MALARIA EVALUATION ANALYSIS BASED ON LAND COVER FACTOR IN OGAN KOMERING ULU REGENCY - SOUTH SUMATERA

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MALARIA EVALUATION ANALYSIS BASED ON LAND COVER FACTOR IN OGAN KOMERING ULU REGENCY - SOUTH SUMATERA

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Key words : *Annual Malaria Incidence, Land Cover, GIS, Medium Endemicity*

Abstract- Malaria is one of the most serious public health problems in the world. The study aimed to analyze the spatial pattern of malaria incidence distribution based on land cover type in Ogan Komering Ulu (OKU) Regency. The research was a descriptive epidemiological research using quantitative approach. The design of the study was an ecological study to compare the frequency of different disease in a population over the same group and period in the different areas. The study was conducted in OKU regency-South Sumatera. The population was all malaria incidence in the sub-district work area of OKU regency which recorded at Puskesmas in recording and reporting system of Malaria year 2013-2015. Furthermore, Land cover and administration were taken from the regional development planning Board of OKU regency and the Public Works Office of Cipta Karta. The presentation of data in maps was used for a spatial approach in the case of malaria with a distance of 2 km from the settlement. The spatial analysis was carried out using geographical approach. The processing of data was done using univariate data analysis by looking at the distribution of malaria cases based on the type of extent and land cover. The distribution of case was mapped by the region with the level of endemicity specified in the classification of each variable. Furthermore, the distribution of case was mapped with overlapping between endemic areas and potential areas for mosquito breeding. The malaria case data analysis was carried out using malaria incidence indicator using extraction and overlay method. The result showed the spatial pattern of malaria spreading using the ecological approach. In addition, the result also confirmed that OKU regency was categorized in the medium level of malaria endemicity with the highest endemicity occurring in Lubuk Batang districts and the lowest endemicity occurring in Lengkiti districts. The GIS approach facilitated the monitoring of malaria and program planning for more accurate control measures.

INTRODUCTION

Malaria is one of the most serious public health problems in the world. In 2010, the case of malaria was 219 million which estimated between 154-289 million cases worldwide. For all the cases, it was estimated that 660,000 (estimated number between 490,000-836,000) people died, who most sufferers were children (WHO, 2015). The highest level of malaria incidences in Indonesia in 2013 was Papua (9.8%), East Nusa Tenggara (6.8%), West Papua (6.7%), Central Sulawesi (5.1%), and Maluku (3.8). The Indonesia have 34 provinces, 15 provinces had a malaria prevalence above the national rate in which mostly located in the eastern Indonesia (The Ministry of Health RI, 2013).

The Annual Malaria Incidence (AMI) per 1000 population of South Sumatera Province rates in 2012, 2013, and 2013 were 6.80, 6.85, and 5.39, respectively. While, the Annual Parasite Incidence (API) in 2012, 2013, and 2014 were 0.62, 0.47, and 0.36 per 1000 population, respectively (South Sumatra Province Health Department, 2014.).

A malaria disease epidemiology surveillance report in OKU Regency for three years from 2012 to 2014 had significantly changed. The Annual Malaria Incidence (AMI) of OKU regency in 2012, 2013, and 2014 was reported to be 10‰, 11‰, and 14‰, respectively (Ogan Komering Ulu District of Health Department, 2014). Activities include early

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diagnosis, prompt and precise treatment, surveillance, and vector control, some efforts had been made to reduce the morbidity and mortality rates through malaria eradication programs whose activities aimed to break the chain transmission of malaria (The Ministry of Health RI, 2013.).

The pattern of malaria transmission had a close relationship to the height of a place. The spreading pattern was increasingly widespread occurs in the areas located at an altitude below 500 m above sea level (asl) and less or not found at an altitude 1000 m asl. The high incidences were caused by the behavior of Anopheles spp. which love to live and breeds in the lowlands (The Ministry of Health RI, 2013; Mahdalena and Ni'mah, 2016).

Olayemi and Ojo (2013), a Nigerian researcher who was doing research in North Central Nigeria had reported that the development of mosquito larvae of *An. gambiae* had a relationship with the soil characteristic contained organic compounds. The results showed that the most productive soil for larvae develop-ment was a clay soil. 87.20 ± 9.11% of larvae maintained in this medium succeeded in becoming an adult mosquito whereas the sand texture soil is only reached to 72.19 ± 15.86%.

In general, the rain would facilitate the mosquitoes breeding and the development of malaria epidemics. According to Arsin (2002); Okuneye and Gumel (2016); Impoinvil *et al*., (2007) and Alamsyah *et al*., (2017), the influence of rain depended on the type and rain intensity, the type of vector, and the type of breeding place. The heat-intense rain would increase the probability of breading Anopheles mosquitoes.

Based on research Mordecai *et al*., (2013); Mordecai, *et al*., (2014) and Benali *et al*., (2014), a study of environmental suitability for the develop-ment of malaria vector in Portugal had been conducted and found that the risk of occurrence of malaria cases would be affected by the vegetation index and the spatial spacing of the optimum spacing. The ecosystem approach required both quantitative and qualitative methods. The quantitative method was the methods which required data to describe the individual variables, household characteristics, ecology, and climate variable, and the use of health service. While according to Carrasquilla (2001) and Jamshed (2014), the qualitative method was the method required to analyze the relationship between the different variables on the different scales. The qualitative was focused on the group, participatory observation, and the in-depth interview.

To evaluate the malaria control and elimination strategies, Geographic Information System (GIS) techniques had been adopted to visualize the risk of malaria and assess the distribution of malaria space and time Mali, West Africa (Coulibaly et al., 2013). GIS with spatial and temporal modeling methods could be used to present the cases of mosquito-borne diseases and might also be used in monitoring and risk management (Bi, 2013) . Furthermore, GIS could also help to understand the distribution of disease in time and space (Hui *et al*., 2009; Bi, 2013). The functional capabilities of GIS obtained from the data which were stored, recorded and displayed by GIS definitions combined with all the elements required for troubleshooting and analysis (Clarke *et al*., 1996; Hakre *et al*., 2004; Gray and Bradley, 2005;). The analysis of the spatial pattern of malaria incidence distribution based on land cover in Ogan Komering Ulu Regions was interesting to be studied.

METHODS

The study was conducted in OKU regency in South Sumatera which geographically position between 103°40'-104033'BT and 3°45'-4°55' LS or located at Trans-Sumatera central traffic line that connected Lampung province with Bengkulu province. The location had a tropical, and wet climate with temperatures varying between 22-31°C. This research was a descriptive epidemiological research using quantitative approach. The design of the study was an ecological study that used data from the entire population to compare the fre-quency of different disease in a population over the same period and the same group in different regions (Rothman, 2008 and Webb and Bain, 2011). The population in this study was all malaria incidence in the districts work area in OKU Regency recorded at Puskesmas in Malaria recording and reporting system in 2013-2015.

The data obtained from OKU Health Office in the form of monthly report, discovery, and treatment of malaria in OKU Regency year 2013-2015. The maps of land type, land cover, and administrative land were taken from the regional development planning board of OKU and the public works office of Cipta Karya. The obtained data analyzed and presented in the form of dummy tables, and maps. The presentation of data in the form of maps was used for the spatial approach in the case of malaria

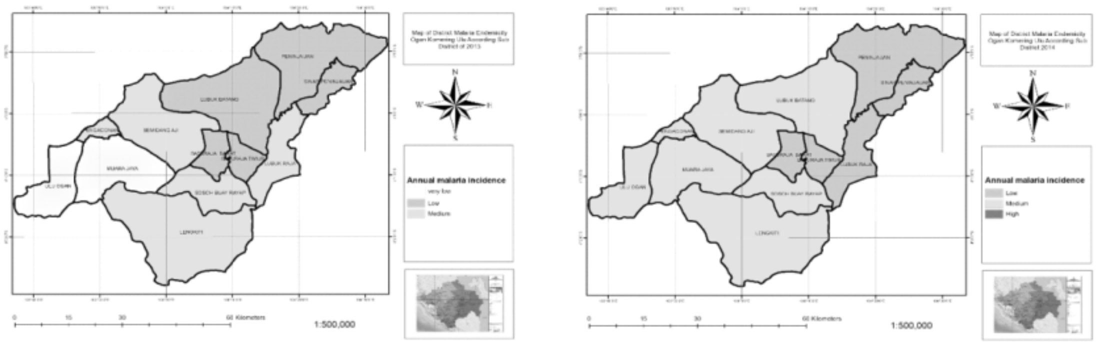

Fig. 1 Annual Malaria Incidents in 2013-2015

both in the form of analysis of endemic areas of malaria cases and endemicity of malaria cases with potential areas of mosquito breeding. The presentation of data would also be collated with the data base that had been collected from the secondary data.

In this study, the Districts area that became the study area was the area located 2 KM from the settlement of the population. The distance determination was based on the buffering approach, on the consideration of Anopheles spp mosquito fly distance where the mosquito could only fly no more that 2 Km from its breeding ground (Gandahusada, 2006). Spatial analysis was conducted by geographical approach and software/tools (Clarke *et al*., 1996; Hakre *et al*., 2004; Bi, 2013). The processed data were analyzed using univariate data analysis by looking at the distribution of malaria cases based on the type of the extent of land cover. The case distribution was mapped by region with the level of endemicity specified in the classification of each variable. Furthermore, it was mapped with overlap between endemic areas and areas with potential for mosquito breeding using spatial analysis. The analysis of data for malaria cases was carried out using malaria incidence indicator. Finally, all the data was analyzed using extraction and overlay method.

RESULTS AND DISCUSSION

Annual Malaria Incidence

Ogan Komering Ulu Regency is one of the regencies in South Sumatera Province wich has 12 districts included endemic areas of malaria. The malaria endemics could be investigated from the indicator of Annual Malaria Incidence (AMI) which categorized very low if <5%, low 5-10%, medium 10-50%, and high category if >50%.

Alamsyah *et al*., (2017) reported that AMI values in OKU regency in 2013, 2014, and 2015 were 11%, 14%, and 8%, respectively. The spatial AMI distribution by districts was shown in Fig. 1. Physical environmental factors indirectly affected the dynamics of transmission of malaria. By monitoring the physical environmental factor, the picture of population dynamics, distribution and location of malaria incidence could be obtained. The physical environmental factor could be projected on a regular basis of space to predict the incidence of malaria to be anticipated.

According to Fig. 1, the incidence of malaria on average per 1000 population in OKU regency in 2013-2015 occurred fluctuation in each district. Fluctuations occurred due to the accumulation of various factors such as mosquitoes, parasites, environment, and humans that changed over time. According to Sunarsih *et al*., (2007), the increasing of malaria incidence was not only caused by physical environmental factor but also behavioral changes.

Fig. 2 showed that the highest incidence of malaria spatially occurred in Lubuk Batang districts in the last two years. The characteristics of districts provided an indication of susceptibility to the spread of malaria. Lubuk Batang had an area of 53,645 m2 and population of 32,146 people. The regional characteristics such as the area of red podsolic yellow soil 8,173 ha and the dry farm area of bushland covering 5,832 ha support the malaria transmission. According to Sunarsih *et al*., (2009) and Alamsyah *et al*., (2017), the other factor that played the highest incidence of malaria in Lubuk

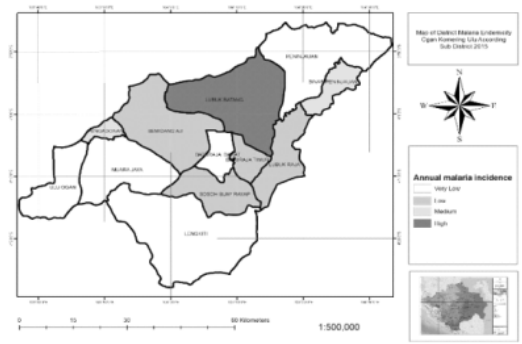

Fig. 2 The AMI value on average per 1000 population in 2013-2015.

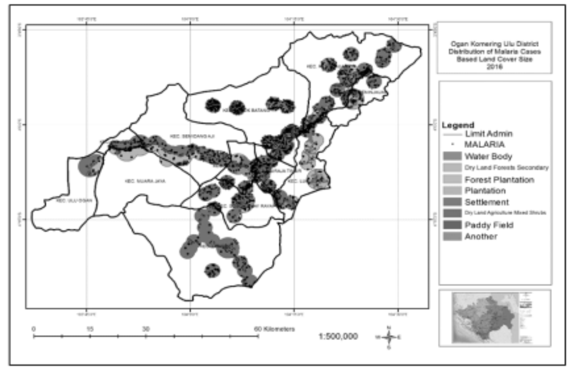

Fig. 3 The spatial pattern of malaria incidence based on land cover factor in 2016.

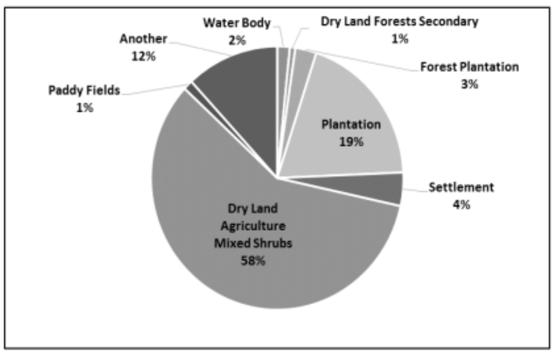

Fig. 4 The percentages of land cover factors by study area.

Batang districts was the lack of public awareness in familiarizing the malaria prevention behavior.

Spatial Pattern of Malaria Occurrence Distribution based on Land Cover Factor

Physical environmental factors were generally dominant as a determinant of the incidence of malaria in a malaria endemic region. Land use changes had become the potential area to become a new *Anopheles* spp mosquito habitat as a malaria vector because *Anopheles* spp. tended to like a new place either for breeding or resting. Fig. 3 showed a research study area that had 59% land cover and dominated by dryland farming species.

The result presents that the land cover which dominated by dryland farming species shown in Fig. 4 was the dominant factor in the distribution of malaria incidence. The result was also related to the primary habitat distribution and mosquito breeding area. These conditions provided a safe place for mosquitos to rest well. The correlation between dryland farming species and *Anopheles* spp population had an interrelated relationship.

The results were consistent with the research conducted by Sunarsih *et al.*, (2009) and Suwito *et al.*, (2010) which concluded that mosquitoes lived in certain areas with specific environmental habitat conditions. The other research conducted Lindblade *et al.*, (2000) in Uganda found that the effects of land-use change could change the transmission of malaria, as planting changes grow to influence local climate patterns, leading to an increase in temperature which could increase the transmission of malaria. This result is the same as another research (Stoop *et al.*, 2008; Stoop *et al.*, 2009).

CONCLUSION

Spatial malaria spreading pattern using ecological approach confirmed that Ogan Komering Ulu Regency belongs to medium malaria endemicity category, with the highest endemicity occurring in Lubuk Batang subdistrict and the lowest endemicity in Lengkiti subdistricts. The GIS approach facilitated the monitoring of malaria and program planning for more accurate control measures.

Further research was needed to explain the factors that affected the actual distribution of malaria incidences such as behavioral factors and the other environmental factors such as biological and chemical environment, social environment, and economic environment.

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