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MAPPING OF DENGUE FEVER DISTRIBUTION BASED ON INDONESIAN NATIONAL STANDARD CARTOGRAPHY RULES AS AN PREVENTION INDICATOR OF OUTBREAKS

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ABSTRACT

The purpose of the study was to know the relationship of population density with DHF cases and determine the fluctuation in dengue fever cases in the Hulu Sungai Selatan Regency in 2008-2014. The population in this study was all DHF cases had recorded by the Public Health Office of Hulu Sungai Selatan Regency in 2014-2018, obtained from DHF cases data and population density data. The data were analyzed using spatial analysis with ArcGIS and linear correlation analysis. The results showed the highest average DHF cases is in Kandangan Subdistrict with 471 cases in 2014-2018. The study showed the relation betweenDHF cases with population density was DHF cases (r) is 0.891, while the Sig. (2-tailed) < 0.05, so the incidence of DHF cases is significant. Spatial analysis showed that the highest DHF cases happened in the area with a high population density. The use of Geographic Information Systems is expected to facilitate government in reduce cases of DHF in Hulu Sungai Selatan Regency. The preventions that can be made are eradication of mosquito nests, periodic larvae checks, and health education so that dengue fever cases can decrease especially in densely populated areas and special education for DHF in schools. This research also can be used as a reference for better regular preventive counseling models by health workers in communities such as government agencies, regional residents and schools.

Keywords: dengue fever distribution; cartography rules; Indonesian national

INTRODUCTION

Dengue Hemorrhagic Fever (DHF) is common in tropical and subtropical regions. The Asian region is the highest in the number of DHF patientspatients every year. One of the factors is high rainfall, especially in East Asia and South Asia, and the other factor is bad environmental conditions (Vyas, 2013). DHF is a health problem that occurs in urban and semi-urban areas. The Vector behavior and relationship with the environment such as climate, vector control, and urbanization influence the occurrence of dengue outbreaks in urban areas (Suryani, 2018).

DHF is caused by the dengue virus of the genus Flavivirus, family Flaviviridae, which transmitted to humans through the bite of an infected Aedes mosquito. Dengue Virus that causes Dengue Fever (DF), Dengue Hemorrhagic Fever (DHF) and Dengue Shock Syndrome (DSS) is included in the B group Arthropod Virus (Arbovirosis) which is now known as the genus Flavivirus, Flaviviridae family, and has 4 types of serotypes, namely: Den -1, Den-2, Den-3, Den-4 (Mau & Sopi, 2014).

Infection with one of these four serotypes does not provide cross-protective immunity, so people that live in endemic areas can be infected by four viral infections (Hadi et al., 2012). Aedes sp, which consists of *Aedes aegypti* and *Aedes al-*

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bopictus, live in different habitats.*Aedes aegypti* lives close to the human environment, while *Aedes albopictus* lives in gardens, swamps, and forests.

Aedes aegypti lay their eggs in calm and clear water, not in dirty water or water that contact directly with the ground (Sahrir et al., 2016). The habitat of *Aedes aegypti* larvae in polluted water shows the mosquitoes can lay any eggs on various media containing polluted water (Hadi et al., 2012). In the last 50 years, DHF has increased 30 times and spread to other countries that not have been infected before. According to WHO from 1955 - 2007, there were 50 million DHF infections each year (Putri & Naftassa, 2017).

According to the Ministry of Health Republic Indonesia, the number of DHF patients in 2014 was 100,347 people, then in 2015 there were 129,650, then in 2016, there were 204,171. Then in 2017 as many as 68,407, then 2018 as many as 53,075, and 2019 as many as 13,683 people (Ministry of Health Republic Indonesia, 2018). In 2015, DHF cases in 13 regencies/cities in South Kalimantan reached 3,589 cases, as many as 40 people in South Kalimantan died, the highest incidence occurred in Hulu Sungai Selatan Regency with 429 people (Public Health Office of Hulu Sungai Selatan Regency, 2018).

At this time, the community needs geographical information. To manage this complex data, an information system that is supported capable of processing spatial and non-spatial data effectively and efficiently is needed (Astuti, 2010). Geographical Information Systems (GIS) are components consisting of hardware, software, geographic data, and human resources that work together effectively to enter, store, enhance, update, manage, analyze, and display geographically based information (Malczewski, 2004; Ruliansyah et al., 2011).

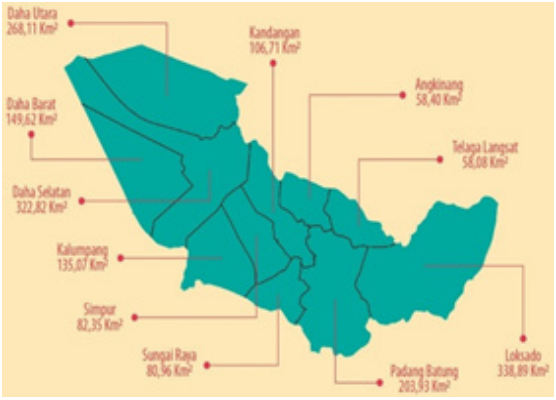

Figure 1. The Map of Hulu Sungai Selatan Regency

The purpose of the study was to know the relationship of population density with DHF cases and making a map of Dengue Hemorrhagic Fever (DHF) distribution to determine the fluctuation in dengue fever cases in the Hulu Sungai Selatan Regency. The use of a Geographical Information System is expected to make it easier for goverment to find out the distribution ofdengue hemorrhagic fever (DHF) cases in Hulu Sungai Selatan Regency.

METHODS

This study was carried out in the Hulu Sungai Selatan Regency in June 2019. The area of Hulu Sungai Selatan Regency is 1,472.43 km^2, consisting of 11 Subdistrict shown to figure 1 (Statistics of Hulu Sungai Selatan Regency, 2018). The population in this study were all cases of Dengue Hemorrhagic Fever (DHF) which were recorded in Dengue Hemorrhagic Fever (DHF) reports in the Public Health Office of Hulu Sungai Selatan Regency from 2014-2018. The entire population was sampled in this study. Secondary data on population density and age group in the Hulu Sungai Selatan Regency was obtained from recording the Statistics of Hulu Sungai Selatan Regency. Spatial data in the form of an administrative map of Hulu Sungai Selatan Regency with *Shp file from the Regional Development Planning Agency of Hulu Sungai Selatan Regency (Regional Development Planning Agency of Hulu Sungai Selatan Regency, 2016), and then spatial data is processed with ArcGIS 10.2 software.

RESULTS AND DISCUSSION

Dengue Hemorrhagic Fever (DHF) in Indonesia was first suspected in Surabaya in 1968, but the virologic certainty obtained in 1970. DHF in adults was first reported by Swandana (1970) which then drastically increased and spread to all regions in Indonesia (Widya & Dhamayanti, 2013).

DHF has clinical manifestations such as fever, muscle pain or joint pain accompanied by leukopenia, rashes, lymphadenopathy, and thrombocytopenia (Butt et al., 2008; Chuang et al., 2008; Hasan et al., 2016; Heilman et al., 2014; Syahria et al., 2015). Population density will facilitate the transmission of dengue virus due to the multiple bitting nature of the virus. Population density is correlated with mosquito flying distances and DHF disease transmission (Farid, 2009).

This is because the more densely populated the easier it is for DHF transmission to occur because mosquito flying distances are estimated to be around 50 m (Alphey, 2011; Faraji et al., 2014; Masrizal & Sari, 2016; Schmidt, 2011). The supporting factor of the dengue cases increase and outbreakare very complex, including high population growth, unplanned and uncontrolled urbanization, lack of effective mosquito vector control in endemic areas (Prasetyowati, 2015).

Based on table 1 regarding the population density of Hulu Sungai Selatan Regency in 2014-2018, it is known that Kandangan Subdistrict is the most densely populated area with an average density of 471 people/km^2, while the area with the lowest density is Loksado Subdistrict with 26.4 people/km^2.

Table 1. Population Density of Hulu Sungai Selatan Regency in 2014-2018

Subdistrict	Years					Mean (pop./km^2)
	2014 (pop./km^2)	2015 (pop./km^2)	2016 (pop./km^2)	2017 (pop./km^2)	2018 (pop./km^2)	
Angkinang	300	303	307	310	313	306.6
Kandangan	461	466	471	476	481	471
Kalumpang	46	47	47	47	48	47
Loksado	26	26	26	27	27	26.4
Padang Batung	101	102	103	105	106	103.4
Simpur	175	177	178	180	181	178.2
Sungai Raya	213	215	217	219	221	217
Telaga Langsat	163	166	168	170	172	167.8
Daha Selatan	128	130	132	133	135	131.6
Daha Barat	51	52	53	54	54	52.8
Daha Utara	119	121	123	124	126	122.6

Based on figure 2, the subdistrict which is categorized as densely populated is Kandangan, it has the highest case every year. The lowest case occurred in the less populated subdistrict namely Loksado.

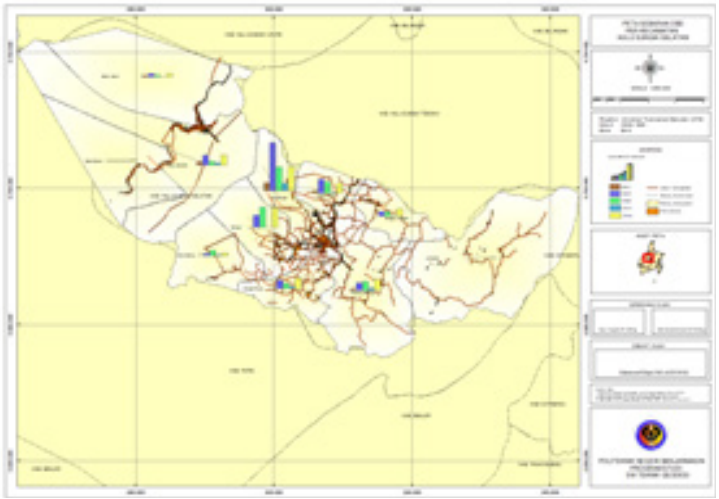

Figure 2: Distribution of DHF Case in Hulu Sungai Selatan Regency

Correlation tests were conducted to determine the effect of population density on the generation of DHF cases in an area. In table 2 can be seen the correlation test results.

Table 2. The Result of Correlation Test of the Population Density Effect on DHF Case.

Correlations			
		Population Density	**DHF Case**
Population density	Pearson Correlation	1	,891**
	Sig. (2-tailed)		,000
	N	11	11
DHF case	Pearson Correlation	,891**	1
	Sig. (2-tailed)	,000	
	N	11	11

**. Correlation is significant at the 0.01 level (2-tailed).

The results of a simple correlation analysis, the correlation between population density and DHF cases (r) is 0.891, while the Sig. (2-tailed) < 0.05, the correlation between population density and the incidence of DHF cases is significant.

There is a shift in the age of dengue victims in Indonesia from the age group of 4-11 months to 15 years to adulthood (Setiati et al., 2006). This information indicates a change in the transmission pattern of dengue virus from domestic (residential) transmission patterns to broader and more open transmission patterns, for example in the workplace, schools and other public places. The emergence of DHF cases, due to several interacting factors, including agents (dengue virus), vulnerable hosts, and the environment that allows the growth and breeding of Aedes spp. (Gubler et al., 2001; Kasjono & Kristiawan, 2008; Murray et al., 2013; Paupy et al., 2009; Sutherst, 2004). DHF case data in Hulu Sungai Regency processed based on age group as shown in table 3.

Table 3. Data on DHF Cases Based on Age

Age	**2014**	**2015**	**2016**	**2017**	**2018**	**%**
< 1 yrs	1	15	6	0	7	2,21
1 – 4 yrs	6	38	33	7	12	7,30
5 – 14 yrs	17	148	109	18	108	30,42
15 – 44 yrs	34	202	175	25	216	49,58
> 45 yrs	9	26	34	16	53	10,49

The highest number of victims in 2014-2018 is the age group of 15-44 years which is 216 people (49.58%) and the lowest in the age group <1 year is 29 people (2.21%).

Researches about Dengue Hemorrhagic Fever (DHF) have been carried out, related to etiological, diagnostic, and prognostic factors of the disease. Some etiologic factors found to be related to dengue are host factors (age, sex, mobility), environmental factors (house density, mosquito breeding places, mosquito resting places, mosquito density, larval free numbers, rainfall), behavioral factors (sleeping patterns, activities to eradicate mosquito nests, drain, throw/bury mosquito nests) (Wahyono et al., 2010).

The use of Geographic Information Systems is expected to facilitate government in reduce cases of DHF in Hulu Sungai Selatan Regency. Preventions that can be made are: 1) increasing awareness and level of community participation regarding environmental cleanliness; 2) eradication of mosquito nests, periodic larvae checks, and health education so that dengue fever cases can decrease especially in densely populated areas; 3) fogging is done by taking into account the direction of the wind and the points where the case is located so that fogging becomes more effective and efficient; 4) special education for DHF in schools. This research can be used as a reference for policy-making related to non-communicable diseases (dengue fever) by local governments also used as a reference for better regular preventive counseling models by health workers in communities such as government agencies, regional residents and schools. Collaboration between health workers and residents supported by the local go-

vernment will make efforts to reduce the number of DHF patients and DHF vector free environment.

CONCLUSION

The dengue distribution map fulfilled 75% of the Indonesian National Standard No. 6502.4:2010 map. This percentage value is obtained from the sum of dengue distribution map layout divided by the sum of Indonesian National Standard No. 6502.4:2010 map layout and multiplied by 100%. It can be concluded that according to the map of DFH distribution per district, the highest case of dengue fever happened in Kandangan district in 2015. The lowest incidence happened in Loksado district in 2017. On the map of DFH distribution based on age group, the highest dengue cases occurred in patients aged 15 to 44 year-old in 2018. There was case in 2017 when DHF affected a patient whom is under one year-old. The highest dengue cases occurred between the end and the beginning of the year from October to February with the highest occurrence in 2015. The lowest dengue incidence happened in the middle of the year, from March to September 2017. Based on the data presented, it is expected that the map can be used by the South Hulu Sungai Public Health Office as a precaution against the rise of DFH cases and can be as reference material for counseling and education activities for patients with DFH.

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