Prediction Of The Epidemiological Aspect For Dengue Outbreaks By Using Local And Remote Sensing Data

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ABSTRACT *- Dengue Hemorrhagic Fever (DF/DHF) cause significant morbidity and mortality in tropical urban-areas. Epidemics of this mosquito borne illness are on the rise worldwide due to increased international travel and unplanned urbanization combined with lack of effective mosquito control measures in tropical developing countries such as Indonesia. The techniques of remote sensing (RS) and geodesy-space have the potential to revolutionize the discipline of epidemiology and its application in human health. We focused on dengue fever which affected by the moisture, vegetation and rainfall accumulation. Since different processes operate at different scales and over different areas in ecology and epidemiology, issues of scale and extent are fundamental to spatial statistical analysis. Exploratory analysis of spatial data sets may help detect patterns at different scales. The Tropical Rainfall Measuring Mission (TRMM) satellite data have been used to derive rainfall these measurements have been used for predictions for di Commonly used leaf area indices are the Normalized Difference Vegetation Index (NDVI) and the Enhanced Vegetation Index (EVI), both available from satellite sensors such as the Advanced Very High Resolution Radiometer (AVHRR) and the Moderate Resolution Imaging Spectrometer (MODIS). NDVI is closely related to photosynthesis, while EVI is closely related to leaf display. Various sea surface temperature anomalies (SSTA) have also been used as indicators of future disease outbreaks. Our method uses variables such as previous dengue incidence, meteorological/climatic data and socio economic data. Particularly, our work is directly contributing to target 3 fight communicable diseases, because this target calls for the epidemic of malaria/dengue.*

Keywords*: dengue, remote sensing, SDG's, disease outbreaks, developing countries.*

1. INTRODUCTION

Dengue hemorrhagic fever (DHF) is a disease that is found in many tropical and sub-tropical regions, especially in Southeast Asia. DHF is caused by dengue virus that belongs to the family Flaviviridae. A study shows the dengue fever outbreak in Indonesia is still a yearly casualty to hundreds of people each year (Koban and Psi, 2005). DHF disease first appeared in the Philippines in 1953 (Yudhastuti, R. and Vidiyani, A., 2005). While in Indonesia, dengue fever was first discovered in the city of Surabaya in 1968. Infected with this disease as many as 58 people infected and 24 people died, with Case Fatality Rate/CFR reached 41.3%. This results in an increase in the number of cases of DHF, which in Indonesia has a risk of contracting DHF (Kemenkes RI, 2010).

The spread of dengue virus based on the information of temperature, rainfall and humidity are factors that influence the occurrence of dengue. From several reports, it is known that dengue often occurs during the rainy season in areas with tropical temperatures, high humidity, relatively close vegetation cover, densely populated settlements, den height less than 1,000 m dpl (Suyana, 2006). Geographic Information System (Geographic Information System) is a computer-based information system used to process and store data or geographic information. In general, GIS is a component consisting of hardware, geographic data software and human resources that cooperate effectively to include, store, repair, update, manage, manipulate, integrate, analyze and display data in geographic-based information (Prahasta E, 2002). The development of remote sensing technology today has provided many benefits including benefits for observation for health epidemiology. This condition will be a benchmark in determining the causes of DHF parameters. Remote sensing (RS) and geodetic-space techniques have the potential to revolutionize epidemiological disciplines and their application in human health. With this study, we focus on dengue fever that is affected by moisture, vegetation and accumulation of rainfall. Because different processes operate at different scales and in various fields in ecology and epidemiology, the scale and level problems are a fundamental spatial statistical analysis.

This study aims to determine the ability of remote sensing images in determining the distribution of dengue fever to mapping the vulnerable areas. At the time of 2013 to 2015.

2. METHODOLOGY

This research is a research with describing that is a research design to know the correlation between risk factor and effect. The population of this study is all residents of Indonesia. While the research sample is all members of the population who suffer from DHF. The type of data in this study is getting from many sources. Where to get from the central statistics Indonesia. Form of case data of disease by province, rainfall, temperature, humidity and vegetation. The combination of AVHRR and MODIS extends the EVI2 datasets from 1981 to 2014 for the current version. We took a subset of the time range of the available data to match other proxies. The VIP30 EVI2 data is available in monthly intervals with a spatial resolution of 0.05◦ (5600 m) from USGS LPDAAC.

3. RESULT AND DISCUSSION

In this study, the effect of rainfall could be affected by the temperature and rise of air humidity. Mosquitoes can survive at low temperatures, but the metabolism process may decrease or stop when the temperature drops to the extreme temperature. At a temperature greater than 35° C undergoes a late change in physiological processes. The average optimum temperature for mosquito growth is 25-27° C. The mosquito will stop growing if the temperature less than 10° C and at the temperature over 40° C. The number of development of metabolic processes is partially influenced by the temperature. Below is a graph of a case of illness influenced by rainfall and temperature. The Tropical Rainfall Measuring Mission (TRMM) satellite data have been used to derive rainfall measurement.

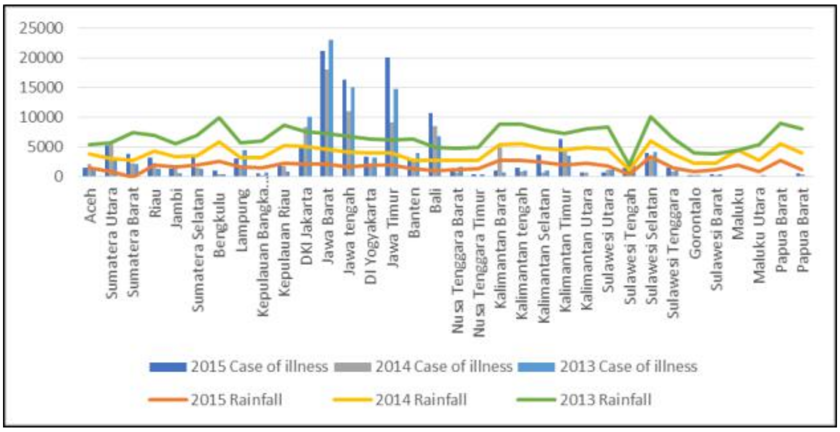

Figure 1. Case of illness plotted by a rainfall period in 2013-2015

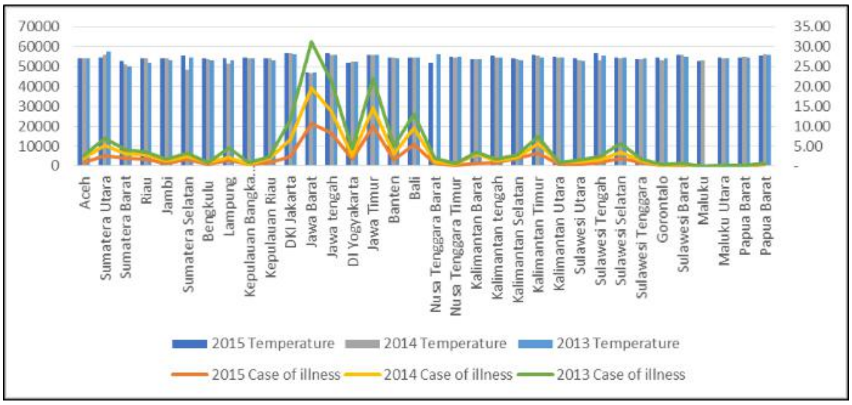

Figure 2. Case of illness plotted by a temperature period in 2013-2015

Regarding **Figure 1** and **Figure 2** it can be concluded that the incidence of DHF increases every number of rainfall and air temperature decrease. Based on data from 2013 to 2015 in the provinces of Indonesia, West Java still got the first position for the case of dengue fever. The average rainfall number of 2423.10 with the total number of rainy days is 215 per day/year. In addition, the average temperature in West Java province is at 23.50° C where the temperature is an ideal condition for Aedes aegypti mosquito's growth. As a pointed out by Adi and Hakam (2014) that climate change has caused the rising of earth surface temperatures that can trigger malaria and dengue fever.

NDVI (Normalized Difference Vegetation Index) is a numerical indicator that uses the visible and Near Infra-Red bands of the electromagnetic spectrum, to analyze and assess whether the target being observed contain live green vegetation or not. In this study, the NDVI difference was generated for DHF assessments.

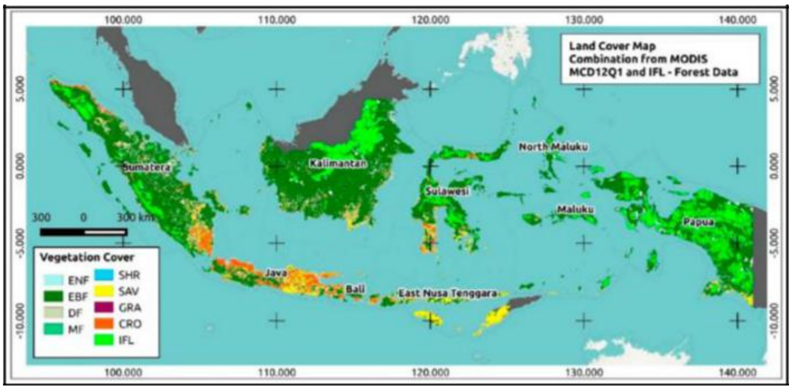

Figure 3. Vegetation cover types in Indonesia based on combined MODIS MCD12Q1 and IFL data with 1 × 1 km spatial resolution
(taken from Arjasakusuma, 2017)

Vegetation index based on NDVI has a value about -1 (non-vegetation) to 1 (vegetation). The forestland type was classified based on the combination between the leaf seasonality, i.e., evergreen and deciduous forest and leaf type, i.e., needle-leaf and broadleaf forest while mixed forest is a forest area with mixture of different type of forests while intact forest landscape data represents the index of DHF disease, the existence of forests is very important for the environment. The relationship between people's forests against dengue incidence is related to the spreading of Aedes aegypti mosquito population. DHF vectors are mosquito species living in community settlements. The flying distance of this mosquito is between 40-100 m and the maximum flight distance of 434 m in the normal wind (Bonnet in Boesri, 2011). West Java, is the one of the populated city in Indonesia.

Based on **Figure 4**, in Indonesia precipitation begins from January until May and October until December, and KBDI begins to increase from June and peak in September. In the case of West Java precipitation begins from January until May and October until December. Like other vector-based diseases, dengue shows patterns related to climate especially rainfall because it affects the spread of mosquito vectors and the possibility of transmitting the virus from one human to another. Vegetation surrounding the settlement is very useful in helping the absorption of rainwater in the soil, so it can reduce the puddles that can become a place of mosquitoes.

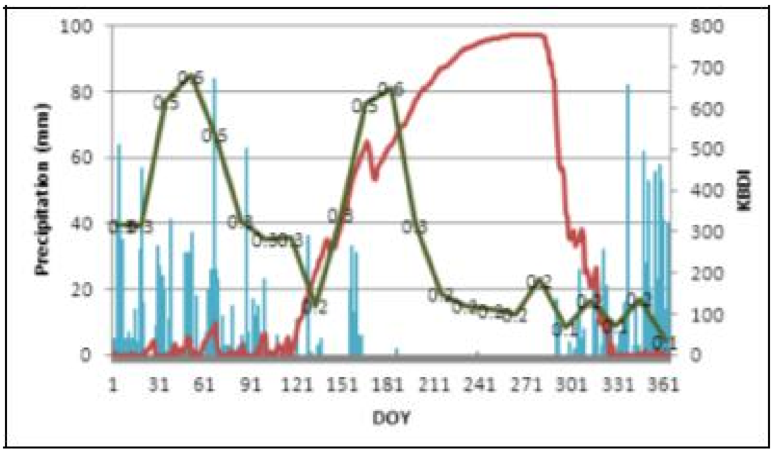

Figure 4. Seasonal variability of precipitation, KBDI and EVI 2012 in West Java, EVI (green line), precipitation (blue line) and KBDI (red line) (taken from Soni, 2014)

Dengue vector mapping should always update the data and information. The vector spatial database of all illnesses should always be developed for the use of program managers and vector-borne disease control sectors. This study has been done to relate the relationship between remote sensing data (rainfall, day temperature, night temperature, NDVI, EVI), and any socio-economic data.

According to Iriani (2012), the peak rain and the peak of the DHF case in the rainy season occurred in January to May. The data shows in March is the high case of DHF in a province in Indonesia. On the other hand, according to the Sugito (2016), May is a month that increased DHF disease with very high rainfall levels. When viewed from these two statements the level of rainfall can affect the increasing number of cases of DHF diseases in a region.

4. CONCLUSION

The conclusions of this study are changes in forest cover and land cover that have a real contribution to increasing the incidence of DHF. Like other vector-based diseases, dengue shows patterns related to climate especially rainfall because it affects the spread of mosquito vectors and the possibility of transmitting the virus from one human to another. For further study, we have to consider the variable of community lifestyle and prosperity or any social-economic data to create analysis in details.

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