International Journal of Multidisciplinary Approach Research and Science
E-ISSN 2987-226X P-ISSN 2988-0076
Volume 1 Issue 03, September 2023, Pp. 419-428
DOI: https://doi.org/10.59653/ijmars.v1i03.198

Role of Geographers in the Analysis and Modeling of the Spread of Communicable Diseases (Malaria & COVID-19) in Ambon City: A Spatial Approach for Epidemiological Analysis

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Received: 29-08-2023 *Reviewed: 01-09-2023* *Accepted: 11-09-2023*

Abstract

This study explores the role of geographers in analyzing the distribution of infectious diseases (malaria and COVID-19) in Ambon City with a spatial approach in epidemiological analysis. The method used in this review is a comparative descriptive study with a qualitative approach using secondary data from relevant sources. This research will review the role of geographers in analyzing and modeling the distribution of infectious diseases (malaria & COVID-19) in Ambon City from previous research. This research integrates geographic and health data to understand the pattern of spread and environmental factors that influence disease. Through case mapping, environmental factor analysis, and modeling of future trends, this research illustrates the important contribution of geographers in infectious disease control and prevention efforts at the local level. Interdisciplinary collaboration plays a key role in this approach, which ultimately supports more informed and effective decision-making in addressing these health challenges.

Keywords: Ambon, COVID-19, Geographers, Malaria

Introduction

Infectious diseases have long been a serious threat to human health, and in recent decades, the spread of diseases such as Malaria and COVID-19 has further underscored the urgency of deeply understanding the dynamics of disease distribution in a geographic context. Ambon City, as one of Indonesia's urban centers located in the tropics, faces a high risk of spreading infectious diseases (Haryanto, 2020). Malaria, for example, is still a public health problem in tropical areas including Indonesia. Meanwhile, COVID-19, which was first reported at the end of 2019, has triggered a global pandemic and shows the need for new approaches in analyzing and understanding the distribution patterns of infectious diseases (Abdullah, 2020)

In dealing with this serious problem, the role of geographers becomes increasingly important. Geography as a scientific discipline plays a crucial role in unraveling the complexity of infectious disease distribution, as the physical, social and human behavioral environments have a significant impact on disease spread (Sambodo et al., 2021). In the context of Ambon City, a number of geographical factors such as rainfall, topography and land use can affect the population of disease vectors such as Anopheles mosquitoes, which transmit malaria (Mulyawati et al., 2021). In terms of Covid-19, an understanding of population mobility patterns and population density are also important factors in analyzing virus distribution (Harding et al., 2022).

The spatial approach in epidemiological analysis provides a holistic approach to understanding the complex interactions between humans and their environment (Martin, 2022). Geographers use tools such as Geographic Information Systems (GIS) to map and visualize disease distribution patterns. With the help of this technology, the distribution patterns of diseases such as malaria and COVID-19 can be interpreted more accurately, which in turn will help health experts and policy makers formulate more effective prevention and control strategies (Franch-Pardo et al., 2020). Moreover, the role of geographers is not only limited to spatial analysis, but also to disease distribution modeling (Ishak et al., 2021). Mathematical and computational models allow geographers to anticipate changes in disease distribution patterns based on various scenarios (Jumadi et al., 2022). In pandemic situations such as Covid-19, this modeling can provide insights into the potential impact of certain policy measures, such as social distancing or mass vaccination.

In a longer time frame, climate change can also affect the spread of infectious diseases in the Ambon City area (Misslin et al., 2016). Previous studies on the use of GIS in the health sector in analyzing and modeling the distribution of infectious diseases (Malaria & COVID-19) have been conducted in Ambon City by Salakory et al., (2013), namely on the use of remote sensing and GIS technology to control the population dynamics of soil transmitted helminths in endemic land units of Ambon Island, and Rakuasa et al., (2021), have conducted research on, analyzing the spatial distribution of the incidence rate of COVID-19 cases with the kernel density method in Ambon City, this certainly shows that a geographer has an important role in understanding how climate change can affect the distribution of disease vectors and overall disease distribution patterns.

This can provide important insights for adaptation and mitigation efforts in the face of future infectious disease threats. By combining spatial data, statistical analysis, and disease mapping models, geographers can help identify disease clusters and high-risk areas in Ambon City. This information can be used by health authorities to direct prevention and intervention efforts more effectively. In addition, engaging communities in understanding the distribution of diseases and prevention measures is also an important aspect that geographers can carry out. The role of geographers in analyzing and modeling the distribution of infectious diseases such as malaria and COVID-19 in Ambon City is very important. The spatial approach and utilization of geospatial technology not only help to better describe disease distribution patterns, but also provide guidance for future disease prevention and control policies. By understanding the linkages between the environment and human health, geographers can make a significant

contribution to efforts to maintain the health of the people of Ambon City and overcome the challenges faced by infectious diseases. Based on the description above, this study aims to determine the role of geographers in analyzing and modeling the distribution of infectious diseases (malaria & COVID-19) in Ambon City.

Literature Review

Health Geography is a field of study that examines the relationship between geographical, physical environmental, social, and economic factors and the health of people and populations (Hazen & Anthamatten, 2019). In Health Geography, researchers and professionals seek to understand how geographic factors such as geographic location, climate, topography, natural environment, as well as social and economic factors such as income levels, access to health services, settlement patterns, and people's lifestyles can influence health and disease (Martin, 2022). The main goal of Health Geography is to identify spatial patterns of disease, health risk factors, and other determinants of health, so that the information can be used to develop more effective interventions in health (Franch-Pardo et al., 2020). For example, research in Health Geography can help identify areas with higher rates of certain diseases, so that resources can be allocated more effectively for prevention and treatment.

In addition, Health Geography can also contribute to health policy planning, health infrastructure development, infectious disease distribution analysis, studies on the accessibility of health services, and a deeper understanding of how the physical environment can affect human health (Planey et al., 2022). In other words, Health Geography tries to combine knowledge about geography with information about human health to gain a better understanding of how environmental and locational factors contribute to health and disease (Arden & Leitner, 2008).

Spatial Approach to Epidemiological Analysis is an approach that uses spatial information (related to geographic location) to understand and analyze the spread of disease and its influencing factors in a population (Eriksson, 2011). It combines disease data with spatial information to identify geographic patterns in disease spread, understand risk factors associated with specific locations, and develop more effective prevention and control strategies (Arden & Leitner, 2008).

Research Method

The method used in this review is a comparative descriptive study with a qualitative approach using secondary data from relevant sources, such as articles (national and international), news portals, and related institutions. This research will review the role of geographers in analyzing and modeling the distribution of infectious diseases (malaria & COVID-19) in Ambon City from research previously conducted by Salakory et al., (2013), with the title of research on the use of remote sensing technology and GIS to control the dynamics of Soil Transmitted Helminths populations in endemic land units on Ambon Island, and Rakuasa et al., (2021), on,

analyzing the spatial distribution of the incidence rate of COVID-19 cases with the kernel density method in Ambon City.

Results and Discussion

1. The Role of Geographers in the Analysis and Modeling of Malaria Disease Distribution in Ambon City

Infectious diseases such as malaria are global health problems that require a comprehensive approach in their analysis and control (Rejeki et al., 2022). In the context of Ambon City, the role of geographers is crucial to understanding and addressing the spread of this disease. The spatial approach to epidemiological analysis, which combines geographic and medical information, allows researchers to look beyond disease case data (Planey et al., 2022). First, geographers play a role in mapping the distribution of malaria cases in Ambon City. Using geographic mapping technology, they can produce maps that illustrate the pattern of disease spread in the region. Second, geographers can analyze the environmental factors that influence the spread of malaria. Through the integration of spatial data such as rainfall, temperature, vegetation and topography, they can identify areas that are vulnerable to malaria transmission. This information is important in designing more effective prevention and control strategies.

Furthermore, geographers can also play a role in modeling the future distribution of malaria based on environmental and demographic changes. Using spatial modeling techniques, they can predict how the spread of malaria might change over the long term and how certain interventions might influence those trends. Finally, collaboration between geographers, epidemiologists and medical personnel is essential in malaria disease management. By involving multiple disciplines, a spatial approach to epidemiological analysis can yield deeper insights into the dynamics of disease spread and provide the basis for more effective health policies in Ambon City. Previously Salakory et al., (2013), have conducted research on the use of remote sensing and GIS technology to control the dynamics of Soil Transmitted Helminths Population in endemic land units of Ambon Island.

Research conducted by Salakory et al. (2013) aimed to investigate the use of remote sensing technology and Geographic Information Systems (GIS) in controlling the population dynamics of Soil Transmitted Helminths (STH) in endemic land units on Ambon Island. STH is a type of parasitic worm that can infect humans through contact with contaminated soil. This research focuses on Ambon Island as the study site and utilizes remote sensing technology to obtain satellite image-based data. This data was then combined with GIS data that included information on the environment, topography and other factors relevant to the spread of STH. This method allows researchers to identify STH distribution patterns and the environmental factors that influence them.

The results of this study show that remote sensing and GIS technology can be useful tools in understanding STH population dynamics on Ambon Island. By mapping the environment and correlating it with STH infection incidence data, this study revealed correlations between environmental factors and parasite distribution. This provides better insight into areas that have a high risk of infection and allows for more targeted control efforts. This study implies that the

integration of remote sensing and GIS technologies can be an effective tool in monitoring and controlling infectious diseases such as STH. The use of these technologies provides a more holistic approach in the understanding of environmental factors that influence the spread of parasites, which in turn can assist in planning more effective interventions in reducing the risk of STH infection in Ambon Island. Map Distribution of soil transmitted helminths infection risk classes in rural residents of Ambon Island by land unit can be seen in Figure 1.

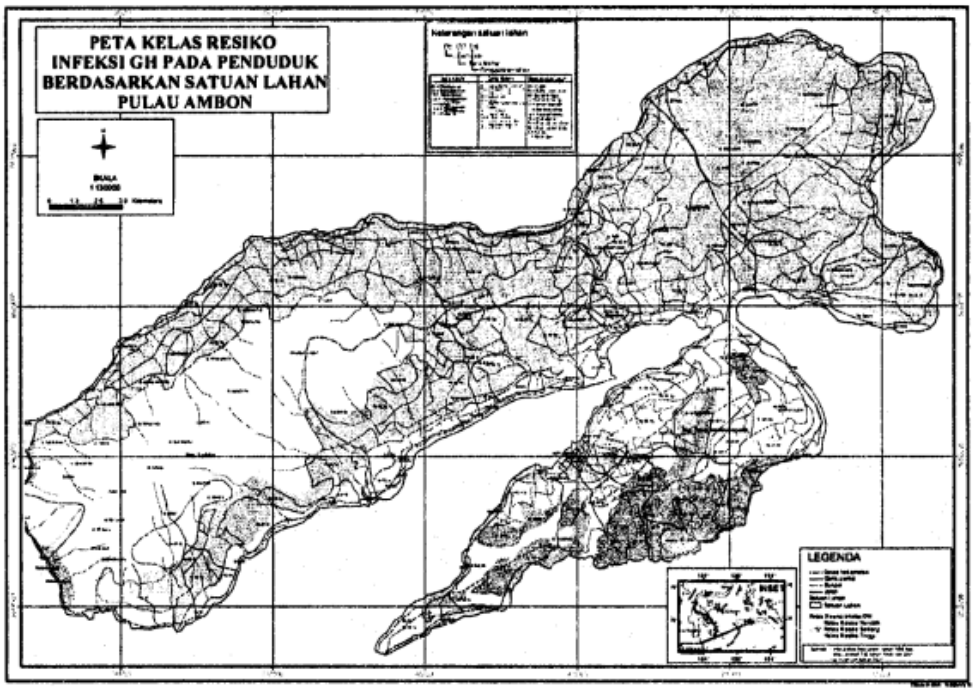

Figure 1. Map of the distribution of soil-transmitted helminths infection risk classes to the rural population of Ambon Island by land unit
Source: (Salakory et al. (2013)

Research conducted by Salakory et al. (2013) highlights the important role of geographers in disease distribution analysis and modeling. Although this study focused more on Soil Transmitted Helminths (STH) diseases and the use of remote sensing technology and Geographic Information Systems (GIS), some relevant aspects can be related to the role of geographers in analyzing malaria disease distribution in Ambon City.

1. Mapping and Spatial Analysis: In Salakory et al.'s study, geographers used remote sensing and GIS technology to map the distribution of STH on Ambon Island. In the context of malaria, a similar role of geographers can map areas with a high risk of disease spread. This will help in identifying case clusters, understanding distribution patterns, and planning control efforts.
2. Environmental and Spatial Factors: Geographers in this study consider environmental and spatial factors in the analysis of STH distribution. In the context of malaria, geographers will analyze factors such as rainfall, temperature, vegetation, and topography that affect the spread of malaria vector mosquitoes. By understanding these factors, they can plan more effective control strategies.

3. Predictive Modeling: Salakory et al.'s research also involves predictive modeling to understand future STH dynamics. Geographers involved in malaria analysis can also develop predictive models to anticipate changes in disease spread patterns due to factors such as climate change or population mobility.
4. Data-driven Decision Making: Geographers have an important role in processing data and generating information that can be used by health experts and policy makers. In the context of malaria disease distribution analysis, geographers can help identify priority areas for intervention, including the placement of health facilities, insecticide distribution, and extension campaigns.
5. Intervention Planning: Based on analysis and modeling, geographers can help plan more targeted interventions. In the case of malaria, this could mean designing vector eradication programs, mapping the distribution of medicines, or organizing control campaigns. Although Salakory et al.'s research focuses more on STH, the concepts used and the role of geographers in analyzing the distribution of infectious diseases with geospatial technology remain relevant in the context of analyzing and modeling the distribution of malaria in Ambon City.

2. The Role of Geographers in the Analysis and Modeling of COVID-19 Disease Distribution in Ambon City

In the face of a global pandemic such as COVID-19, the role of geographers is crucial in analyzing and modeling the distribution of this disease in Ambon City. The spatial approach in epidemiological analysis provides an important framework for understanding the spread of the disease and the factors that influence it. First, geographers have an important role in producing mapping of the distribution of COVID-19 cases in Ambon City. This mapping helps identify clusters of cases, patterns of spread, and the most affected areas, enabling the development of more targeted countermeasures. Second, through spatial analysis, geographers can identify environmental and demographic factors that contribute to COVID-19 transmission. Factors such as population density, access to health facilities, and population mobility can be analyzed to understand why some areas are more vulnerable to the spread of the virus. This analysis provides important insights for health policy decision-making.

Furthermore, geographers can also play a role in modeling the future development of COVID-19 in Ambon City. Using historical data, environmental factors, and community behavior, they can design predictive models to forecast trends in disease spread. These models can help the government and health agencies in planning measures to prevent, control and treat cases. Finally, cooperation between geographers, epidemiologists, data scientists and medical personnel is key in the spatial approach to COVID-19 epidemiological analysis. This cross-disciplinary collaboration allows the incorporation of data and knowledge from various sources, resulting in a more comprehensive view of the dynamics of disease spread in Ambon City. Thus, the role of geographers in analyzing and modeling the distribution of COVID-19 is very important in efforts to manage and prevent this disease at the local level. Previously, Rakuasa et al. (2021), have conducted research on, analyzing the spatial distribution of the incidence rate of COVID-19 cases using the kernel density method in Ambon City.

Research conducted by Rakuasa et al. (2021) aims to analyze the spatial distribution of the incidence rate of Covid-19 cases in Ambon City using the kernel density method. This method is an approach used to map the spatial distribution of data points in the form of density. This research focuses on Ambon city as a research location and takes data on Covid-19 cases as the main variable to be analyzed. This research uses Covid-19 case data collected from official and reliable sources. The data was then analyzed using the kernel density method to produce a density map of the distribution of Covid-19 cases in Ambon City. This kernel density method produces a visual map that shows areas with high and low case density. The Spatial Distribution Map of the Incidence Rate of COVID-19 Cases in Ambon City can be seen in Figure 2.

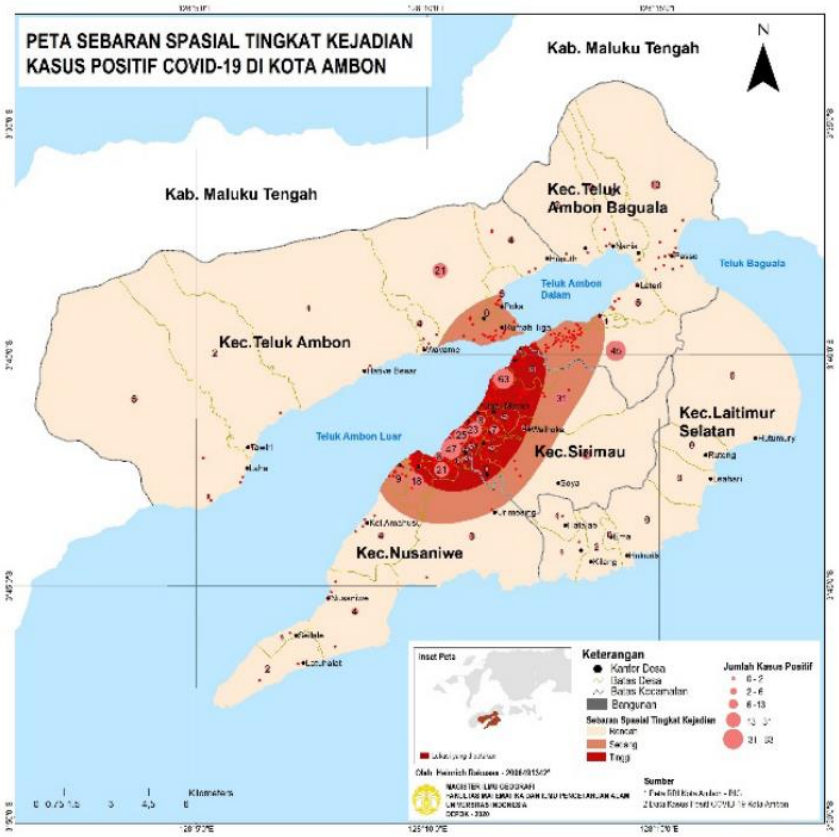

Figure 2. Spatial Distribution Map of the Incidence Rate of COVID-19 Cases in Ambon City
Source: (Rakuasa et al., 2021)

The results of this study show the spatial distribution pattern of Covid-19 cases in Ambon City. The resulting density map identifies areas with higher case rates, which can help health experts and policy makers in directing Covid-19 response and prevention efforts. This study also reveals patterns of distribution that may be related to factors such as population mobility, population density, and access to health services. By using the kernel density method in analyzing the spatial distribution of the incidence rate of Covid-19 cases, this study provides important insights into the pattern of disease spread in Ambon City. The results of this study can be the basis for making more effective policies in controlling the spread of Covid-19 in the region.

In research conducted by Rakuasa et al. (2021) on analyzing the spatial distribution of the incidence rate of COVID-19 cases using the kernel density method in Ambon City, the role of

geographers has an important impact in several aspects of analyzing and modeling the distribution of this disease.

1. Spatial Mapping and Visualization: Geographers play a role in spatial mapping of COVID-19 cases in Ambon City. They used kernel density techniques to generate case density maps. In the analysis of disease spread such as COVID-19, accurate mapping and visualization of density maps are essential to understand the pattern of disease spread and identify areas of high risk.
2. Spatial Analysis: Geographers analyze spatial data to identify patterns of COVID-19 case distribution. By mapping the distribution of cases on a map, geographers can identify highly clustered areas and understand patterns of disease spread, including factors that influence case distribution.
3. Identification of Environmental and Social Factors: Geographers can identify environmental and social factors that may affect the distribution of COVID-19 in Ambon City. This involves understanding population mobility, population density, and access to health services, all of which can affect the pattern of virus spread.
4. Model Development: Geographers can play a role in developing spatial analysis models such as kernel density methods. The development of these models requires a deep understanding of mathematics and spatial statistics, which enables the use of these techniques in disease mapping.
5. Contribution to Health Policy: Spatial distribution analysis results generated by geographers can provide insights to health experts and policy makers. This information can be used to plan and implement more targeted interventions, such as the location of emergency health facility arrangements, mass testing arrangements, or specific area restrictions.
6. Understanding Transmission Patterns: With spatial analysis and case density maps, geographers can assist in understanding the transmission patterns of COVID-19 in Ambon City. This can help health experts identify areas with a high risk of transmission and plan more effective prevention and control strategies. Overall, the research conducted by Rakuasa et al. highlights the key role of geographers in analyzing and modeling the distribution of infectious diseases such as COVID-19 in Ambon City. Through spatial analysis approaches and the utilization of geospatial technologies, geographers can make a significant contribution to the prevention and management of infectious diseases in the region (Coşkun et al., 2021).

The spatial approach to epidemiological analysis is an essential concept in the role of geographers in understanding and addressing the distribution of infectious diseases such as malaria and COVID-19 in Ambon City. This approach focuses on using geographic information to identify patterns, trends and environmental factors that influence the spread of disease. First, in the context of malaria, geographers use this approach to map areas with high malaria cases or case clusters (Jumadi et al., 2022). This helps in identifying areas that require special attention in disease control efforts. Secondly, in the case of COVID-19, the spatial approach helped in understanding how the virus spread across Ambon City. This involved mapping positive cases, daily spread rates, and case clusters. Using spatial data, geographers can identify potential transmission centers and guide the allocation of health resources more efficiently (Pant et al., 2020).

Furthermore, this approach allows geographers to analyze environmental factors that influence disease distribution. In the context of malaria, they can look at the relationship between rainfall, temperature, and vegetation density with the presence of disease-carrying mosquitoes (Juhairiyah et al., 2021). In terms of COVID-19, spatial analysis can reveal how population mobility, settlement density and access to health facilities affect the spread of the virus. Finally, spatial approaches also play a role in modeling disease spread. Geographers can use spatial modeling techniques to predict how disease spread will evolve in the long term (Eriksson, 2011). In the case of malaria, this helps plan long-term prevention strategies based on environmental changes. In the case of COVID-19, this modeling helps in forecasting future caseloads and identifying areas that may experience a surge in cases. Thus, a spatial approach in epidemiological analysis involves the integration of geographic and medical data, which allows geographers to provide deep insights into the distribution of infectious diseases. Collaboration between geographers, epidemiologists, and other health stakeholders is important in addressing infectious disease challenges in Ambon City with a holistic approach.

Conclusion

This study highlights the important role of geographers in analyzing and modeling the distribution of infectious diseases such as malaria and COVID-19 in Ambon City using a spatial approach in epidemiological analysis. Mapping the distribution of cases, analyzing environmental factors, and modeling future trends are core aspects of this approach. Collaboration between geographers, epidemiologists and health professionals forms the foundation of more informed and effective decision-making in disease control. Spatial approaches allow the fusion of geographic and health data to generate more holistic insights into the dynamics of disease spread. Thus, the role of geographers in epidemiological analysis with a spatial approach has a positive impact on efforts to prevent and control infectious diseases in Ambon City.

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