# Application of Geographic Information Systems (GIS) for Health Data Management in Kalipecabean Village: Enhancing Public Health Interventions

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**Abstract**

This study focuses on the development of a thematic map using Geographic Information Systems (GIS) to assist Kalipecabean Village officials in monitoring and managing public health conditions. The current mapping system lacked the necessary detail to identify the locations of healthcare service points and specific health issues, such as maternal health, elderly care, and stunting prevalence. Through consultations with village officials and data collection from healthcare posts, both spatial and non-spatial data were integrated into a comprehensive thematic map. This map provides a clear visualization of health conditions across the village, enabling more targeted and efficient healthcare interventions. The map was created in both printed and digital formats, with the digital version allowing for regular updates and access via online platforms. The implementation of GIS has enhanced the village's ability to manage public health data securely, minimizing the risks of data loss. However, challenges related to the training of village officials in GIS usage and the availability of technological infrastructure need to be addressed for long-term sustainability. The results of this study demonstrate the effectiveness of GIS-based thematic mapping in improving public health monitoring and resource allocation in rural areas, offering a model for other communities facing similar challenges.

**Keywords**: Geographic Information Systems (GIS), thematic map, Kalipecabean Village, spatial data, healthcare service points.

## Introduction

Public health is one of the critical aspects of village development, particularly in areas with limited access to healthcare facilities. To enhance the quality of life in these communities, structured and periodic monitoring of health conditions is essential. Kalipecabean Village,

located in Candi District, Gresik Regency, has undertaken various efforts to improve the health of its residents. One such initiative is the development of a territorial map (Figure 1) depicting the public health conditions. However, the existing map does not yet provide a comprehensive overview of healthcare facility locations and the community's health status. The current map is more general in nature and lacks the specificity required to categorize various health conditions, such as maternal health, elderly health, and stunting.


Figure 1. Map of Kalipecabean Village Area, Candi District, Gresik Regency
Source: Primary Data (2024)

The creation of a thematic map integrated with community health data would significantly benefit village authorities in monitoring and evaluating health programs. Monthly health assessments are conducted, and the data gathered through local healthcare centers (Posyandu and Puskesmas) must be processed accurately to deliver precise information on the community's health status. The application of Geographic Information Systems (GIS) in developing a thematic map allows village authorities to visualize the spatial distribution of various public health issues. This approach aligns with the need for accurate and up-to-date information as a basis for decision-making.

*Context and Need for Thematic Mapping in Kalipecabean Village*

Kalipecabean Village is a coastal community in Gresik Regency. As a developing village, it faces numerous challenges in public health, particularly regarding inadequate healthcare facilities. Posyandu, which serves as a healthcare post at the village level, plays a vital role in providing basic health services such as child growth monitoring, maternal health services, and immunization. However, the distribution of these healthcare centers has not yet been well-documented in thematic maps, making it difficult for local authorities to identify areas that require more intensive health services.

The importance of using GIS in thematic mapping has been widely discussed in various studies. According to Longley et al. (2015), GIS is an effective tool for analyzing and visualizing spatial data, enabling users to better understand the spatial distribution of observed phenomena. This is further supported by Zhou et al. (2018), who found that thematic mapping in public health management can significantly improve the efficiency of planning and implementing health programs.

Developing a thematic map is a crucial step in improving public health in Kalipecabean Village. With a map integrated with public health data, local authorities can monitor community health more effectively and efficiently. Thematic maps enable the spatial visualization of various health issues, such as maternal health, elderly health, and stunting, allowing health intervention programs to be more targeted.

The use of GIS technology in thematic mapping has proven effective in enhancing the quality of healthcare services in developing countries. Therefore, it is hoped that the development of thematic maps in Kalipecabean Village can serve as a model for other villages in monitoring and evaluating community health conditions.

## Methodology

The method used in this research combines consultations with village officials, data processing using Geographic Information Systems (GIS), and spatial analysis to identify the distribution and patterns of public health conditions. In detail, the research methodology can be divided into several main steps, including consultations with village officials, data collection and processing, thematic map creation, field verification, and final evaluation.

*Consultation with Kalipecabean Village Officials*

The first step in this methodology involved consultations with the Secretary of Kalipecabean Village and relevant parties within the village administration. The objective of these consultations was to identify the challenges faced by the village in effectively and efficiently monitoring public health conditions. Through these meetings, the research team was able to understand the specific needs of the village, including resource constraints and the current processes used to monitor public health.

One of the primary challenges identified during these discussions was the village's base map, as shown in Figure 1. The map lacked sufficient information regarding the locations of healthcare service points, making it difficult to determine which areas required further intervention. Additionally, the use of WhatsApp as a tool for gathering public health data was considered suboptimal because the data collected was not securely stored and was at risk of being lost if the smartphone used was damaged or lost. This aligns with the findings of Longley et al. (2015), who emphasized the importance of using more structured and secure technology in managing both spatial and non-spatial data.

As a result, it was agreed during the discussion that the most effective solution would be to create a more comprehensive thematic map. This map would not only include the healthcare service points but also map the overall public health conditions. The use of GIS in thematic mapping would allow for more secure and integrated data processing, minimizing the risk of data loss.

*Data Collection and Processing*

After the consultations with village officials were completed, the next step was to collect the data needed to create the thematic map. The collected data included both spatial and non-spatial data. The spatial data included the base map of Kalipecabean Village, which outlines the boundaries, road networks, and existing healthcare service points. This spatial data was obtained from the village government as well as through field surveys conducted by the research team.
In addition to the spatial data, non-spatial data was collected, covering information about public health conditions such as maternal health, elderly health, and the prevalence of stunting in various parts of the village. This data was obtained directly from the healthcare service points and from pre-existing records. The use of tools like GIS was crucial in processing this data, as it allowed the integration of spatial and non-spatial data into a unified platform.

The data processing was conducted using GIS software. The collected spatial data was input into the software and then processed to generate a map showing the distribution of healthcare service points and the public health conditions across different areas. This data processing was performed carefully to ensure the accuracy and relevance of the data to field conditions.

*Thematic Map Creation*

Once the necessary data had been collected and processed, the next stage was the creation of the thematic map. This map aimed to visualize information on the locations of healthcare service points and the public health conditions in Kalipecabean Village. Each healthcare service point was marked with a different symbol, depending on the type of service provided, such as centers for maternal health, elderly care, and stunting management.
In addition, the thematic map displayed information on the distribution of health issues across the village. For example, areas with a high prevalence of stunting were highlighted, allowing village officials to easily identify these areas and plan more targeted interventions. According to Zhou et al. (2018), the use of thematic maps in public health management has been proven effective in improving the efficiency of health programs, particularly in identifying areas that require further attention.

*Field Verification*

After the thematic map was completed, the next step was field verification. This verification was carried out to ensure that the information displayed on the thematic map matched the actual conditions in the field. The research team conducted field visits to various healthcare service points in the village to verify the locations and the types of services provided.
This verification process also involved further discussions with the Secretary of Kalipecabean Village and healthcare staff, to ensure that the map created fully met their needs and expectations. During this process, the research team also gathered feedback from the village officials regarding potential improvements or additional information that could be included in the thematic map.

By following these methodological steps, the research ensured that the thematic map produced would be both accurate and practical for village officials to use in monitoring and managing public health conditions.

## Results and Discussion

*Results of Thematic Map Development*
At this stage, the result obtained is a thematic map illustrating the distribution of healthcare service points in Kalipecabean Village, along with the recorded public health conditions. The map, as shown in Figure 2, is the product of the collection, processing, and analysis of spatial and non-spatial data conducted by the service team. It contains vital information about the distribution of healthcare service points, including Posyandu (maternal and child health services), elderly care centers, and maternal health examination posts.

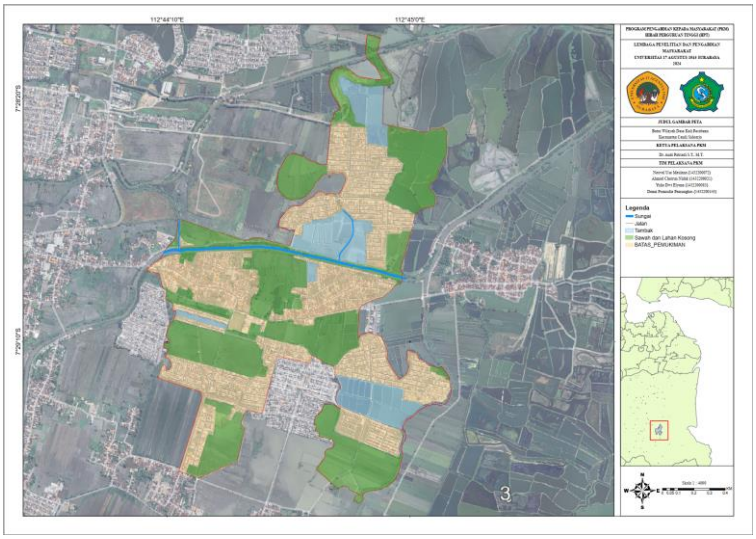


Figure 2. Thematic Map 2024 of Kalipecabean Village, Candi District, Sidoarjo Regency

Additionally, the map visualizes public health conditions across the village, focusing on key indicators such as stunting prevalence, the distribution of pregnant women, and the number of elderly individuals requiring special healthcare services. With this map, village officials can more easily monitor the distribution of health issues and plan more targeted health interventions.

The thematic map has been handed over to the Secretary of Kalipecabean Village in printed form (Figure 3). It was printed in a large format so it can be displayed in the village office as a guide for officials in planning health programs. In addition to the printed version, the map was also created in a digital format using Geographic Information Systems (GIS), allowing it to be accessed and updated regularly by the village government. This aligns with the importance of GIS technology in managing both spatial and non-spatial data, as highlighted by Longley et al. (2015).


Figure 3. Handover of the 2024 Kalipecabean Village Thematic Map

*Implementation of Geographic Information Systems (GIS) in Public Health Mapping*

One of the advantages of creating this thematic map is its integration with GIS, which allows for the digital and structured management of public health data. The use of GIS in thematic mapping not only aids in data visualization but also facilitates the monitoring and analysis of public health conditions on an ongoing basis. By employing GIS, the data previously collected manually through WhatsApp and physical records can now be processed and stored digitally, thereby minimizing the risk of data loss due to device damage or storage failures.

The data digitalization process was conducted by integrating information collected from healthcare service points with a GIS-based data management system. The input data includes residents' addresses, recorded health conditions (such as pregnant women, the elderly, and children experiencing stunting), and healthcare service points' locations. Using GIS, this data was transformed into spatial information visualized in the thematic map, enabling village

officials to quickly see the distribution of health issues within the village and identify areas requiring further attention.
The implementation of GIS also allows the thematic map to be accessed online by village officials through computers or smartphones connected to the internet (Patriadi et al., 2023). This is highly beneficial in situations where healthcare workers or village officials need to quickly access public health information, for instance, when there is an urgent need to follow up on reports from the field. Moreover, GIS enables village governments to update public health data periodically, ensuring that the thematic map remains current and accurately reflects the latest community health conditions.

According to Zhou et al. (2018), the use of GIS in public health monitoring can improve the efficiency of healthcare programs in rural areas, particularly by providing structured and easily accessible data management. This finding aligns with our results, where GIS implementation has enabled village officials to more effectively monitor public health conditions in real-time and respond more swiftly to changes in the field.
This result is supported by research conducted by Steinmann et al. (2019), which showed that the use of thematic maps in public health management can enhance the efficiency of healthcare program planning, especially in scheduling services and allocating healthcare resources. In the case of Kalipecabean Village, the thematic map not only assists in monitoring public health conditions but also serves as an effective planning tool for future healthcare programs.

*Discussion*

Based on the results obtained, it can be concluded that the creation of a thematic map using GIS offers many benefits to the village government in monitoring and managing public health conditions. The implementation of GIS not only allows for more accurate health data visualization but also facilitates digital data management, thus minimizing the risk of data loss.

However, several challenges need to be addressed in implementing this thematic map. One of the main challenges is the need for adequate training for village officials on how to use GIS software. Although the thematic map has proven highly beneficial in monitoring public health, the long-term success of the system depends heavily on the ability of village officials to operate GIS independently. Therefore, training programs on GIS use are essential to ensure that village officials can continuously update the data and use the thematic map effectively.
Another challenge to consider is the availability of adequate technological infrastructure at the village level. Although the thematic map has been implemented in a digital format accessible online, some areas in Kalipecabean Village still face limited internet access. This could pose difficulties for village officials in accessing the map online. To address this issue, the village government may need to collaborate with internet service providers or explore alternative solutions, such as local data storage.

Despite these challenges, the thematic map created using GIS has proven to be an effective tool for improving the efficiency of public health monitoring and planning in Kalipecabean Village. By providing accurate, up-to-date spatial information, the map allows village officials to make informed decisions and target interventions where they are most needed.

## Conclusion

In conclusion, the development of a thematic map using Geographic Information Systems (GIS) in Kalipecabean Village has proven to be an effective tool for facilitating more efficient and targeted monitoring and management of public health conditions. The integration of spatial and non-spatial data in this thematic map enables village officials to visualize health issues such as stunting prevalence, maternal health, and elderly conditions, allowing for more focused health interventions. While the implementation of GIS offers significant advantages, such as improved data accuracy and digital management, challenges remain in terms of training village officials and ensuring adequate technological infrastructure. Therefore, further efforts are required to enhance human resource capacity and improve technology access to ensure the thematic map is optimally utilized in the long term.

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