Spatial Pattern Analysis on Dengue Hemorrhagic Fever (DHF) Disease in Tanjung Emas Port Area using Moran Index

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Abstract—Tanjung Emas Port area is the State's entrance in Semarang City's administrative area. Data shows a significant increase of Dengue Hemorrhagic Fever (DHF) disease cases from 38 cases in 2018 to 137 cases in 2019. The objective of research was to conduct a spatial analysis using spatial autocorrelation to find out the correlation pattern between locations. A descriptive and analytical observational study of 137 coordinate points of DHF patients was carried out for mapping purpose. This research employed spatial autocorrelation with Moran's Index. Using such the method, the spatial autocorrelation of DHF spread can be determined, and so can be the spatial distribution of DHFin Tanjung Emas Port area, Semarang. Spatial autocorrelation analysis showed Moran's Index value of 0.192725 at interval of 0 < I ≤ 1 indicating positive spatial autocorrelation; Moran's index>0 indicates the Cluster spread pattern. One-way significance test showed the positive autocorrelation in Dengue hemorrhagic fever case in Tanjung Emas Port and cluster spread spatial pattern.

Keywords—Dengue Hemorrhagic Fever, Spatial Autocorrelation, Moran's Index.

I. INTRODUCTION

Dengue hemorrhagic fever (DHF) case is still fairly high in Indonesia, about 65,602 cases in 2018, with Incidence Rate (IR) of 24.73 per 100,000 Population and Case Fatality Rate (CFR) of 0.70%.[1] In Central Java province area, DHF disease is still a serious problem, as 35 regencies/cities have ever been affected by this disease, with 3,133 DHF cases.[2] Semarang City is an endemic region in Central Java Province. Data of Semarang City's Health Office shows that an extraordinary incidence has occurred on December 2018 at City level, with 27 cases. In 2018 there were 102 DHF cases (IR = 6.17) and 1 death (CFR = 0.97%).[3]Tanjung Emas Port belongs to Semarang City's administrative area as the state's entrance and national and international ship traffic. Tanjung Emas Port area consists of 2 subareas: perimeter and buffer. Buffer subarea belongs toPort Health Office (KKP) Class II of Semarang work area located in a land with 2 (two)-kilometers radius beyond the Perimeter subarea.[4]

Dengue Hemorrhagic Fever (DHF) is a disease found widely in some tropical and subtropical regions, particularly South East Asian, Central American, American and Caribbean areas. The natural host of DHF is human being, while its agent is dengue virus belonging to *Flaviridae* family and *Flavivirus* genus, consisting of 4 serotypes: Den-1, Den-2, Den-3 and Den-4. DHF is transmitted to human beings through the bite of mosquito infected, particularly *Aedesaegypti* and *Ae. Albopictus* mosquito.[5]

The control of DHF in Tanjung Emas Port area including perimeter and buffer subareas is inseparable from the activity of controlling environmental risk conducted by Port Health Office (KKP) Class II of Semarang. The objective of research is to find out whether or not there is a spatial autocorrelation and the spread pattern of dengue hemorrhagic fever (DHF) in Tanjung Emas Port area, so that the spatial information provided can be utilized as surveillance data understandable to DHF program holders. This research is expected to be basic information for program planning and decision making to policy holder in the attempt of preventing and controlling DHF cases.

Some spatial analytical studies on DHF disease have been conducted, one of which is Andri Ruliansyah's study on Spatial Analysis of Dengue Hemorrhagic Fever in Tasikmalaya city, in 2011-2015.

II. METHODS

Data of DHF case came from Semarang City's Health Office in 2019. The sample of research was total population of DHF patients in Tanjung Emas Port area, based on hospital's diagnosis. Data collection was conducted by plotting DHF patients' houses using GlobalPositioning System (GPS). The result of plotting is included into Semarang City's Basic Map on which Buffering has been conducted over 2-km Port land. The combining process aims to represent qualitative and quantitative data visually with 2-kilometer radius. Thus, spatial data of Dengue Hemorrhagic Fever disease was obtained. The spatial data provides integrated information, the location of Tanjung Emas Port area in the form of vector and attribute information constituting the number of Dengue Hemorrhagic Fever casesin each of locations. Furthermore, the calculation process was conducted using spatial statistical model to identify the autocorrelation occurring, whether it is positive or negative. Spatial data analysis was conducted using ArcGIS.GIS was used to solve problem and to give necessary understanding in using its analytical system and result.[6]

The author employed a map developing application for data processing purpose. Shapefile(shp) produced was then opened on the map developing application to be processed further. The application will edit all Shapefile to produce sign or symbol that can represent individual characters. The spatial analysis used is the spatial autocorrelation of DHF disease spread measured using spatial autocorrelation using Moran's index. The interval of Moran's index value in standardized spatial weighted matrix case is $-1 \leq I \leq 1$. Value interval of $-1 \leq I < 0$ indicatesnegative spatial autocorrelation while value interval of $0 < I \leq 1$ indicates positive spatial autocorrelation, Moran's index value of zero (0) indicates spreading. Moran's Index value of I (I) found by calculating the spatial autocorrelation can indicate the created feature pattern.[7]

Table 1. Created Feature Pattern

Moran's I	Notes
I > 0	Cluster (there are many value similarities in the feature)
I < 0	Random (unclear feature pattern)
I = 0	Spreading (high and low feature values spread in dataset)

Source: (Mitchell, 2005)

This research has passed successfully the ethical study conducted by Ethical Commission of Health Researchers, Faculty of Public Health, Diponegoro University, No: 540/EA/KEPK-FKM/2019, on November 27, 2019.

III. RESULTS

Tanjung Emas Port, in addition to serving as an economic and trading center, is also the entrance and the exit of transportation vehicles, people, and commodities at national and international scales in Central Java Province. Data of 2019 shows 381 ships from foreign countries and 11,988 ships home visiting this port.[8] Therefore, an attempt should be taken to detect, to prevent, and to respond to any diseases potentially resulting in public health emergency, including DHF disease, in Tanjung Emas Port area.

Table 2. Distribution of DHF in 2019 of Urban Village inTanjung Emas Port Area.

No	Village	DHF Case	No	Village	DHF Case
1	Bandarharjo	7	16	MuktiharjoLor	0
2	Bangun Harjo	0	17	Pandansari	1
3	Bugangan	0	18	PanggungKidul	4
4	BuluLor	1	19	PanggungLor	16
5	Dadapsari	7	20	Plombokan	1
6	Kaligawe	2	21	Purwodinatan	4
7	Kauman	0	22	Purwosari (North Semarang)	6
8	Kebonagung	1	23	Rejomulyo	2
9	Kembangsari	0	24	SawahBesar	0
10	Kemijen	15	25	Sekayu	0
11	Kranggan	0	26	Tambakrejo	4

12	Kuningan	16	27	Tanjungmas	28
13	Mlatibaru	10	28	Tawang Mas	0
14	Mlatiharjo	11	29	Tawang Sari	1
15	MuktiharjoKidul	0	30	TerboyoKulon	0
			31	TerboyoWetan	0
	Total				137

The data shown in the table above shows the list of 31 villages and the spread of DHF case (137 cases) in2-kilometer buffer of Tanjung Emas Port land.
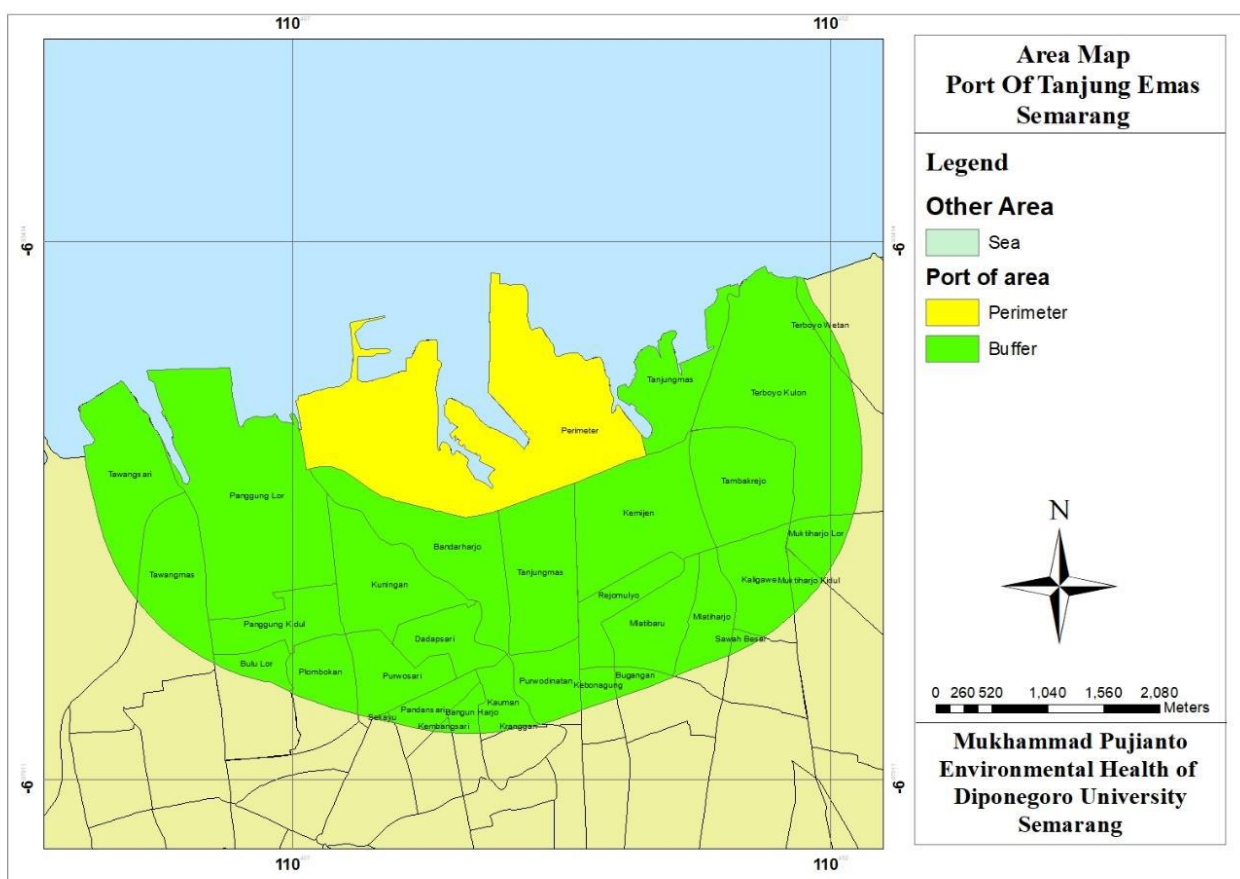
Fig.1: Map of Perimeter and Buffer Subareas in Tanjung Emas Port.
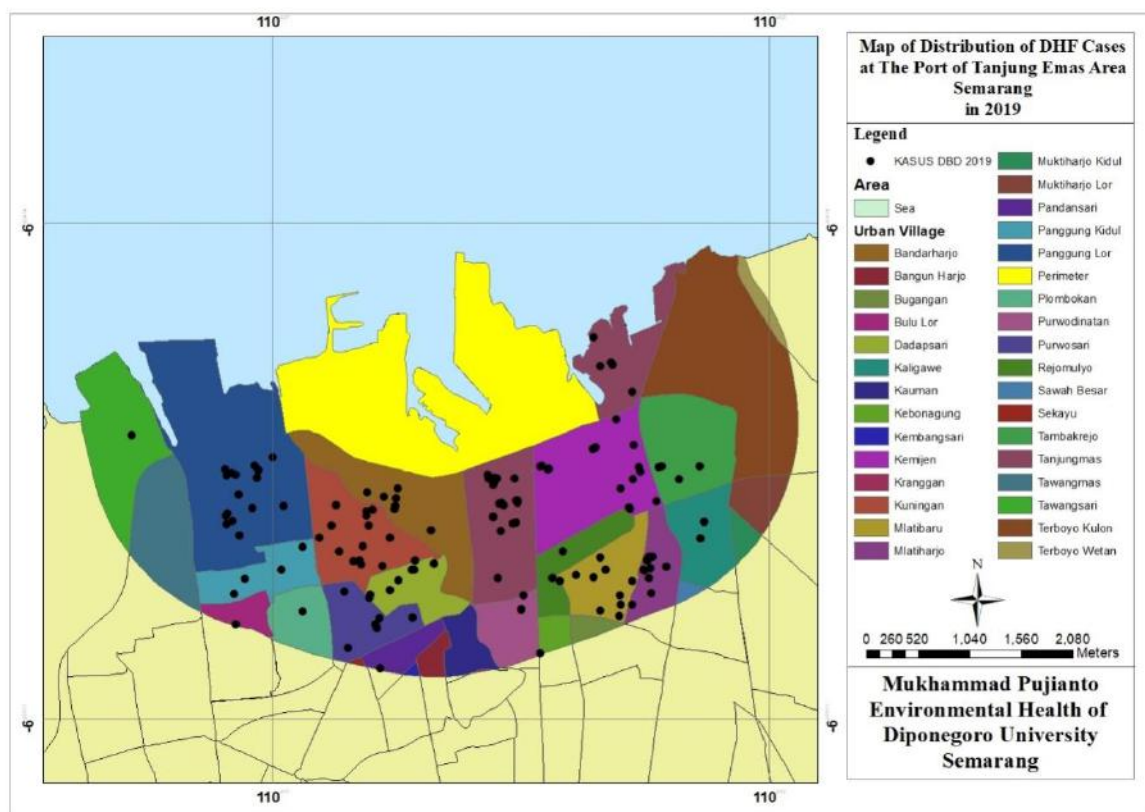
Fig.2: Distribution of DHF patients in Tanjung Emas Port area, Semarang, in 2019

Figure 1reveals the Map of Tanjung Emas Port area consisting of Perimeter and Buffer subareas. Buffer subarea includes 2-km land beyond Kilometer area, with administrative area distributed in 31 urban villages in Semarang City.
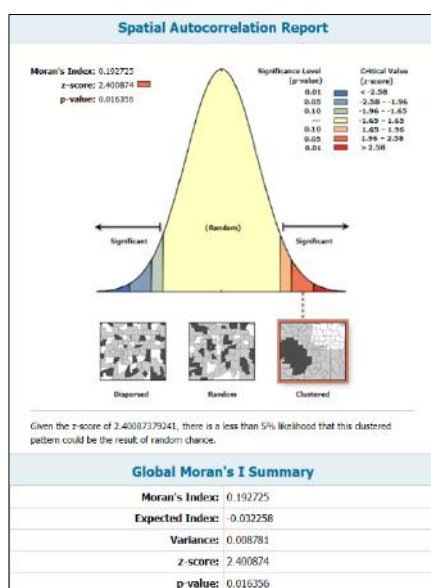

Fig.3: Result of Spatial Autocorrelation Analysis on Dengue Hemorrhagic Fever Disease in 2019

The map above shows that there are 12 Villages free of DHF case, while 29 Villages are the area with DHF cases, with Tanjung EmasUrban Village being the areas with highest number of DHF cases, 28 cases.

From the result of spatial autocorrelation analysis on Dengue Hemorrhagic Fever as shown in Figure 4, it can be obtained Moran's Index value of 0.192725 at value interval of $0 < I \leq 1$ indicating the positive spatial autocorrelation, Moran's Index value > 0 indicating Cluster spread pattern (there are many value similarities in the feature). Recalling z-score of 2,400874, there is a less than 5% probability that this cluster pattern can be random result, thereby having confidence interval of 95 %.

IV.   DISCUSSION

In this research, DHF case was obtained based on hospital's diagnosis as reported by Semarang City's Health Office. Spatial interrelationship in DHF spread is measured using spatial autocorrelation with Moran's Index, indicating the positive spatial autocorrelation in 2019. The cluster case spread pattern indicates that there is vector habitat concentration, thereby more potentially resulting in local transmission. It is in line with another study finding

that DHF spread shows positive spatial autocorrelation, with cluster case spread pattern (in group or colony); the areas where clusters are formed are the ones vulnerable to DHF disease.[9]

Still another study found that there is a significant relationship between DHF incidence and Larva Free Index (LFI), House Index (HI), Container Index (CI), and behavior. The highest risk of DHF transmission occurs in the location with unqualified LFI, HI, CI, and DHF preventing behavior. Spatial analysis revealed that risky LFI and HI, and poor practice of coping with mosquito nest increase the DHF incidence rate.[10]

Generally, the clustering of DHF incidence tends to follow the high population density and the low larva-free index (LFI). It is in line with Agcrista Permata Kusuma's study finding that the cluster pattern of DHF spread occurs in the urban villages with highest population density potentially leading to DHF transmission.[11] This current study is also in line with the research conducted by Rika Hernawati on Spatial Pattern Analysis of Dengue Hemorrhagic Fever in Bandung City using Moran's Index finding that there is a positive spatial autocorrelation. From the result of significance test with Moran's index method, it can be concluded that the spatial spread pattern created for Dengue Hemorrhagic Fever has cluster spread pattern.[12] The cluster spread pattern also occurs in Tanjung Pinang city and the result of analysis indicates that there is a relationship of H1 and RR to DHF spread pattern in Tanjung Pinang.[13]

The risk factor of environment is also closely related to the cluster spatial pattern occurring. The significant relationship also occurs in the area with high rainfall with high DHF case, while the area with high larva free index (LFI) is closely related to low DHF case, the area with high population density is related to high DHF case incidence, so that the preventive attempt can be taken by increasing LFI in each area and increasing the alertness in the areas with high population density and rainfall.[14]

Integrated Vector Management (IVM)is one of attempts taken to control DHF case. Similarly, Mursid Raharjo's study on malaria control in Purworejo found that no ecological monitoring for early warning system, poor collaboration between sectors, no cross-institutional program, and no society's culture in managing malaria are main factors leading to the ineffectiveness of IVM and the increased number of vector-transmitted disease case.[15] In addition to IVM, the reengineering of vector control is very desirable. Nanotechnology is the new form of reengineering in vector control and it has been developed. Toxicity test on nano-particle (Ag2NO3) shows that nanosilver(Ag2NO3) kills the tested animal (*Aedesaegypti* larva) more effectively.[16]

Population density factor affects transmission process or the process by which a disease moves from an individual to another. Without adequate preventive attempt, the denser the population, the more conducive is the situation to the proliferation of virus, thereby resulting in the increase in the case number. Population density needs special attention from government, in relation to human's life feasibility particularly due to unplanned and uncontrolled urbanization. For that reason, information on population distribution geographically is required to enable the government to solve the population density problem. Information on density highly affects the health interest efforts.[17]

Climate change contributes considerably to the increase and the emergence of vector with new species. It is in line with a previous study finding that weather triggers the increase of *Anopheles* species population. *Anopheles aitkenii* is identified as a new species with density of 4 species/day and is the vector of malaria transmission.[18]

Environment and behavior factor also contributes considerably to the increased number of vector-transmitted disease cases. A study conducted in Pekalongan found that environment and behavior factor contributes to filariasis case incidence.[19] Meanwhile a study conducted in Semarang Regency revealed that water reservoir containing larva and habit of applying mosquito repellent are related significantly to DHF incidence.[20] The presence of place where mosquito proliferates, the number of mosquito proliferation places, ABJ, CI, and HI are related to DHF case.[21]

Surveillance should be conducted on endemic area of DHF and other vector borne diseases for the controlling program purpose. It is in line with a studied conducted in Pekalongan City finding *Culexquinquefasciatus, Aedesaegypti,* and *Armigeressubalbatus* mosquito. The surveillance activity is intended to be an effective attempt of controlling *filariasis* and DHF in the future.[22] Bad habitat appropriate to mosquito's proliferation place and public participation can contribute considerably to the transmission of *Filariasis* and other vector borne diseases.[23]

V. CONCLUSION

The spread of Dengue Hemorrhagic Fever cases in Tanjung Emas Port area occurs in cluster, so that the surrounding areas are vulnerable to DHF disease. Spatial

analysis is recommended to be done more in DHF case endemic area periodically as it can provide basic information in the attempt of preventing and controlling DHF case.

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