

Spatial Analysis of Diarrhoea in Brebes District, Indonesia

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DOI: 10.29322/IJSRP.9.06.2019.p9076

<http://dx.doi.org/10.29322/IJSRP.9.06.2019.p9076>

Abstract- Diarrhea cases in Brebes District by the year 2016 increased more than 60% from year earlier. The objective of this study was to determine the priority intervention areas of diarrhea cases related to environmental sanitation, behavior and community access parameters based on the Brebes District Health Profile, 2016. Priority areas display spatial information in thematic maps that provides benefits, convenience and control through the output categorized into three levels of good, moderate and poor. This study uses spatial analysis methods at the sub-district level utilizing ArcView GIS 3.3 software considering the variety of topography and diverse population densities in Brebes District. The highest incidence diarrhoea (14%) is in Brebes sub-district, while the lowest (2%) is in Salem sub-District. The main priority for intervention is Larangan sub-district with poor category. The third priority is Salem sub-district with Good category, and others categorized in moderate as the second priority. Low community access over water providers aspect (<25%), moderate both in Environmental Sanitation and Healthy Lifestyle. High Community Led Total Sanitation (30.77%) applied in Salem sub-district. Promoting in healthy household, Community Led Total Sanitation, healthy hygiene habits and monitoring over drinking water provider it is expected to prevent diarrhoea in the future.

Index Terms- ArcView GIS, Diarrhoea, Priority intervention area, Spatial analysis

I. INTRODUCTION

Diarrhoea remain the second leading cause of death and morbidity in the world. Nearly 1.7 million cases of Diarrhoea occur with a total death of around 525,000 deaths every year. Diarrhoea widespread over developing countries due to several factors such as low awareness of good hygiene and sanitation, unsuitable water for consumption, lack of nutrition and poor of public health status. Almost 780 million people over the world do not have access to proper drinking water and 2.5 billion people live with poor sanitation. Another condition of Diarrhoea can lead to reduced nutrition for growth, and malnutrition conditions make a person vulnerable to disease and experiencing illness.¹

Other contributing factors to the prevalence of Diarrhoea are inadequate clean water, fecal contaminated water, lack of hygiene facilities such as latrines, lack of sewerage system, open defecation, poor environmental hygiene, poor personal hygiene and improper food preparation and storage.^{2,3,4,5} Hosts factor in human for Diarrhoea include malnutrition, immunodeficiency, breastfeeding and comorbidities.^{6,7} Direct and indirect Factors such as agent, host, environment and lifestyle factors can be a driver of Diarrhoea. Another factor that also plays a role in the prevalence of Diarrhoea in terms of sociodemographic is vocation and education level of mothers of children under five.⁸

Diarrhoea is an endemic disease that contributes to death in Indonesia. Diarrhoea morbidity rates in Indonesia tend to increase, based on diarrhea morbidity survey in 2014 there were 411 incidences per 1000 population. During 2016 diarrhoea outbreaks occurred in 3 provinces and 3 districts caused 198 cases and 6 deaths. Central Java Province contribute 56 cases and 3 deaths occurred during outbreak. Cases handling in Central Java Province showed a relatively small number (10.5%).⁹ One of the districts in Central Java is Brebes, which is categorized as a district that needs special attention, because some indicators of environmental, maternal and child health are still low.

Brebes district is the most populated district in Central Java Province. In terms of environmental achievement, coverage of villages applied community led total sanitation is very low in 8.77%, food hygiene vendor 54.36%, healthy household 53.04% and healthy hygiene habit 70.84% and healthy latrine 64.92%. In terms of maternal and child health services, Brebes is the district with the lowest ANC4+ coverage, which was 86.63 and has the highest cases of maternal deaths, which was 52 cases. In the percentage of service for children under five even Brebes district is also among the lowest, which was 26.94 percent and the number of cases of malnutrition with indicators of body weight according to the highest body height is in Brebes district, namely 92 cases. Cases of diarrhoea that handled in Brebes Regency by the year 2016 increased to 76.9% from 12.5% in 2015.^{10,11,12}

The Hendrik L. Blum concept of health paradigm stated that the lifestyle and environment plays a role as a causal factor, support, transmission media or aggravate existing diseases.¹³ Brebes District has various environmental form of topography and population density between sub-district.¹⁴ Utilization of the Geographic Information System to conduct spatial analysis provides benefits, convenience and control through the output of deployed in thematic map images. Spatial analysis of diarrhoea has not been done at the Brebes District level. Conducting analysis based on environmental conditions supported by developed system information is needed.¹⁵ The analysis goals to anticipate the incidence of diarrhoea outbreaks that have the potential to cause death. The analysis is expected to be effective in determining the necessary health handling related to diarrhoea in Brebes District. The objective of this study was to determine the priority intervention areas of diarrhea cases related to environmental sanitation, behavior and community access.

II. METHODS

This study uses quantitative descriptive method with ecological approach to analyze the association between lifestyle and environment condition in Brebes areas with the incidence of diarrhea at the whole population of the district by the year 2016. The Data source that used is secondary data of Brebes District Health Profile year 2016. The district health profile collected based on the results of the implementation of minimum services in the health sector. The district health profile contains 120 health indicators that describe the situation and condition of public health in Brebes District, including diarrhea incidence and influenced factors. The data profile published on the incidence of diarrhoea and the factors that influence the incidence has not been analyzed spatially.

Diarrhoea cases related to the percentage of people who have access to clean water, the percentage of healthy hygiene habits, the percentage of healthy household (HH), the number of villages with Community Led Total Sanitation (CLTS), the percentage of drinking water providers (DWP) that meet health requirements, the number of food processing sites (FPS), percentage of population with access to proper sanitation / healthy latrine (HL).^{2,8,16}

Diarrhoea prevalence were classified based on sub-districts while the priority areas of intervention were analyzed based on scoring and weighting on parameters like Environmental Sanitation Factors (healthy household, Community Led Total Sanitation and food processing sites), Lifestyle Factors (healthy hygiene habit) and Community Access Factors (access to clean water, access to proper sanitation / latrine and quality of drinking water provider). Algorithm for scoring and weighting through mathematical equations, the results of this equation determine where priority areas of intervention that show low, medium and high value with the formula below.

$$X = \sum_{i=1}^n (W_i \times X_i)$$

Descriptions:

X = Score of the intervention priority

W_i = Weight on parameter-i

X_i = Score on parameter-i

Analysis was carried out using Arcview GIS 3.3 software produced by ESRI (Environmental Systems Research Institute) so that it can display spatial information and create thematic maps based on obtained spatial data.³ Outputs of thematic maps that deployed by software describe priority intervention area in three categories which are good (for the lowest X value), moderate (for medium X value), and poor (for the highest X value). This study approval was granted by research ethics and community engagement committee from the University of Indonesia's Faculty of Public Health dated on May 14, 2019 No. KET-354/UN2.F10/PPM.00.02/2019

III. RESULT

Geographically, Brebes District located in the northern part of Central Java Province between 108° 41' 37,7" - 109° 11' 28,92" Long and 6° 44' 56,5" - 7° 20' 51,48" Lat, with neighbouring locations to the West Java Province and other district namely Cilacap, Tegal and Banyumas. Neighbouring location has influence as a causal factor, support, transmission media or aggravate existing diseases.¹³ Diarrhoea outbreak in 2016 occurred in Tegal district that neighbouring with sub-Districts namely Jatibarang, Songgom, Brebes, Tonjong Sirampog, Paguyangan and Larangan. Brebes District population was 1,788,880 people, Calculated with 1,663.39 km² wide area, the average population density in Brebes District is 1,075.72 people for every square kilometre, meant density is very high population according to UU No. 56/PRP/1960 and the density of inhabitants with close contact between people are potential for rapid spread of communicable disease.^{17,18} The furthest north-south distance is 58 km and east-west are 50 km. There are 292 villages (98.32%) spread in 17 sub-Districts and there are only 5 sub urban villages (1.68%). The condition of the Brebes District area is 87.54% categorized as rural areas, while the population of Brebes District is the largest percentage of the population living in urban areas. Based on the topography, the area is divided into 3 parts, namely coastal areas, lowlands and highlands. The north is a flat coastal area, the middle area is a lowland to hills and the south is a mountainous area.^{19,20}

Health facilities in Brebes District consist of 9 Hospitals, 38 Public Health Centre "Puskesmas" in 17 sub-Districts, 22 of them are inpatient facility and has 60 satellite health centers "Puskesmas Pembantu". Mobile health centers consist of 56 units with PKD (Village Health Post) as many as 236 units. The number of Clinics (primary and specialist) is 23 units and GP are 70 units.¹⁰

The prevalence of Diarrhoea treated in Brebes District in 2016 was 48028 cases. High category area in prevalence of diarrhoea consist of 6 sub-Districts (Bantarkawung, Ketanggungan, Songgom, Jatibarang, Brebes and Larangan) but the highest cases were in Brebes sub-District as many as 6506 cases (14%). While low category in prevalence if diarrhoea consist of 4 sub-Districts (Sirampog, Tonjong, Kersana and Salem) and the lowest cases were in Salem Sub-District as many as 978 cases (2%). The average case in that year was 2825 cases (5.8%). (Table 1)

Table 1. Characteristic of Brebes District by the year 2016.

Sub-Districts	Total Area (Km ²)	Population	Population Density	Cases of Diarrhoea	Percent
Salem	152.09	59 706	393	978	2%
Bantarkawung	205.00	89 158	435	3 942	8%
Bumiayu	73.69	97 980	1 330	2 420	5%
Paguyangan	104.94	100 454	957	1 926	4%
Sirampog	67.03	63 982	955	999	2%
Tonjong	81.26	66 437	818	1 306	3%
Jatibarang	35.18	85 949	2 443	3 782	8%
Larangan	164.68	139 771	849	4 526	9%
Ketanggungan	149.07	137 573	923	5 091	11%
Banjarharjo	140.26	121 574	967	2 234	5%
Losari	89.43	122 581	1371	2 186	5%
Tanjung	67.74	95 819	1415	1 979	4%
Kersana	25.23	59 027	2 340	1 120	2%
Bulakamba	102.93	169 542	1 647	2 733	6%
Wanasari	74.44	149 644	2 101	2 532	5%
Brebes	80.96	160 050	1 977	6 506	14%
Songgom	49.03	69 633	1 420	3 768	8%
Total	1 662.96	1 788 880	1 076	48 028	100%

Source: Brebes District Health Profile year 2016; BPS Statistic of Brebes District year 2016

The environmental sanitation shows that most of area in Brebes District are moderate category (15 sub-Districts). The sub-District with good category in environmental sanitation is Salem. While the sub-District with poor category in environmental sanitation is Banjarharjo. (figure 1)

Areas with high category in lifestyle factors (77.13 - 99.09%) are in 7 sub-Districts namely Tanjung, Banjarharjo, Salem, Bantarkawung, Bumiayu, Sirampog and Ketanggungan. Whereas the percentage are low (35.89 - 55.89%) located in 4 sub-Districts namely Losari, Songgom, Larangan and Tonjong Sub-Districts. The other 6 sub-Districts, namely Brebes, Kersana, Bulakamba, Jatibarang and Paguyangan are moderate (55.89 - 77.13%). (Figure 2)

Most area (11 sub-Districts) in Brebes District have moderate category in community access like access to clean water, healthy latrines and drinking water provider that meets health requirements. Only Songgom sub-District having good category access with 100% coverage on three aspects above. Areas with poor categories for access consist of 5 sub-Districts namely Jatibarang, Bumiayu, Wanasari, Paguyangan, and Larangan. (Figure 3)

The main priority area for intervention is Larangan Sub-District with poor category. The third priority area is Salem Sub-District with good category, and other are included in the second priority with moderate category consist of 15 sub-Districts (Bulakamba, Brebes, Wanasari, Jatibarang, Losari, Tanjung, Kersana, Songgom, Banjarmajo, Ketanggungan, Tonjong, Bantarkawung, Bumiayu, Sirampog, Paguyangan). (Figure 4).

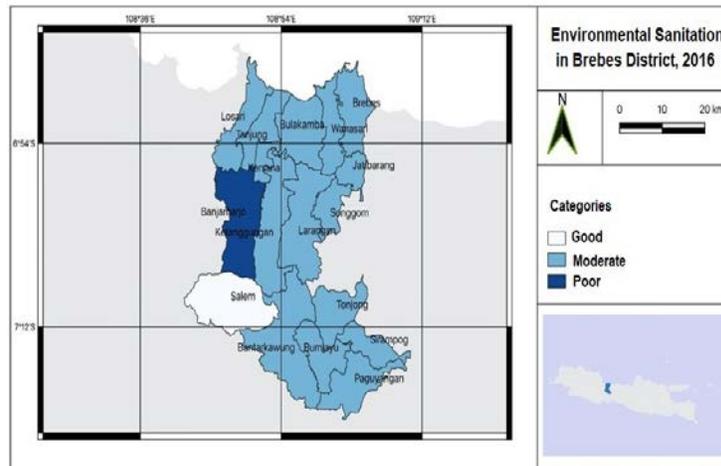


Figure 1. Environmental Sanitation in Brebes District by the year 2016

Description:

Good : healthy household (%) > 62; CLTS (%) > 28; FPA (%) > 55

Moderate : 51 > healthy household (%) < 62; 7 > CLTS (%) < 28; 33 > FPA (%) < 55

Poor : healthy household (%) < 51; CLTS (%) < 7; FPA (%) < 33

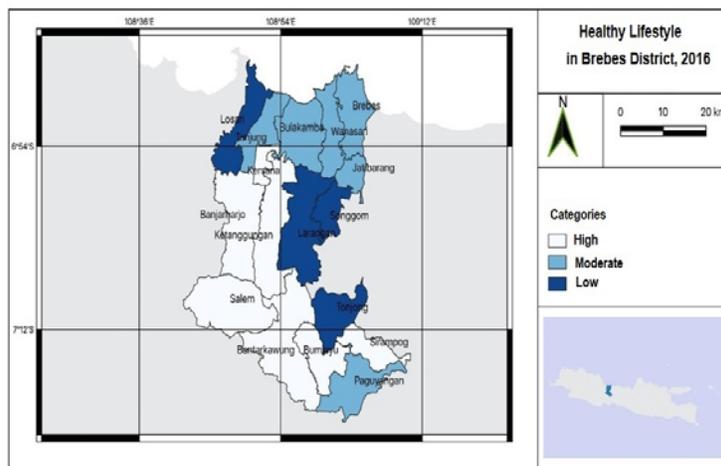


Figure 2. Healthy Lifestyle in Brebes District by the year 2016

Description:

High : 77.13 - 99.09 %; Moderate: 55.89 - 77.13 %; Low: 35.89 - 55.89 %

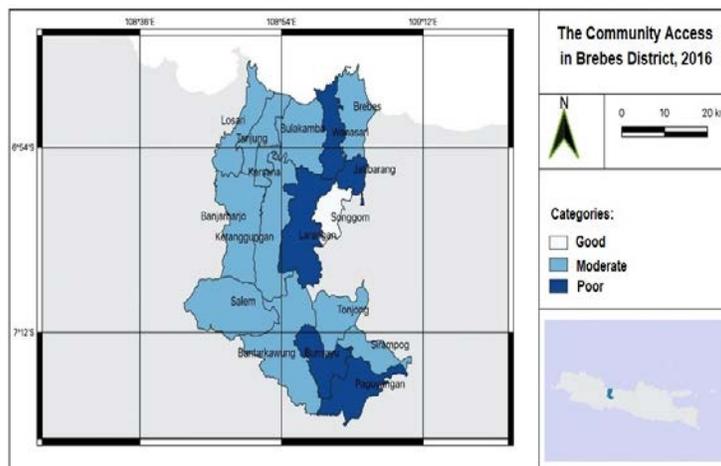


Figure 3. The community access in Brebes District by the year 2016

Descriptions:

Good : CW (%) > 79.82; HL (%) > 69.33; DWP (%) > 77.78

Moderate : 67.21 > CW (%) < 79.82; 69.33 > HL (%) < 51.59; 77.78 > DWP (%) < 25

Poor : CW (%) < 67.21; HL (%) < 51.59; DWP (%) < 25

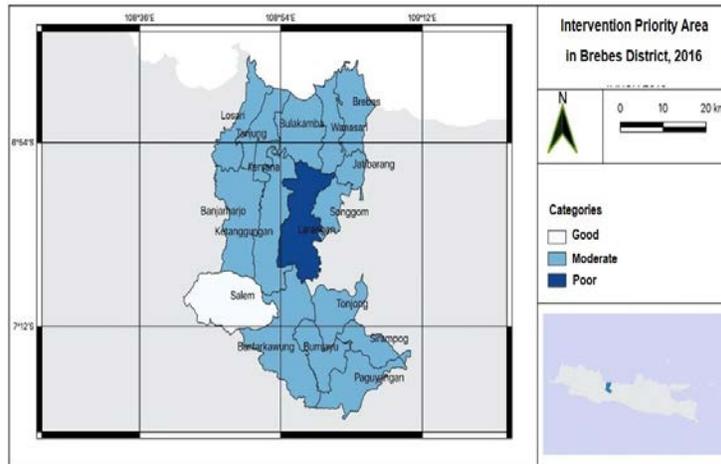


Figure 4. Intervention Priority in Brebes District by the year 2016

IV. DISCUSSION

Based on analysis, spatially the highest score of the intervention priority disclosed that Larangan Sub-District as the main priority for the intervention of diarrhoea prevalence. Larangan Sub-District has a very high density population (849 per Km²) and included in 8 sub-Districts with high category of diarrhoea cases. Environmental sanitation and healthy lifestyle factors are categorized in moderate, and community access factors is the lowest between other 16 sub-Districts. The lowest aspect in community access factor is the percentage of drinking water providers (DWP) that meet health requirements <25% in Larangan Sub-District. Former study in Semarang stated that there was no significant relationship between bacteriological quality of clean water and the incidence of diarrhoea but its conclusion nearly similar with study in Manado that stated about increase in regional vulnerability to the incidence of diarrhoea caused by the quality of drinking water that does not meet the requirements, disposal facility and sewerage system.^{3,4}

The lowest prevalence of Diarrhoea in Salem Sub-District as many as 978 cases (2%), influenced by environmental sanitation, healthy lifestyle, and community access which have good categories. Salem population density categorized in high density (393 Km²), compared to another sub-District, it was the lowest. Salem Sub-District became the third priority area for intervention in Diarrhoea prevalence. It has supporting data by high coverage of healthy household (62.29%), high percentage of healthy hygiene habits (99.09%) and achieving the highest number of villages applied Community Led Total Sanitation (30.77%) compared to other 16 sub-Districts. Earlier study in district of Tegal, Tangerang, Yogyakarta and Kutai Kertanegara stated similar sound of significant association between community led total sanitation and healthy hygiene habits with the incidence of diarrhoea. It also had dominant aspect in reducing vulnerability to diarrhoea in the aspect of stopping open defecation free, promoting hand washing with soap, personal hygiene, and hygiene level.^{2,3,21,22,23,24}

V. CONCLUSION

Spatially the main priority area for intervention related diarrhoea was Larangan Sub-District. The most relevance aspect to suppress the incidence of Diarrhoea in Brebes District is intervention by promoting coverage of healthy household, conducting villages applied with Community Led Total Sanitation, coverage of family with Health Hygiene Habit and control over drinking water providers that meets health requirements.

VI. RECOMMENDATION

This study suggests that intervention in diarrhoea prevention should be location-specific, while considering spatial variation and the neighboring locations. Few areas identified in moderate category for interventions priority need to get further health guidelines and triggers to improve health over community and become a neighboring support to other sub-District.

ACKNOWLEDGMENT

We are grateful to Ministry of Health of Indonesia for study funding. Thank you very much to Ginoga Veridona, Maula Ismail Mohammad for GIS material guidance, support and assistance

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<http://dx.doi.org/10.29322/IJSRP.X.X.2018.pXXXX>

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