams & Wilkins.

South Sumatra Province Health Department, 2014. *Profileof South Sumatra Province Health Department*.

Palembang. South Sumatera.

Stoops, C.A., Gionar, Y.R., Shinta, Sismadi, P., Rachmat, A., Elyazar, I.F. and Sukowati, S. 2008. remotely-sensed land use patterns and the presence of Anopheles larvae (Diptera: Culicidae) in Sukabumi, West Java, Indonesia. *J Vector Ecol*. *33*(1): 30-39.

Stoops, C.A., Rusmiarto, S., Susapto, D., Munif, A., Andris, H., Barbara, K.A. and Sukowati, S. 2009. Bionomics of *Anopheles* spp. (Diptera: Culicidae) in a malaria endemic region ofSukabumi, West Java,Indonesia.*J Vector Ecol.* 34 (2): 200-207.

Sujari, Setiani, O. and Sulistiyani, 2007. Faktor-faktor Risiko Kejadian Malaria Pada Wilayah Penambangan Timah Di Kabupaten Bangka Tengah Provinsi Kepulauan Bangka Belitung. *Jurnal Kesehatan Lingkungan Indonesia*. 6(2): 47 – 53.

Sunarsih, E., Nurjazuli and Sulistyani, 2009. Faktor Resiko Lingkungandan Perilaku yang Berkaitandengan Kejadian Malaria di Pangkalbalam Pangkalpinang. *Jurnal Kesehatan Lingkungan Indonesia.* 8(1) : 1-9.

Suwito, Hadi, U.K, Sigit, S.H. and Sukowati, S. 2010. HubunganIklim, KepadatanNyamuk Anopheles danKejadianpenyakit Malaria. *J. Entomol. Indon*. 7(1): 42-53.

The Ministry of Health RI.2013. *Basic of Health Research*. Jakarta.

Webb, P. and Bain, C. 2011. *Essential Epidemiology: An Introduction for Students and Health Professionals. Second Edition*. UK. Cambridge University Press.

World Health Organization. 2015.*World Malaria Report*. Geneve. Switzerland. World Health Organization.

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