Spatial distribution of Infectious Disease Epidemic in The Soppeng Regency, 2016-2018

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Abstract. Diarrhea, typhoid fever and dengue hemorrhagic fever (DHF) are environmental-based infectious diseases that contribute to the mortality rate of humans. This paper investigates the spatial distribution and the infectious disease epidemic that occurs based on environmental factors. The three primary diseases analyzed were diarrhea, typhoid fever, and dengue hemorrhagic fever. We abstracted data from several sources, including administrative maps, Regional Spatial Planning, BAPPEDA Soppeng Regency, the Central Statistics Agency (BPS), Public Health Centre, RBI Maps, and National DEM. The tool used in this research is a computer equipped with ArcGIS. The analysis documented that the trend of the three primary diseases did not represent a consistent decline in three consecutive years and even increased in certain sub-districts. Spatial data shows that the spread of infectious diseases based on the incidence rate is still dominated at low levels, although medium and high IR categories are also found in several areas in The Soppeng district. This paper proposes information for local government to implement health development planning and programs, particularly preventing and treating infectious diseases in Soppeng District.

1. Introduction
Attention to infectious diseases is increasing day by day due to the increasing frequency of occurrence in the community. Of the various environmental-based infectious diseases, diarrhea, typhoid fever and dengue hemorrhagic fever (DHF) humans’the leading causes of death [1]. WHO (2005) defines "disease" to mean the presence of a medical condition disorder, regardless of origin or source, which has the potential to cause or can cause significant harm to humans [2]. At the same time, the epidemic refers to an increase in the number of certain infectious diseases cases that exceed what is reasonable in a population at risk [3]. The Sustainability Development Goals (SDGs) have set ambitious targets to control and eliminate epidemics of infectious diseases by 2030 to ensure healthy lives and promote well-being for all at all ages. Communities and governments focus on the threat of epidemics of infectious diseases because they can affect the existence of public health on a scale that will further disrupt global health security and people's livelihoods, beyond their impact on human health. [4]. Indonesia is one of the developing countries with the potential to be affected by the possibility of the spread of infectious diseases that are emerging and spread on a local, national and international scale. [5].
The importance of knowledge about infectious diseases is motivated by the increasing tendency of infectious diseases in society, especially the people of Indonesia [6]. The Indonesian nation, which is currently building itself from a developing agrarian country to an industrial society, brings a new trend in societal ills—Changes community structure, especially Indonesian society [7]. The Indonesian nation, which is currently building itself from a developing agrarian country to an industrial society, brings a new trend in disease patterns in society. Changes in the structural pattern of an agrarian society to an industrial society have contributed to changes in community management, forest and land management, demands for socio-economic needs and environmental exploitation, which can spur the increase in infectious diseases [8]. As an autonomous region, the Soppeng Regency Government is required to improve health, identify community diseases, and plan supporting infrastructure for prevention, health improvement and community development in general. To provide an essential document to describe the distribution of communicable diseases in Soppeng District, we propose the spatial distribution of epidemics of three major infectious diseases, including diarrhea, typhoid, and DHF. The spatial distribution results will produce a comprehensive compilation of data on infectious disease epidemics based on trends and spatial distribution of incidence rates [9]. The advantage of this method is that the information is spatially summarized by village and is a summary for the 2016–2018 period, which was not previously available. The study aims to investigate the spatial distribution and of the infectious disease epidemic that occurs based on environmental factors.

2. Method

2.1. Study location

Soppeng Regency is one of the 24 regencies/cities in South Sulawesi Province, whose capital is Watansoppeng. Bone Regency borders Soppeng to the south, and east, Barru Regency to the west, Sidrap Regency to the north and Wajo Regency to the north and east. Located at 4°6'00” to 4°32'00” South Latitude and 119°47'18” to 120°06'13” East Longitude. Soppeng area has an area of about 1,500 km² with an altitude between 5 to 1500 meters above sea level. Soppeng Regency is an area of land and hills, with a land area of 700 km² located at a mean altitude of approximately 60 m above sea level and hills with a range of 800 km², average altitude of 200 m above sea level. Soppeng Regency is divided into eight sub-districts, 21 sub-districts, 49 villages, 39 neighborhoods, 124 hamlets, 438 hamlets, and 1,163 Neighborhoods [9].

2.2. Types, source, and techniques of data collection

The data used in this study are secondary data obtained from related agencies. Secondary data consists of administrative maps, Regional Spatial Planning (RTRW) maps obtained from BAPPEDA Soppeng Regency, District Data in Figures in 2016-2018 obtained from the Central Statistics Agency (BPS), data on the number of infectious disease events in 2016-2018 from Public Health Centre (Puskesmas) spread over Soppeng Regency, RBI Maps and National DEM Images were obtained from the Geospatial Information Agency (BIG). The tool used in this research is a computer equipped with mapping software, SPSS ver. 21.0 and Microsoft Office.

2.3. Data analysis

Incidence rate (IR) is calculated based on the number of residents and the incidence of disease in residents in each village [11]. The annual IR calculation is by the formula:

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\text{Incidence rate (IR)} = \frac{\text{Total number of new case of specific disease during a given time period}}{\text{Total population at risk during the same time period}} \times 10,000
\]
3. Results and discussion

3.1. Trend of infectious disease

One of the characteristics of infectious diseases is a change in the trend of cases which is generally influenced by the characteristics of the individual as the host, the time of occurrence of the disease and the presence of the physical environment in which the disease develops [12]. The results of observations made in Soppeng Regency showed different trends in nine major infectious diseases.

Based on trends in the three environmental-based diseases, there are differences in the number of cases by year and sub-district. The highest diarrhea case was in the Lilirilau sub-district, especially in 2016, although it decreased in 2017 and increased in 2018. At the same time, the lowest diarrhea case occurred in Donri-donri sub-district as the capital city of Soppeng district, with a decreasing trend of cases in 2016-2018. The highest typhoid fever cases occurred in the Marioriwawo sub-district, which peaked in 2016 and decreased in 2017 and 2018 (238, 169, and 137, respectively). Meanwhile, the most DHF cases were found in Lalabata sub-district, with the highest incidence occurring in 2016, then gradually decreasing in 2017 and increasing in 2018 (158, 11, and 24, respectively. A detailed explanation is presented in Figure 1.

![Figure 1. Trends of infectious diseases in Soppeng Regency by 2016-2018.](image)

3.2. Spatial distribution of infectious disease

3.2.1. Diarrhea

The incidence of diarrheal disease is spread in several sub-districts in Soppeng Regency. Diarrhea is divided into three categories, namely high, medium, and low, with an interval of 655-981 per 10,000 people (high category), 328-654 per 10,000 people (medium category), 0-327 per 10,000 people (low category). The incidence of diarrheal disease with a high category was found in the village of Enrekeng. The incidence of diarrheal disease with a moderate category was found in the villages of Kessing, Leworeng, Tottong, Ganra, Barang, Respectively, Parenring, Paroto Tetewatu, Panincong, Patampanua, Bila, Galung, Macanre, Ujung, Kaca, Limpomajang, Manorang Salo, Labessi, Tettikenrae. At the same time, other villages are included in the incidence of diarrheal disease with a low category (Figure 2).

As a food borne disease, the high IR of diarrheal disease in an area is influenced by the consumption of water contaminated by human waste [13]. Sources of pollution may come from wastewater, septic tanks and cases, and possibly animal waste [14]. Infections are more common when the area lacks adequate sanitation and hygiene and clean water for drinking, cooking and cleaning. Poor sanitation and hygiene conditions as well as low access to clean water supply for daily household needs contribute to the occurrence of infections in at-risk groups. In addition, the habit of storing food in unclean and
unhygienic conditions is the main cause of diarrhea cases, especially in children [15]. The process of managing household waste that is not healthy becomes a risk for the development of infectious diseases. Consumption of fish and seafood from polluted water also causes health problems.

![Figure 2. Spatial distribution of the incidence rate of diarrhea in Soppeng.](image)

It is generally known that diarrhea is the primary cause of malnutrition and if not treated, it will cause chronic disease in children [16]. WHO reports that approximately 2.5 billion people do not have access to proper sanitation and around 780 million do not have access to safe and healthy drinking water [17], which contributes to high cases of diarrhea, especially in poor areas. In general, for people living in developing countries, children under three years experience an average of three episodes of diarrhea each year. Each episode deprives the child of the nutrients necessary for growth. As a result, diarrhea is a significant cause of malnutrition, and malnourished children are more likely to fall ill with diarrhea [18].

Research has proved that children living in poor areas have an opportunity to get one to three episodes of diarrhea annually, with an incidence rate of up to 10 per year. [19]. In developing countries, the mortality rate in children aged five years reached 20-25 percent in the decade of the 1900s. [20]. For this reason, an effective intervention is needed, including appropriate case management in cases of diarrhea, typhoid, and DHF in risk areas. The involvement of stakeholders and the community in handling cases must be considered by the implementers of the infectious disease control program in the affected area.

3.2.2. Typhoid
The incidence of typhoid disease was found in 70 villages in Soppeng Regency. The grouping of the incidence of Typhoid disease is divided into three categories, namely high, medium, and low, with an interval of 64-94 per 10,000 people (high category), 32-63 per 10,000 people (medium category), and 0-31 per 10,000 people (moderate category). The incidence of typhoid disease with a high category was found in Arang, Gattareng, Gattareng Toa, Marioriaja, Watu, Batu-Batu village, Limpomajang, Manorang Salo. Furthermore, the incidence of typhoid disease in the moderate category was found in Jampu, Congko, Soga, Watu Toa, Galung Village, Cabenge, Macanre, Pajalesang, Labessi, Tettikenrae
villages. At the same time, other villages are included in the incidence of Typhoid disease with a low category (Figure 3).

Figure 3. Spatial distribution of the incidence rate of typhoid in Soppeng.

3.2.3. Dengue hemorrhagic fever

Figure 4. Spatial distribution of the incidence rate of DHF in Soppeng.
Figure 4 shows the incidence of dengue fever in 70 villages in the Soppeng Regency. The grouping of the incidence of DHF is divided into three categories, namely high, medium, and low, with disease incidence intervals of 19-27 per 10,000 people (high category), 10-18 per 10,000 people (moderate category), and 0-9 per 10,000 people (category). The incidence of dengue disease with a high category is found in the villages of Bila and Pajalesang. Furthermore, the incidence of DHF in the moderate category was found in Kampiri, Kessing, Leworeng, Ganra, Lompulle, Maccile, Boto Village, Lalabatarilau, Lapajung, Lemba, Galung, Pattojo, Parenring, Tetewatu, Canbenge. While other villages are included in the incidence of DHF with a low category (Figure 4).

4. Conclusion
Infectious diseases are a significant health problem in almost all parts of Indonesia as a developing country, including the Soppeng Regency. Attention to infectious diseases is increasing day by day due to the relatively high incidence and mortality in a short period. Infectious diseases are generally acute and attack all levels of society. Infectious diseases are a priority given their nature which can cause and incur huge losses. In general, the trend of infectious diseases in diarrheal diseases, typhoid fever and DHF did not show a consistent decline from year to year, and there was a gradual increase in the observed sub-districts. Spatial data shows that the spread of infectious diseases based on the incidence rate is still dominated at low levels, although medium and high IR categories are also found in several areas in the Soppeng district. The spread of communicable diseases and prevention of non-communicable diseases need serious attention from the Soppeng Regency government (Health Department) and the community to improve public health status. This paper results from a survey and mapping of infectious diseases in the Soppeng Regency as an essential part of the health development process. Although decreasing in all types of diseases in all sub-districts, infectious disease cases are feared not to be a real decline but due to inaccurate reports and need an active case tracking system (active case finding). The Health Office of Soppeng must consistently develop and implement health system policies, governance and regulation, health research, human resource development, health education and training.

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