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Spatial Analysis of the Free Nutritious Meal Program Distribution for Junior High Schools in Jayapura City

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The implementation of the Free Nutritious Meal (MBG) program involves not only providing meals to beneficiaries but also the capacity of the distribution system to reach schools equitably. Disparities between the locations of Nutrition Fulfillment Service Units (SPPG) and the distribution of junior high schools (SMP) in Jayapura City can lead to varying levels of service accessibility across different areas. This study aims to analyze the spatial distribution of SPPGs and MBG-recipient junior high schools, determine school accessibility levels based on distance to SPPGs, and identify schools with relatively low service access. A quantitative approach utilizing Geographic Information System (GIS)-based spatial analysis was employed. The data used included the locations of 20 SPPGs and 44 junior high schools, as well as the road network in Jayapura City. Accessibility analysis was conducted by measuring the distance between SPPGs and schools, using a maximum radius of 6 km as a service assessment benchmark. The results indicate that 14 SPPGs (70% of the total) serve 25 junior high schools (56.8% of the total 44 schools). Twenty-one schools fall within the 6 km radius, while four schools lie outside it. Schools with relatively low accessibility were identified in Muara Tami District: SMP Negeri Muara Tami (10.31 km away), SMP Negeri 10 Jayapura (26.20 km away), and SMPIT As Salaam Jayapura (16.24 km away). The findings demonstrate that MBG distribution to junior high schools in Jayapura City is not yet fully equitable; therefore, future SPPG placement should take into account school distribution, service distances, and road network conditions to ensure more even distribution coverage.
Keywords: Free Nutritious Meal Program; SPPG; Junior High Schools; Spatial Analysis; Accessibility

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1. Introduction

The Free Nutritious Meal (MBG) program is a government initiative aimed at helping meet the nutritional needs of students and supporting the improvement of human resource quality. Its implementation involves not only the provision of meals but also the process of distributing them from service centers to beneficiary schools. Consequently, the program's success is measured not merely by the quantity of meals provided or the number of student recipients, but also by the distribution system's ability to reach schools accurately, consistently, and in a timely manner. Research on school meal programs in Indonesia indicates that providing meals at school is linked to consumption patterns, dietary diversity, hygiene habits, and the students' learning environment [1]. This highlights that distribution is an integral part of school meal program implementation, as delays or logistical obstacles can impact the students' receipt of benefits.

The implementation of the MBG program in Jayapura City has reached numerous schools across various areas, including junior high schools (SMP). An increasing number of participating schools necessitates a distribution system capable of effectively linking Nutrition Fulfillment Service Units (SPPG) with the schools. Schools operate under varying conditions due to their locations and differing geographical characteristics. Factors such as topography, settlement density, urban development, and road network conditions can influence the ease of distributing meals from SPPGs to schools. Furthermore, the straight-line distance between locations does not necessarily correspond to the actual travel distance covered by vehicles, as distribution relies on existing road networks. Therefore, assessing MBG distribution solely based on the number of recipient schools is insufficient to capture the true level of service accessibility. The relationships between SPPG locations and junior high schools—considering travel distances, road networks, and accessibility levels—must be analyzed holistically to gain a clearer understanding of distribution dynamics.

Spatial approaches have been employed in various studies to assess the equitable distribution of educational services. Wang et al. [2] utilized an accessibility-based approach to examine disparities in educational service equity across regions, whereas Han et al. [3] links accessibility with service coverage to identify locations where service levels remain low. Research on school distribution in Jakarta also indicates that the spatial distribution of educational facilities is linked to issues of spatial equity [4]. Sharma and Patil [5] found that variations in travel time and socio-spatial conditions can influence the level of public access to educational facilities. Marques et al. [6] also demonstrated disparities in school accessibility across different regions. Furthermore, studies by Meena et al. [7], Deniz [8], and Abulibdeh et al. [9] show that Geographic Information Systems (GIS) can be utilized to calculate distances, analyze transportation networks, and visualize the distribution patterns and accessibility of educational facilities [24], [25]. Research specifically concerning school meals has largely focused on program benefits, food quality, consumption patterns, and service implementation [1], [10]–[14]. Meanwhile, location-allocation approaches have been employed to examine the relationship between service facility locations and user locations, as well as to determine more effective service patterns [15]–[17]. These findings indicate that a spatial approach is suitable for analyzing distribution issues; however, studies specifically linking Free Nutritious Meal (MBG) supply points (SPPG) to recipient junior high schools (SMP) based on the road network in Jayapura City remain limited.

Given this context, this study specifically aims to analyze the distribution of the Free Nutritious Meal Program among junior high schools in Jayapura City. The research focuses on the spatial distribution of SPPG locations and recipient junior high schools, the distance between SPPGs and schools, connectivity via the road network, and the level of service accessibility. The scope is limited to the junior high school level to ensure a focused analysis and to avoid conflation with distribution characteristics associated with other educational levels. This study does not address nutritional content or student health impacts; instead, it concentrates on the spatial aspects of the MBG distribution process. With this focus, the study titled “Spatial Analysis of the Distribution of the Free Nutritious Meal Program for Junior High Schools in Jayapura City” aims to determine the spatial distribution patterns of Free Nutritious Meal Program (MBG) service providers and recipient junior high schools, analyze the level of school accessibility to these providers based on distance and road networks, and identify schools or areas with relatively low service accessibility. The findings of this study are expected to provide an overview of the spatial distribution of the Free Nutritious Meal (MBG) program and serve as a basis for consideration in improving the equitable distribution of services for junior high schools in Jayapura City.

2. Literature Review and Problem Statement

In spatial analysis, accessibility is used to assess the ease with which a location can access services from specific facilities. Measurement is not based solely on distance but also considers travel time, transportation network conditions, regional characteristics, user numbers, and service capacity. In the education sector, this approach is employed to examine the equitable distribution of facility coverage across regions. Wang et al. [2] and Han et al. [3] demonstrated that accessibility analysis can evaluate the equity and coverage of school services, while Sharma and Patil [5] and Marques et al. [6] highlighted disparities in educational facility accessibility resulting from spatial conditions and travel times. Research by Iscahyono et al. [19] indicated that the accessibility of junior high schools (SMP) from residential areas is influenced not only by distance but also by road network conditions. Ruuhulhaq et al. [20] utilized GIS to identify the availability and accessibility of junior high schools relative to residential areas, whereas Ghani and Rahmi [22] employed spatial analysis to determine the distribution patterns and service reach of educational facilities. Andari et al. [23] further demonstrated that network analysis can be used to measure school accessibility based on travel routes. This approach is relevant to the distribution of the Free Nutritious Meal (MBG) program, positioning the Free Nutritious Meal Service Center (SPPG) as the service hub and the junior high school as the recipient location. This is reinforced by the Decree of the Head of the National Nutrition Agency of the Republic of Indonesia Number 401.1 of 2025 regarding Technical Guidelines for the Governance of the Free Nutritious Meal Program for Fiscal Year 2026, which stipulates that SPPG locations should ideally be situated near educational units or target beneficiary groups, within a maximum radius of 6 km. These provisions underscore that distance and location are critical factors in facilitating the distribution of the MBG program. Research on school meals has largely focused on program benefits, food quality, consumption patterns, and implementation [1], [10]–[14], whereas the spatial relationship between service centers and recipient schools via road networks remains under-studied. A location-allocation approach can be employed to examine the relationship between facility locations and service users by considering distance, demand, and service coverage [15]–[17]. Research by Taufiq et al. [21] demonstrates that service area and location-allocation analyses can be used to assess equitable access to education by examining the relationship between school locations and service areas. Consequently, evaluating the distribution of the Free Nutritious Meal (MBG) program requires looking beyond the mere presence of supply centers (SPPG) or service radii; it necessitates an examination of SPPG positions, school locations, travel distances, and the road networks connecting them. To date, studies specifically examining the spatial relationship between SPPGs and recipient junior high schools (SMP) based on road networks in Jayapura City remain limited. Against this backdrop, this study aims to determine the distribution patterns of SPPGs and MBG-recipient junior high schools, measure the level of school accessibility to SPPGs based on distance and road networks, and identify schools or areas with the lowest levels of service accessibility.

3. Method

This study employs a quantitative approach utilizing spatial analysis via Geographic Information Systems (GIS). This approach was selected because the objects of analysis—Nutrition Fulfillment Service Units (SPPG), junior high schools (SMP) participating in the Free Nutritious Meal (MBG) program, and the road network—can all be represented as spatial data. The analysis was conducted in stages: data collection; data verification and preparation; determination of coordinates for SPPG locations and schools; and the integration of all data into a unified coordinate system. Once the data was ready, the spatial distribution of SPPGs and junior high schools was mapped to visualize the locational relationship between them. The subsequent stage involved network analysis to determine travel distances and routes from SPPGs to schools. The road network was used because distribution vehicles do not travel in straight lines but rather

follow available road segments. These measurements were then used to assess the level of accessibility of each school relative to the SPPGs. The analysis assumes that the coordinates for SPPGs and schools accurately reflect actual conditions, that the road network used is navigable by distribution vehicles, and that road network conditions remained stable throughout the study period without changes that would significantly alter service routes. Measurements were based on consistent data across all schools, ensuring that results could be compared reliably between locations.

The study sample comprises all SPPGs serving the MBG program and all junior high schools in Jayapura City registered as program participants during the study period. This comprehensive selection ensures that the distribution overview reflects the service relationship between SPPGs and junior high schools across the study area, rather than relying on a partial sample of schools. The data utilized includes the locations and identities of SPPGs and junior high schools, the number of students receiving MBG, and the Jayapura City road network. Data regarding SPPGs and program recipients were obtained from the relevant authorities or MBG program managers, while school data were sourced from the Education Office and/or the schools themselves. Road network data were obtained from relevant geospatial sources and adjusted to meet the analysis requirements. Each school was then paired with the SPPG serving it—or the SPPG offering the most feasible access based on the road network. The parameters analyzed included travel distance, distribution networks or routes, and the level of school accessibility to the SPPG. The evaluation involved comparing accessibility results across schools to identify locations that were relatively easy to reach versus those with limited access. Student population figures served as supplementary data to illustrate the scale of service demand at each school, rather than as a substitute for distance or accessibility metrics. The final analysis yielded maps showing the distribution of SPPGs and junior high schools (SMP), distribution network maps, and a classification of service accessibility levels for the MBG program across junior high schools in Jayapura City.

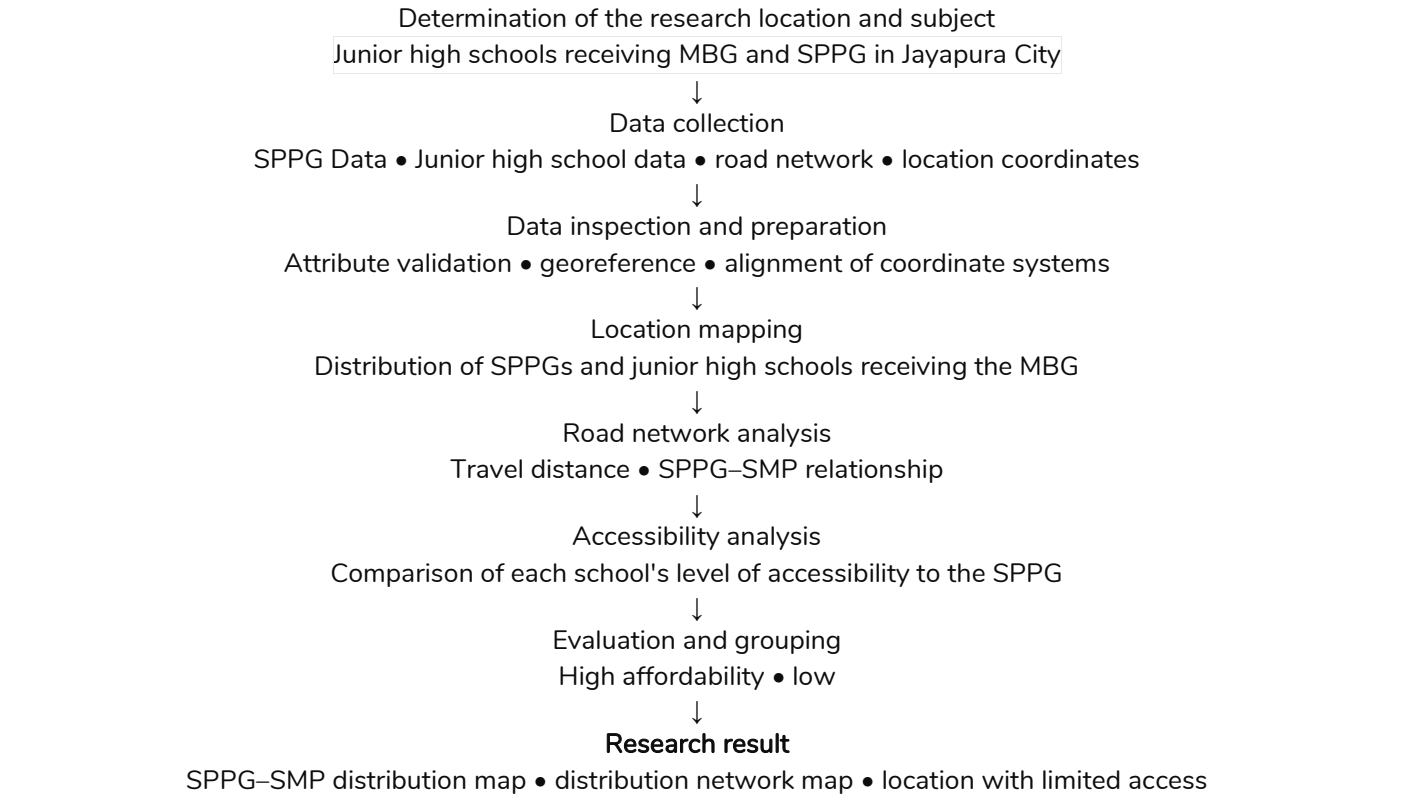

Figure 1. Spatial analysis workflow for the distribution of MBG in junior high schools in Jayapura City
Source: Processed by the research team, 2026

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4. Results and Discussion

Distribution of Junior High Schools in Jayapura City

Table 1. Distribution of Junior High Schools

District	School
Abepura	8
Heram	9
Jayapura Selatan	9
Jayapura Utara	10
Muara Tami	8
Total	44

Source: Processed by the research team
based on data from the Jayapura City Education Office, 2026

Based on Table 1, there are 44 junior high schools distributed across Jayapura City. North Jayapura District has the highest number of junior high schools, with 10 schools, while Abepura District and Muara Tami District have the lowest, with 8 schools each.

Distribution of SPPGs in Jayapura City

Table 2. Distribution of SPPGs

District	SPPG
Abepura	7
Heram	4
Jayapura Selatan	2
Jayapura Utara	4
Muara Tami	3
Total	20

Source: Processed by the research team
based on data from the Jayapura City Education Office, 2026

Based on Table 2, there are 20 SPPGs distributed across Jayapura City. Abepura District has the highest number of SPPGs, with 7, while South Jayapura District has the lowest, with 2.

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SPPG Services for Junior High Schools in Jayapura City

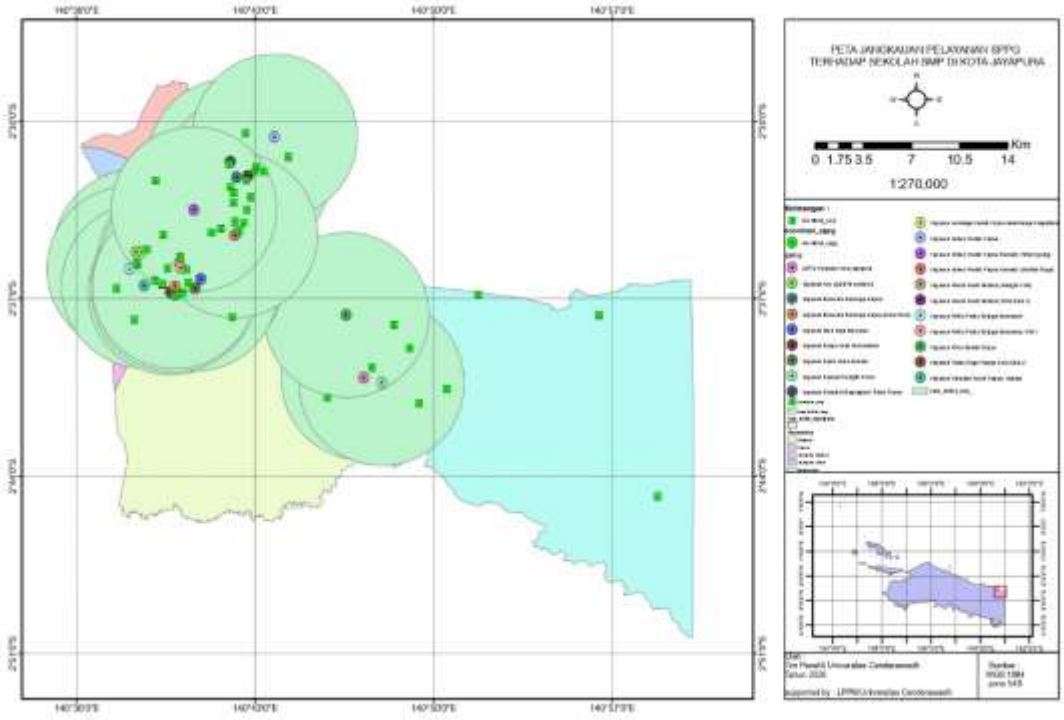

Figure 2. Map of SPPG Service Coverage for Junior High Schools
Source: Processed by the research team, 2026.

Table 3. SPPG Services for Junior High Schools

No.	SPPG	SMP	District	Straight-line distance (km)	Affordability Grouping
1.	SPPG Yayasan Noken Peduli Papua	SMP HIKMAH YAPIS JAYAPURA	Jayapura Utara	2.60	High
		SMP Wahana Cita		3.81	High
2.	SPPG Yayasan Karya Anak Perdamaian	SMP Kartika VI – 1	Jayapura Utara	6.68	Low
		SMP Nurul Huda		1.51	High
3.	SPPG Yayasan Kemala Bhayangkari Polda Papua	SMP YPK Sion DOK VIII	Jayapura Utara	0.22	High
4.	SPPG Yayasan Noken Peduli Papua Hamadi (Hotel Agung)	SMP N 3	Jayapura Selatan	2.93	High
5.	SPPG Yayasan Noken Peduli Papua Hamadi (Mustika Raya)	SMP NEGERI 9 JAYAPURA	Jayapura Selatan	1.11	High
		SMP YAPEN 45 ENTROP		0.99	High

No.	SPPG	SMP	District	Straight-line distance (km)	Affordability Grouping
		SMP ANAK HEBAT PAPUA		0.42	High
6.	SPPG Yayasan Peduli Kasih Mimika (Kota Baru 3)	SMP Negeri 2 Jayapura	Abepura	0.38	High
7.	SPPG Yayasan Bersama Berkarya Papua, Kota Baru 1	SMP Al – Ihsan Kotaraja	Abepura	1.45	High
8.	SPPG Yayasan Asy Syarif Al Mubarok	SMP NEGERI 11 JAYAPURA	Heram	0.78	High
9.	SPPG Yayasan Vaimbari Suluh Papua, Hedam	SMP NEGERI 13 JAYAPURA	Heram	2.14	High
		SMP NEGERI 7 JAYAPURA		2.01	High
		SMP YPPK SANTO PAULUS ABEPURA		1.32	High
		SMP YPK HEDAM ABEPURA		0.86	High
		SMP ADVENT ABEPURA		1.31	High
10.	SPPG Yayasan Lembaga Peduli Papua Membangun Sejahtera	SMP Papua Kasih	Heram	5.03	High
11.	SPPG POLRESTA KOTA JAYAPURA	SMP MODERN DARUSSALAM	Muara Tami	0.94	High
		SMP NEGERI MUARA TAMI		10.31	Low
13.	SPPG Yayasan Pintu Berkat Papua	SMP NEGERI 10 JAYAPURA	Muara Tami	26.20	Low
		SMP NEGERI 8 JAYAPURA		3.53	High
14.	SPPG Yayasan Kasuari Bangkit Prima	SMP ALAM TERPADU NURUL HAQ	Muara Tami	3.09	High
		SMP YPPK Kristus Juru Selamat		4.77	High
		SMPIT AS SALAAM JAYAPURA		16.24	Low

Source: Processed by the research team, 2026

Based on Figure 2 (SPPG service coverage map for junior high schools) and Table 3 (SPPG services for junior high schools), the analysis indicates that of the 20 SPPGs located in Jayapura City, 14 (70%) provide services to junior high schools. These 14 SPPGs serve 25 junior high schools, representing 56.8% of the

total 44 junior high schools in Jayapura City. These findings show that while MBG services at the junior high level extend across five districts, the coverage does not yet encompass all existing junior high schools. This situation demonstrates that the mere presence of SPPGs does not automatically result in equitable service coverage, as the relationship between SPPG locations and recipient schools is heavily influenced by their respective geographical positions. This aligns with the study by Wang et al. [2], which explains that the equitable distribution of educational services can be assessed through inter-regional accessibility, while Han et al. [3] demonstrate that the spatial disparity between facilities and service recipients can lead to varying levels of service coverage. In the context of the MBG program, the location of the SPPG is a critical factor, as the SPPG functions as a service hub required to reach schools—the target beneficiary group.

When measured by straight-line distance, the majority of connections between SPPGs and junior high schools fall into the high-accessibility category. Of the 25 schools served, 21 are located within a distance of 6 km or less, while four are located more than 6 km away. Schools located at relatively long distances include SMP Kartika VI–1 (6.68 km from the Karya Anak Perdamaian Foundation SPPG), SMP Negeri Muara Tami (10.31 km from the Jayapura City Police SPPG), SMP Negeri 10 Jayapura (26.20 km from the Pintu Berkat Papua Foundation SPPG), and SMPIT As Salaam Jayapura (16.24 km from the Kasuari Bangkit Prima Foundation SPPG). These distances are significant because Decree No. 401.1 of 2025 issued by the Head of the National Nutrition Agency of the Republic of Indonesia stipulates that SPPG locations should ideally be situated near educational institutions or target beneficiary groups, within a maximum radius of 6 km. Consequently, schools exceeding this limit present accessibility issues that require attention during the implementation of the MBG distribution program. This reinforces the views of Sharma and Patil [5] and Marques et al. [6] that variations in distance and spatial conditions can lead to disparities in facility accessibility across different regions.

Regional Disparities in Service Affordability

The accessibility patterns of SPPGs (Free Nutritious Meal Service Points) relative to junior high schools (SMP) indicate that while most schools are located relatively close to an SPPG, some remain at a considerable distance. The most striking example is found in the Muara Tami District. In this area, SMP Modern Darussalam is located 0.94 km from the Jayapura City Police (Polresta) SPPG—falling into the high accessibility category—whereas SMP Negeri Muara Tami is 10.31 km away, placing it in the low accessibility category. An even greater disparity is observed regarding the SPPG at Yayasan Pintu Berkat Papua; the distance to SMP Negeri 10 Jayapura is 26.20 km, while the distance to SMP Negeri 8 Jayapura is only 3.53 km (categorized as high accessibility). These findings demonstrate that a single SPPG can exhibit varying levels of accessibility regarding the schools it serves. Consequently, assessing distribution based solely on the number of schools served is insufficient; one must also consider the specific location of each school relative to the service center. This aligns with the accessibility concepts proposed by Wang et al. [2] and Han et al. [3], which state that service coverage is heavily influenced by the spatial relationship between facilities and user locations.

These conditions also highlight the importance of a GIS-based approach in evaluating the distribution of the Free Nutritious Meal Program (MBG). Mapping results allow for the identification of schools situated close to SPPGs as well as those located further away. Studies by Meena et al. [7], Deniz [8], and Abulibdeh et al. [9] demonstrate that GIS can be utilized to measure distances, visualize facility distribution patterns, and analyze accessibility based on spatial conditions. However, the straight-line distance used in this study does not fully capture the actual travel distance required for distribution. Actual distances may be longer, as distribution must follow existing road networks, topography, and available transportation patterns. Therefore, schools located within a service radius based on straight-line distance do not necessarily share

the same level of distribution accessibility. This is particularly important for Jayapura City, where spatial characteristics and road network configurations vary across different areas. Consequently, the study findings indicate that enhancing the equitable distribution of the Free Nutritious Meal (MBG) service involves more than simply increasing the number of service points (SPPG); it also requires considering the location of SPPGs relative to schools, distribution distances, and road network conditions. This approach aligns with the location-allocation concept, which treats facility locations and user locations as two critical components in determining more effective service patterns [15], [17].

5. Conclusion

Research findings indicate that the distribution of 44 Junior High Schools (SMP) and 20 SPPGs across the five districts of Jayapura City is uneven, based on a straight-line distance analysis. Fourteen SPPGs (70%) serve 25 SMPs (56.8% of the total); specifically, 21 schools fall within a maximum radius of 6 km, while four lie outside this radius. The greatest distances were recorded for SMP Negeri 10 Jayapura (26.20 km), followed by SMPIT As Salaam Jayapura (16.24 km) and SMP Negeri Muara Tami (10.31 km) from their nearest SPPGs. Although these findings highlight limited coverage based on the applied distance criteria, they do not directly imply that these schools do not receive MBG services.

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