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Article

Geospatial Analysis of Stunting: A QGIS-based Case Study in Jember Regency

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Abstract: Malnutrition, particularly stunting, remains a significant public health concern in Indonesia. In Jember Regency, the prevalence of stunting in 2024 reached 11.4%, which is notably higher than the East Java provincial average of 5.1%. Despite various intervention efforts, the reduction in stunting cases has not been significant, largely due to the lack of evidence-based approaches. This study aimed to analyze the spatial distribution of stunting cases using a geospatial approach. Data were obtained from the electronic Community-Based Nutrition Recording and Reporting System (e-PPGBM) of the Jember District Health Office for the years 2024–2025. The unit of analysis was 31 sub-districts in Jember Regency. Spatial analysis was conducted using Quantum GIS (QGIS) version 3.40.2. In 2024, 58% sub-districts were categorized as very high prevalence, 19.4% sub-districts as high, 19.4% sub-districts as moderate, and 3.2% sub-districts as low. In 2025, the distribution shifted, with 32.3% sub-districts categorized as very high, 25.8% sub-districts as high, 25.8% sub-districts as moderate, and 16.1% sub-districts as low. Trend analysis revealed that 12.9% sub-districts experienced an increase in stunting cases, 41.9% sub-districts remained unchanged, and 45.2% sub-districts showed a decline. Regarding the spatial relationship between regional distance and stunting incidence, urban and coastal areas tend to have fewer cases than highlands areas. Research findings indicate that this is due to limited access to animal protein sources, particularly seafood. Most residents rely on their own livestock products, such as eggs, chicken, and others. Prioritizing interventions in areas with high and very high prevalence rates while strengthening programs to sustain regions with low stunting cases, supported by enhanced geospatial analysis in nutritional surveillance to enable more effective stunting reduction strategies.

Keywords: E-PPGBM; Malnutrition; Quantum GIS; Stunting

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1. Introduction

The nutritional status of children under five serves as a key indicator for measuring the achievement of the Sustainable Development Goals (SDGs), specifically Goal 2: Zero Hunger, which calls for ending all forms of child malnutrition, including stunting, by 2030. This target has also been adopted in the National Medium-Term Development Plan (RPJMN) 2025–2029 under the fourth priority, namely strengthening human resource development in the health sector. The main objective of this priority is to reduce the prevalence of stunting and severe stunting from 21.5% to 14.4% by 2029. Currently, stunting assessment in children under five uses the anthropometric indicator of height-for-age [1] [2] [3] [4].

Based on the 2023 weighing month data at the district/city level in East Java, the prevalence of stunting among children under five reached 5.1%, while in Jember Regency in 2024, stunting cases were recorded at 11.4%, which is significantly higher than the East Java average [5] [6].

The handling of malnutrition cases has been carried out since stunting became a national priority issue. Several efforts undertaken by the Jember District Health Office include strengthening stunting prevention and acceleration teams, providing special food (PKMK) for 50 community health centers (CHC) and Nutrinitdrink, conducting CHC supervision, training on maternal and neonatal emergency care and ultrasound (USG), providing supplementary food for children under five and pregnant women made from local ingredients, as well as mentoring for pregnant women and children under five at high risk. These efforts, of course, need to be evaluated through case identification and mapping. The expectation is that by recognizing case clusters and trends, they can serve as the basis for determining appropriate prevention and treatment strategies.

Mapping stunting cases in the form of infographics has never been carried out in Jember Regency. Previous research, however, has developed a geographic information system (GIS) using the prototype method. [7]. Therefore, it is necessary to conduct stunting case mapping applied to a wider population using the support of the latest geospatial-based software, in order to identify stunting clusters in each area. The aim of this study is to analyze the spatial distribution of stunting cases using a geospatial approach. The mapping results are used to: identify priority areas for intervention, support the planning of nutrition or health programs, and serve as a basis for resource allocation, then the novelty lies in their applicative (practical) function. The advantages of the application used are that it is open-source, has a more attractive interface, and provides greater accuracy. Hence, it is expected to serve as a consideration in formulating long-term strategic policies, which can then be outlined into an annual work program based on evidence-based planning [6].

2. Materials and Methods

This study was conducted using a quantitative descriptive approach with 31 sub-districts in Jember Regency as the units of analysis. The data were obtained from secondary sources provided by the CHC of the Jember District Health Office, covering the period from January 2024 to April 2025. Data analysis was performed using Quantum GIS (QGIS) version 3.40.2 for spatial mapping of malnutrition cases. The collected data consisted of prevalence data from the Jember District Health Office, calculated using the formula: the number of children aged 0–59 months categorized as stunted and severely stunted divided by the number of children aged 0–59 months whose body length or height was measured × 100%. The classification of length-for-age (PB/U) for children under 2 years or height-for-age (TB/U) for children 25-60 months years old. indicators followed the Regulation of the Minister of Health of the Republic of Indonesia No. 2 of 2020 on Child Anthropometry Standards. Children are classified as severely stunted if the Z-score < -3.0 SD (Standard Deviation), and stunted if the Z-score is between > -3.0 and < -2.0 SD [3]. Subsequently, two maps of stunting case distribution will be created for the years 2024 and 2025 in order to observe the trend. For the 2024 stunting classification into four interval ranges were used: 0–4.65% (low); 4.66–9.32% (moderate); 9.33–13.99% (high); and >14% (very high). This classification was based on the stunting prevalence target set by the Jember District Health Office for 2024, which was 14%. Meanwhile, for the 2025 stunting classification, four interval ranges were applied: 0–6.25% (low); 6.26–12.52% (moderate); 12.53–18.7% (high); and >18.8% (very high), referring to the stunting prevalence target determined by the Jember District Health Office for 2025, which was 18.8%.

3. Results

The distribution of stunting cases in Jember Regency, based on secondary data from the Community Health Unit of the Jember District Health Office covering the period from January 2024 to April 2025, the pattern of stunting case grouping is based on spatial areas, using sub-districts as the unit of analysis. The occurrence of stunting is determined by the number of stunting cases in each unit analysis, calculated by dividing the number of stunting cases by the total number of toddlers weighed within a certain period. The distribution pattern is visualized in Figures 1 and 2:

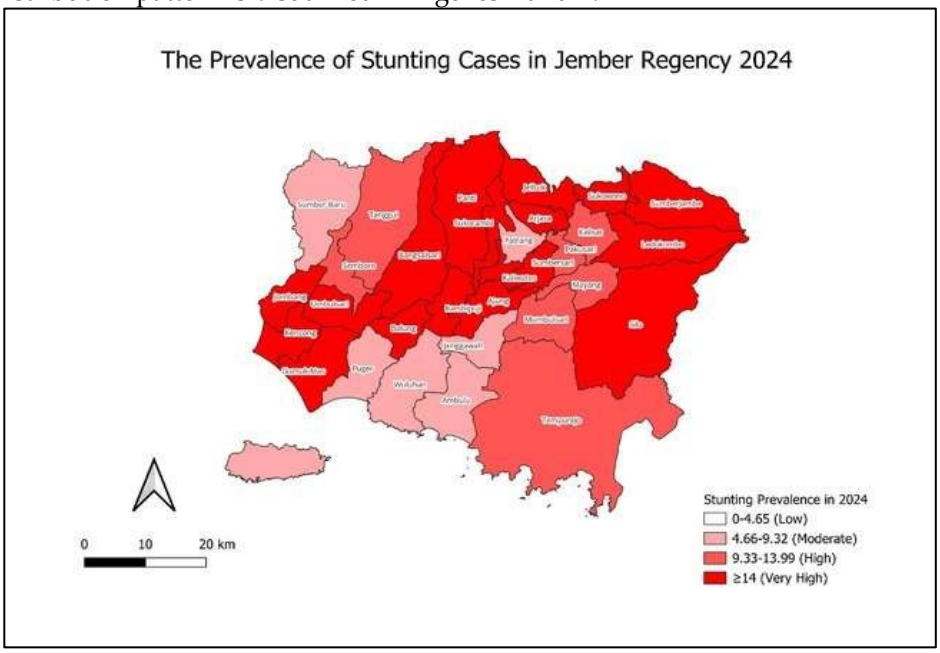


Figure 1. Spatial Distribution Map of Stunting Cases in Jember Regency, 2024

Figure 1. The results show that in 2024, very high category: 18 sub-districts (58%), high category: 6 sub-districts (19.4%), moderate category: 6 sub-districts (19.4%) and low category: 1 sub-district (3.2%). Regarding the spatial relationship between regional distance and stunting incidence, urban and coastal areas tend to have fewer cases than highlands area.

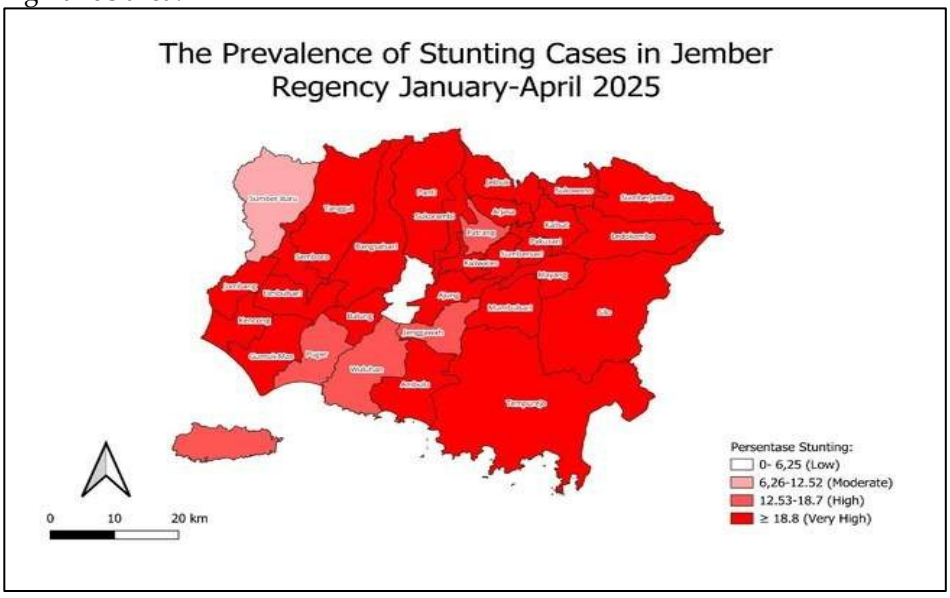


Figure 2. Spatial Distribution Map of Stunting Cases in Jember Regency (January–April 2025).

Figure 2. The results show that in 2025, the very high category was found in 10 sub-districts (32.3%), the high category in 8 sub-districts (25.8%), the moderate category in 8 sub-districts (25.8%), and the low category in 5 sub-districts (16.1%). There were 4 sub-districts (12.9%) showing an increasing trend of stunting cases, namely Sumberbaru, Puger, Jenggawah, and Mayang; 13 sub-districts (41.9%) with a stable trend; and 14 sub-districts (45.2%) with a decreasing trend.

The distribution of stunting cases in Jember Regency in 2024, when viewed from demographic areas divided into four categories—highlands, urban, rural, and coastal—shows that the four sub-districts located in the highlands (Silo, Ledokombo, Jelbuk, and Sumberjambe). Jelbuk and Ledokombo are classified as hard-to-reach or remote areas.

4. Discussion

Stunting cases distribution in Jember Regency in 2024 based on demographic areas divided into highlands, urban, rural, and coastal, the four sub-districts located in the highlands (Silo, Ledokombo, Jelbuk, and Sumberjambe) recorded very high stunting prevalence. The highland parameter was determined based on the official topographic map/elevation table from the Jember Regency Central Bureau of Statistics (BPS) [8]. Of these four sub-districts, 50% are classified as hard-to-reach or remote areas. Jelbuk Sub-district is located very far away, prone to landslides, and has poor signal/communication access. Meanwhile, Ledokombo Sub-district was once used as a simulation site for distributing polling station logistics using horses, as the area is inaccessible to regular vehicles [9] [10].

The distribution of stunting cases in coastal areas categorized as very high—above 14%, according to the target set by the Jember District Health Office—includes Kencong and Gumukmas sub-districts. Based on the Food Security and Vulnerability Atlas (FSVA) guidelines, which are used to determine a region's food insecurity status based on transient indicators—such as the frequency of natural disasters caused by climate factors, changes in monthly rainfall or rainfall variability, the average loss of food crop production due to climate change impacts (floods, forest fires, droughts, and storms), and the effects of plant pest organisms (OPT)—Gumukmas Sub-district is identified as one of the areas experiencing food crop production loss, reaching 26.48% [11]. Another factor that may also have an influence is the conversion of agricultural land into non-agricultural or industrial areas. This has led to a decline in income after land conversion, due to factors such as age, education level, limited capital, lack of farming skills, and the generally low educational attainment of farmers. These factors significantly affect their income, which in turn impacts their access to food and nutrition [12].

The Jember Regency Government, particularly in Gumukmas Sub-district, has carried out comprehensive efforts to prevent and address stunting by ensuring that children under five in the area receive adequate nutrition and proper health services. These efforts are implemented through the Stunting Forum (Rembuk Stunting), which incorporates several agendas under the Go-Besti Program (Gumukmas Sub-district Optimistic to be Free from Stunting), including:

1. Stunting Data Mapping: Ensuring accurate data on stunted children at the village level to guide appropriate interventions;
2. Healthy Lifestyle Campaigns: Education on the importance of balanced nutrition, exclusive breastfeeding, and clean and healthy living habits;
3. Integrated Intervention Program: Plans for supplementary feeding (PMT), routine health check-ups, and support for families at risk of stunting;
4. Strengthening the Role of Posyandu Cadres: Enhancing the capacity of community health volunteers to conduct early detection and provide family assistance.

In addition, emphasis is placed on the crucial role of pregnant women in maintaining a nutritious diet during pregnancy in order to prepare a future generation that is healthy, intelligent, and competitive, contributing toward Indonesia Emas 2045 [13].

The distribution of stunting based on rural topographic areas shows that six sub-districts recorded very high prevalence, namely Bangsalsari, Umbulsari, Jombang, Panti, Rambipuji, and Sukorambi. The contributing factors to stunting in Bangsalsari Sub-district include chronic energy deficiency among pregnant women, maternal anemia, inadequate sanitation, and insufficient consumption of at least 90 iron tablets during pregnancy. In Umbulsari Sub-district, the causes include chronic energy deficiency among pregnant women, maternal anemia, incomplete basic immunization, and wasting. The very high prevalence of stunting in Jombang Sub-district may be attributed to chronic energy deficiency among pregnant women, maternal anemia, inadequate sanitation, incomplete basic immunization, and wasting. In Panti Sub-district, the contributing factors are maternal anemia and inadequate sanitation. In Rambipuji Sub-district, the causes include chronic energy deficiency among pregnant women, maternal anemia, incomplete basic immunization, and wasting. Meanwhile, in Sukorambi Sub-district, the high prevalence of stunting is linked to maternal anemia, lack of exclusive breastfeeding, inadequate sanitation, and insufficient consumption of at least 90 iron tablets during pregnancy [14].

The distribution of stunting in urban topographic areas of Jember Regency shows that the very high category occurred in Kaliwates and Sumbersari sub-districts. The contributing factors in Kaliwates Sub-district include maternal anemia, lack of exclusive breastfeeding, inadequate sanitation, and insufficient consumption of at least 90 iron tablets during pregnancy. Meanwhile, in Sumbersari Sub-district, the causes are chronic energy deficiency among pregnant women, poor sanitation, and wasting [14].

In addition to topographic areas potentially influencing stunting prevalence in each region, cultural and ethnic factors may also contribute. This was highlighted by previous researchers who reported on the distribution of ethnic groups in Jember Regency, which includes Javanese, Madurese, Osing, Chinese, Sundanese, and Arab communities. Javanese and Madurese are the dominant ethnic groups in Jember Regency, with a clear administrative division between the northern and southern areas. The Madurese predominantly occupy the northern to eastern regions, with the Osing ethnic group from Banyuwangi found along the eastern border. Meanwhile, the Javanese dominate the southern to western regions, with the Sundanese located in Panti Sub-district. In the central area of Jember Regency, the distribution of ethnic groups is relatively balanced and not heavily concentrated in any single ethnicity [15]

Regarding the spatial relationship between regional distance and stunting incidence, urban and coastal areas tend to have fewer cases than highlands area. Research findings indicate that this is due to limited access to animal protein sources, particularly seafood. Most residents rely on their own livestock products, such as eggs, chicken, and others.

Therefore, priority interventions are needed in sub-districts with rising and stable stunting trends, as well as those with moderate, high, and very high prevalence. So this research to the policy was identify priority areas for intervention, support the planning of nutrition or health programs, and serve as a basis for resource allocation.

5. Conclusions

The distribution of stunting prevalence in Jember Regency in 2024 reached 58% of sub-districts in the very high category, meanwhile, the stunting prevalence in 2025 shows 32.3% in the very high category. In 2025 there were 4 sub-districts (12.9%) with an increasing trend in stunting cases, 13 sub-districts (41.9%) with a stable trend, and 14 sub-districts (45.2%) with a decreasing trend. This study has at least provided baseline information on the spatial distribution patterns of stunting cases and the influencing health service factors in each region. Consequently, these findings can serve as a basis for determining intervention policies, including prioritizing areas, program planning, and the allocation of resources. Therefore, future research will be directed toward multivariate spatial analysis.

6. Patents

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