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Spread Pattern of Dengue Fever Incidence and Used of System Information Geographic Data into Surveillance Activities in Dungingi Subdistrict City of Gorontalo.

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ABSTRACT

All of regions in Indonesia are at risk against spread of dengue fever, because a virus or vector has been spread throughout in residential and public places in all regions of Indonesia. DHF epidemic period which mainly take place during the rainy season is closely related with high humidity during on rainy season which provide an optimal environment for incubation period and increased of vectors biting activity. The utilization of GIS as a tools for analyze spatial, lately has been used with widely in public health sciences. This research was describing pattern of dengue fever spreads incidence and application of geographic information system data on surveillance activities for dengue control efforts in Dungingi Subdistrict of Gorontalo City. This research was descriptive analytic with ecological and geographic information approach, design study used a time series. Data used was monthly incidence of dengue fever data which derived from data Public health center of Dungingi and climate data such rainfall, rainy day and the temperature obtained from the Meteorology and Geophysics Agency (BMKG) for period 2010 to 2014. Accorded with *spearman correlation* test, the spread pattern of dengue incidence in Dungingi Subdistrict of Gorontalo city was not related with climatic factors (temperature, humidity, rainfall and rainy days) $p > 0,05$. The spread pattern of dengue incidence in Dungingi Subdistrict City of Gorontalo was no related with climatic factors (temperature, humidity, rainfall and rainy days). Required an innovation by implementing a geographic information system technology into surveillance activities for improve the early warning and designed control measures based on spatial distribution of risk factors.

Keywords: Spread Pattern, Dengue Fever Incident, System Information Geographic

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INTRODUCTION

DHF epidemic period which mainly occurred during rainy season has closely related to high humidity during on rainy season which provide an optimal environment for incubation period and increased biting vectors activity. That is why, in the tropics region's pattern of incidence dengue are generally matched with the pattern of rainy season [2].

Based on data by Health Agency of Gorontalo City in 2010, the village with the highest of DHF patients in Dungingi Subdistrict was Libuo Village with amount of patients was 27 people [4]. considering amount of patients in Dungingi Subdistrict especially in Libuo Village will require an innovation into activity in efforts for suppressing the spread of dengue.

Monitoring activity against patient are needs to prevent transmission diseases caused by mosquito bite of intermediaries vectors. Monitoring efforts conducted by cleaning area around of patient's residence. Cleaning area has aims to controlled the mosquitoes breeding places which transmit of dengue disease from patient to people are vicinity of residence. It has required to be done because, according with research which shows that, a new case will occur at the location which amount of early patients are above average [16]. It's shows that although source of breeding place has been resolved but the transmission has been occurring in region which has sufferers.

Utilization of (GIS) Geographic Information Systems about monitoring and identification of mosquito can causes dengue has not been complete [16]. Utilization of GIS as a tool to analyze spatial, lately has been used with widely on public health sciences [17]. The function of GIS has capability for displaying the spatial spread of patient and patterns spread of disease. So that, using this system can predict a potential endemic sites with infectious diseases by means of merge a maps of conditions by location against distribution of patients.

Subdistrict of Dungingi was choose on this study because of mobility of the population are so high and amount of larvae free index just only reached 61% (this value is below by national standard value was 95%) [1].

MATERIALS AND METHOD

This research was descriptive analytic with ecological and geographic information approach, design study used a time series. This study for analyzed the relationship between incidence of dengue fever with climatic factor conditions (rainfall, rainy day and the temperature) based on secondary data obtained. Data used was monthly incidence of dengue fever data which derived from data Public health center of Dungingi and climate data such rainfall, rainy day and the temperature obtained from the Meteorology and Geophysics Agency (BMKG) for period 2010 to 2014.

Another performed a statistical analysis, this study was also conducted an analysis of Geographic Information System data such as the coordinates of patients with dengue fever for used to development a dengue surveillance information system that will be used as early warning data system in effort of controlling dengue fever in Dungingi.Subdistrict City of Gorontalo.

Data Incidence of dengue and climate factor data was analyzed by *Spearman correlation test* Statistical Package and Service Solutions (SPSS) for windows 10. Way point data of patients with dengue was design and convert into the map by ArcGIS for windows.

RESULTS

Description of dengue cases per village in Subdistrict Dungingi of Gorontalo City

DHF cases in Dungingi Subdistrict over the last 5 years according with figure 1 has been declined. The amount of cases in 2010 was 60 cases with an avarege of case was 5 cases per month. Village with the highest cases of dengue in 2010 was Libuo Village as many as 27 cases. There was only 1 case in Tomulabutao Selatan Village, in 2011 and increased to 4 cases in Huangobotu village in 2012. In 2013, there was an increase to 5 cases, for Tomulabutao village with 1 case, Huangobotu with 1 case, Libuo with 1 case and Tomulabutao

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Selatan with 2 cases. In 2014, DHF cases has been increased to 13 cases, with each of 4 cases in Huangobotu village, Libuo with 6 cases, Tuladenggi with 2 cases, and 1 case in Tomulabutao Selatan village. The increased of DHF cases in 2012 to 2014 didn't exceed with amount of cases in 2010 and village with the most of DHF cases from 2010-2014 was Libuo, with cases on period of 5 years as many as 34 cases.

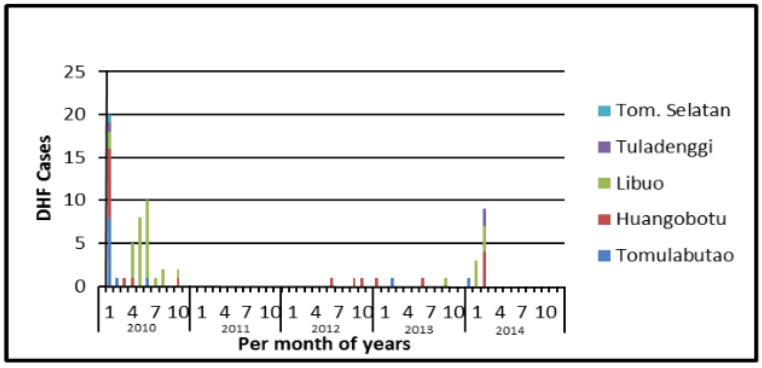

Figure 1: Monthly distribution of dengue cases per village in 2010-2014, Dungingi Subdistrict.

Monthly Climate Patterns of Dungingi Subdistrict in 2010-2014

According from the seasonal pattern of temperature and humidity in Figure 2, the increased of monthly temperature in period of 2010-2014, occurred average in May and October with temperature 27.5 ° C. the temperature average in Dungingi Subdistrict reached 27 °C. This rate was optimal temperature for support of dengue vector's life cycle. A humidity conditions of Dungingi Subdistrict has increased in May that reached 84%, then fell in June to October and increased again on November and December with value of humidity (83 and 84%). The humidity average of years in 2010-2014 has reached 82%.

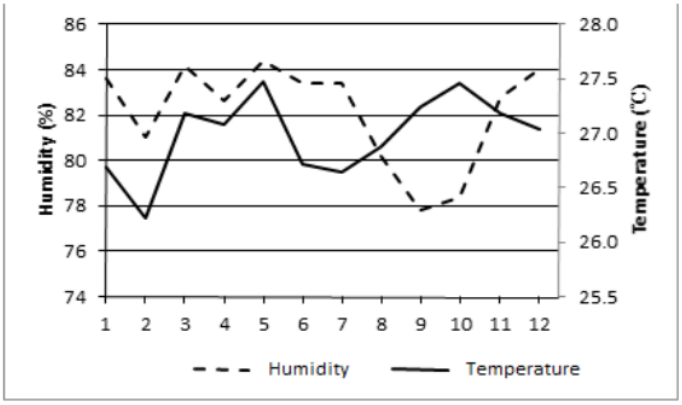

Figure 2: The monthly average temperature and humidity with seasonally of Dungingi Subdistrict in 2010-2014

Based on figure 3. The seasonal pattern of rainfall shows increased in May with amount 187.34 (mm) and decreased amount of 109.04 (mm) in June and July in to the lowest rainfall in September, was 73.80 (mm). Rainfall has increased in November with value that 134.59 and then fell in December with value of rainfall reached that 27 (mm). The highest of rainfall rate had decreased in April with 20 (mm), then down to amount of 16 (mm) in July. The decreased of rainfall values was occur in August and October and has increased with continually until reaches on highest level that 21 days on December. This translates into 21 times of rain in the month of December. This mean, rain was occurs 21 times of rain in one month on December.

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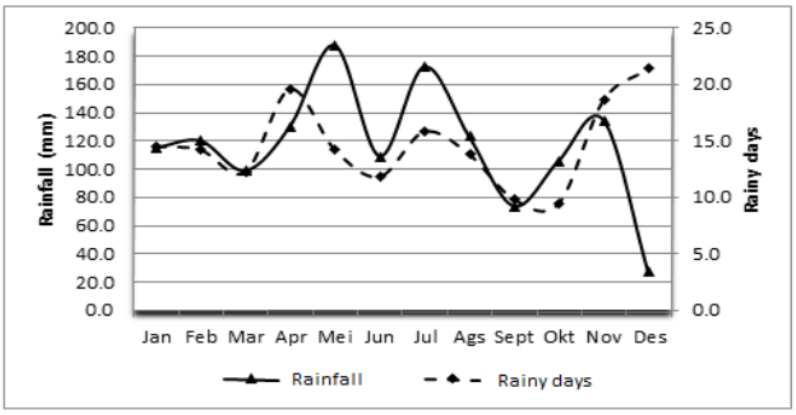

Figure 3: The monthly average of rainfall and rainy days with seasonally of Dungingi Subdistrict in 2010-2014.

The spread pattern of dengue incidence in Dungingi Subdistrict City of Gorontalo City in 2010-2014

The spread pattern of dengue incidence and rainfall per month in 2010-2014

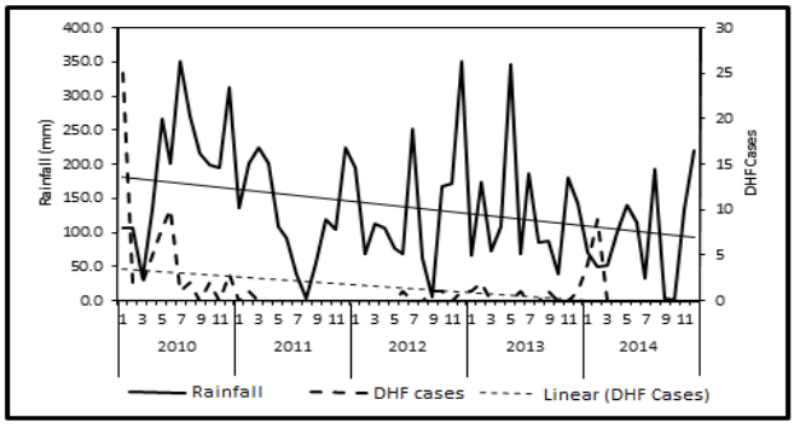

Figure 4: Graph of patterns of dengue cases distribution with rainfall in Dungingi Subdistrict in 2010-2014

Based on trend of rainfall in figure 4, the condition of rainfall in early 2010 and the end 2014 was increase, but when viewed from the whole of rainfall data with the fluctuating patterns, it was indicating that the rainfall trend has decreased. There is no significant relationship between rainfall and incidence of dengue in Dungingi Subdistrict because in some period, the rainfall was increasing but dengue cases were decreased and conversely.

The spread pattern of dengue incidence and rainy days per month in 2010-2014

Based on figure 5, distribution cases in 2010-2014 had decreased while the rainy days increased. Average rainy days in 2010 to 2014 reached 15 times per month, the lowest rainy days was 2 times a month and the highest rainy days was 28 times a month. The graph of patterns on figure 5 presented an increase of rainy days was not following by increased of dengue cases on over period of 5 years.

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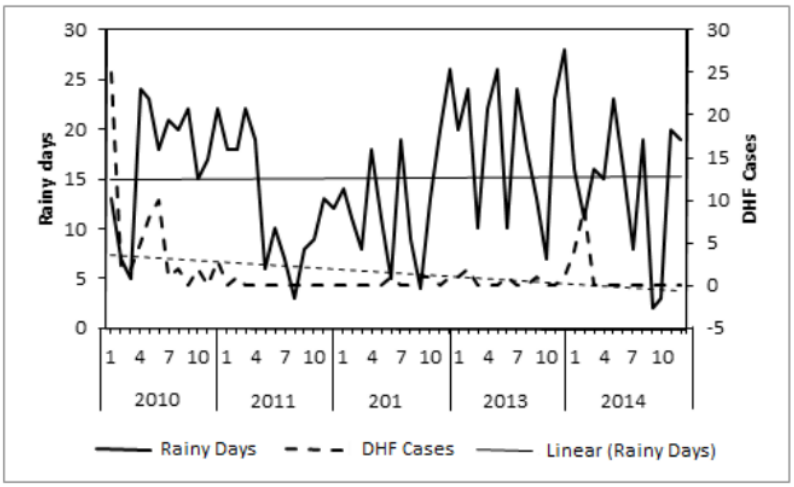

Figure 5: Graph patterns distribution of dengue cases with rainy days in Dungingi Subdistrict in 2010-2014

The spread pattern of dengue incidence and temperature per month in 2010-2014

Based on Figure 6 viewed a trend decrease of temperature. The highest temperature in period 2010 to 2014 was to 28 ° C, minimum temperature was 24.2 ° C, and the average temperature reaches was 27 ° C. The decreased of dengue cases occurred, but did not show a strong pattern of relationship between temperature decreased and a decreased of dengue cases, although increased of dengue cases on April and May in 2010 which followed by temperature increased of this month from 27 to 28 ° C. But if looked with closely after that's month, an increased or decreased of cases didn't show a significant relationships pattern, with decreased or decreased of temperature conditions in Dungingi Subdistrict.

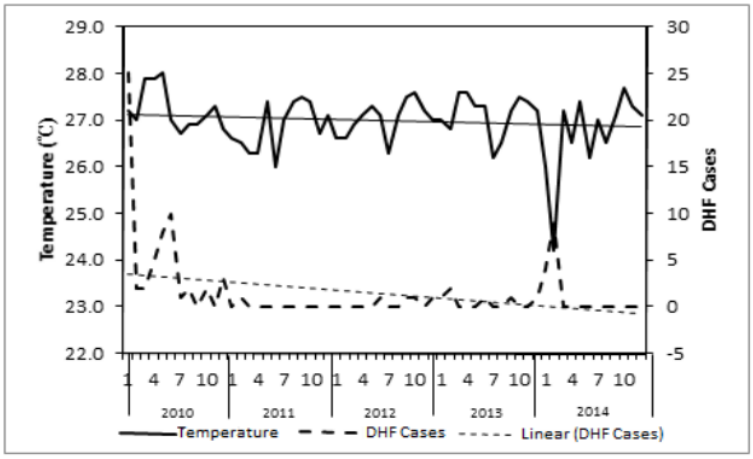

Figure 6: Graph patterns of DHF cases distributions with temperature in Dungingi Subdistrict in 2010-2014

The spread pattern of dengue incidence and humidity per month in 2010-2014

According with figure 7, there was no significant relationship patterns between humidity factor and increased or decreased of DHF Cases. There was a decrease humidity on October 2012 by 78% and February 2014 by 72%, but there was 1 case of dengue on October and 9 cases on February.

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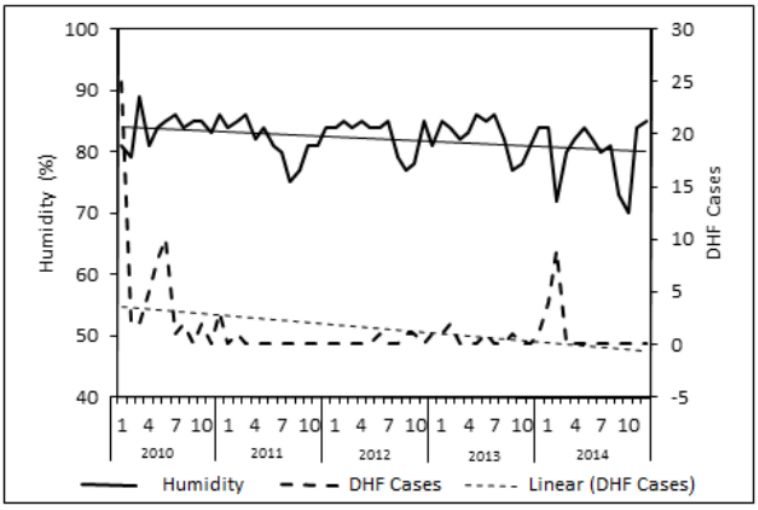

Figure 7: Graph patterns of dengue cases with humidity in Dungingi Subdistrict in 2010-2014

Based on Spearman correlation test between climatic factors condition against DHF incidence had significant p value > 0.05, it defines that based on results of statistical tests performed to secondary data were obtained there was no relationship between climatic factors and dengue incidence was increasing or decreasing of dengue cases in Dungingi Subdistrict, City of Gorontalo.

Table 1: Spearman correlation test results of climatic factor conditions against dengue cases in Dungingi Subdistrict

Climatic Factor	DHF Incidence
Rainfall	p = 0.322
Rainy days	p = 0.294
Temperature	p = 0.795
Humidity	p = 0.431

Implementation of GIS data in to dengue surveillance for dengue disease control efforts in Dunging Subdistrict

Based on way point of dengue patients address data during 2010-2014 were found and showed in to the buffer zone map form. The researchers were difficulty finding the address people had suffered DHF. It caused, based on address patients survey activities and way point data collected by GPS which accompanied by Health Cadres and health center officer, as many as sufferers that were not a native people of Dungingi Subdistrict which registered on Dungingi's community health center working territories. With resulted that buffer zone map created, with data from 2010 was most visible sufferers, it was because generally of patients in 2010 were a native people of Dungingi Sub district.

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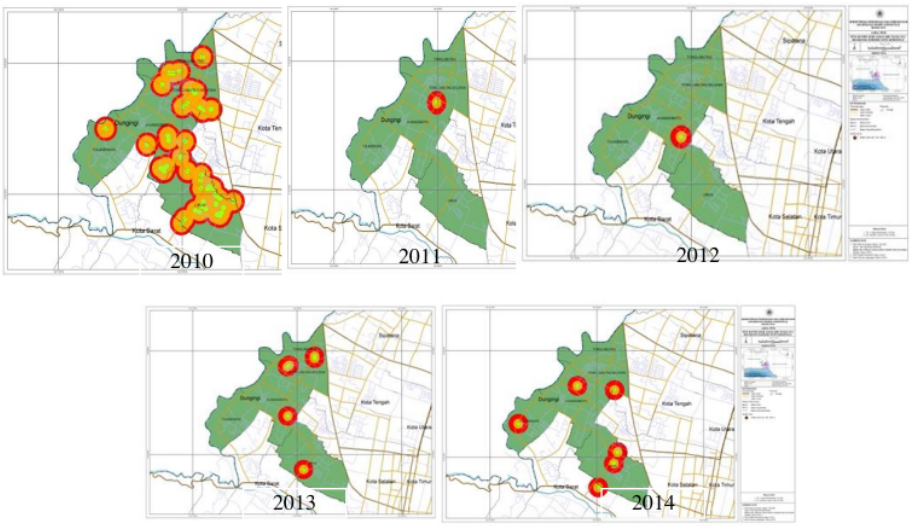

Figure 8: Buffer zone maps DHF cases in Dungingi Subdistrict in 2010-2014

DISCUSSION

Some of environmental factors that affected of dengue endemicity in Libuo Village Dungingi Subdistrict, such environmental physical factors (house density and existence container), environmental biology factors (existence of ornamental plants, yards owner, and mosquito larvae existence), environmental social factors (people's education, occupation, income, mobility, mosquito breeding places eradication). Environmental factors such as houses density would be at risk of being infect with dengue disease. Must be consider that a shortest flying distance of Aedes Mosquito which can be reached 100 meters [18].

House density was an indicator amount of container houses in a residential area, its existence is affecting the level of density of Aedes aegypti. Container is a breeding place for mosquitoes so that the population continues to increase. The existence of the container has a positive correlation with the increase in dengue cases this is according to research conducted by Nicholas Duma in 2007 [3]

Besides gonotrofik cycle, the social environment factors such perception and people's mindset have a role in spread of dengue disease in some area. Perception and mindset influenced by level of education. Based on research results by Sarwono, people with good education has a great concern to their health problems and are more likely to easy for received information and new ideas by health workers [7]. The occupation will affect to earnings, which impacted to level of public for visits to health services likes hospitals and health centers services, and affected to quality of health care their received which adjustable of their power purchasing [6]. More overs, the income factor can affect to rate of community participation for dengue control efforts [5].

Mobility factor has affected the incidence of dengue in Libuo Village, if considered its location which adjacent to main traffic lanes and center of public economic activities in Gorontalo city so that, the incidence of dengue in this village was higher than other villages in Dungingi Subdistrict. This is accordance with the opinion by Sunaryo about population mobility has facilitated the transmission of dengue disease, the usually starting from a source of transmission and then following the population traffic. The more density of traffic population, it will be possibility of its spread has been increasing [15].

Based on climate data by Indonesian Agency for Meteorological, Climatological and Geophysics, temperature average per month city of Gorontalo belonging Dungingi Subdistrict that reached 27 ° C, it was

the optimum temperature which suitable for life cycle of *Aedes aegypti* mosquito. The ranges of temperature are suitable for life cycle of *Aedes aegypti* mosquito has range 25-27 °C, when the temperature was below 10 °C and above 40 °C growth of mosquitoes will be stop [9].

Humidity average per month in Subdistrict from 2010-2014, it was up to 82% with the highest humidity was reach 84%. Humidity has influence habits of Aedes aegypti mosquito lay their eggs, for humidity below 60% would affect to life cycle of the mosquito Aedes aegypti, it has not optimized for vector for infected a virus. Transfered of virus by stomach to salivary glands required a long time, so that Aedes mosquito required an optimal humidity for supporting their role as a dengue vector [10].

The rainfall average in Dungingi Subdistrict reached 116.37 (mm). Rainfall conditions has been supporting a mosquito breeding places that rainfall has not high intensity which caused a flood. High rainfall which may damage the breeding place of Aedes aegypti. Average days of rain per month in 2010 and 2014 reached 15 times the rainfall in every month. Rain and heat alternate at the turn of the season a more positive effect on the development of mosquitoes, this is caused by inundation caused rainwater does not flow [11].

According with graph pattern of climatic factors against distribution of dengue incidence in Dungingi Subdistrict not shows an obvious pattern. Occurred a decline cases when climatic factors comprised rainfall, temperature, rainy days and humidity increases and otherwise. This results are consistent with research conducted by Dini et al., (2010) in Serang District. They said that incidence of dengue in Serang district has nothing to do with climate factors. An another possible cause of dengue incidence in Dungingi Subdistrict has more caused by social factors and kind of a programs do by community health center for eradication of dengue disease, and success levels of the programs [10].

Based on statistical test by Spearman correlation test between climatic factors comprised rainfall, rainy day, temperature, and humidity were indicated that, there was no significant relationship with the incidence of dengue in Dungingi Subdistrict. It should be affirmed that in addition to climatic factors there are other factors associated with an increase of dengue cases such of behavioral hanging clothes factors, level of community education, and the level of community awareness for a clean and healthy living behavior. The habit of hanging clothes can increase the mosquito populations that live in the house, especially that breeding on clothes were hung [14]. There is a positive relationship between the habit of hanging clothes with presence of dengue vector [12].

People's education factor has influenced to behavior of mosquito eradication [8]. Based on research that factor of drain practice and closed of water containers and bury the discarded container can affect the incidence of dengue [19]. It can be concluded that, the level of public awareness in clean and healthy life behaviors are greatly influence the spread of dengue cases.

As for dengue surveillance activities in community health centers of Dungingi,based on information was getting by researcher including; (1) recording data of suspect and DHF patients with diary book of dengue patients, (2) Processing and Presentation of Data were consisting of monitoring of DHF situation per weekly in working area of Dungingi community health center, reports of basic data of individual patient, distribution of patients with DHF per village and patients deaths by year, age group and gender and amount of DHF patients per years.

Based on this information, dengue surveillance activities in community health center of Dungingi within scope by health agency of Gorontalo city, they have not utilized of Geographic Information Systems, even thought this system has more advantage for supply attributes and spatial that can describe the distribution or spatial spread pattern of patients. The researcher's problem when collected the surveillance data on location was data of patients were not conformed with their residency, so that the distributions of dengue fever patients report based on region of Dungingi Subdistrict was less accurate.

In the era with information technology are thrive, the community health centers must be following this trend by design some surveillance systems based on information technology. A variety of information technology devices that can be used to visualize, to update, and create an infectious disease data more accurate and more up to date with the open source operating system that can be developed with oriented by wishes and needs of user.

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Geographic information systems can use for mapping the risk factor data some population had collected by surveillance activities, so it can be obtained the description of risk factors which variated in some region. The use of this technology can be improve the early warning, so that from the data gathered and visualized can be planned a program of intervention for anticipate the occurrence of dengue on context of early warning systems [13].

The Application of GIS technology into surveillance activities are conducting by community health center workers and health volunteers can be approach directly in location. For currently, gadgets technology based on Android are thrive so as the software available on it, the health workers can use this for record the locations of the sample into the form of WPT (waypoint) using *GPS essential*, WPT data attributes and locations of sample will processing by *ArcView program* for obtain the distribution of dengue fever conditions in some region.

CONCLUSION

The spread pattern of dengue incidence in Dungingi Subdistrict City of Gorontalo was no related with climatic factors (temperature, humidity, rainfall and rainy days). The length of data captured was less, and lack of data frequency of dengue incidence in community health center were affect statistical analysis results, against of climatic factors and dengue incidence. Mapping of area by community health centers of Dungingi just a stratification of endemicity that created manually, so it requires some innovation with implementing a geographic information system technology into surveillance activities in order to improve the early warning and designing a control efforts based on spatial distribution of risk factors.

Must be required for training the health workers and health cadres about surveillance activities based GIS are integrated with android operating system by using of gadget. Android is an operating system that user friendly on this programs such SIG, can be used with free. Besides the need to develop a geographic information system software of DHF are user friendly, practical and easy to operate just by using android gadget at the time of the field.

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