

ANALYSIS OF THE SETTLEMENT SERVICE CENTER SYSTEM ON THE EFFECTIVENESS OF KUPANG CITY SPATIAL PLANNING POLICY

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ABSTRACT

The purpose of this study is to analyze the settlement service center system in relation to the effectiveness of spatial planning policy in Kupang City. This study employs a descriptive quantitative approach using scalogram analysis, the Hansen gravity model, and an evaluation of the Kupang City Spatial Plan (RTRW) 2011–2031. The results indicate that the Coefficient of Reproducibility (COR) value is below the feasibility standard (<0.9), showing that the distribution of facilities in Kupang City is still uneven. Gravity analysis reveals that Oebobo and Maulafa Districts have relatively higher levels of accessibility and regional interaction compared to other districts. Meanwhile, several districts still experience limitations in educational, health, and economic facilities. These conditions indicate that the implementation of spatial planning policy has not yet fully aligned with the directions of the Kupang City RTRW 2011–2031. This study recommends the equitable distribution of public facilities, the strengthening of secondary service centers, and the improvement of interregional infrastructure to support balanced development and the effectiveness of spatial planning policy in Kupang City.

Keywords: Settlement Service Centers, Effectiveness of Spatial Planning Policy, Scalogram, Gravity Model, RTRW, Kupang City.

I. INTRODUCTION

Globally, rapid urban growth in developing countries has presented various challenges in ensuring equitable access to public services and residential facilities. A 2022 UN-Habitat report indicates that approximately 40% of the world's cities still experience spatial inequality in the provision of basic services. This situation places the issue of equitable facilities as a key agenda item in sustainable development, particularly through Sustainable Development Goals (SDGs) Goal 11, which emphasizes inclusive, safe, resilient, and sustainable urban and residential development.

Within this framework, spatial planning policy serves as a key instrument for controlling spatial structures and regulating the settlement service center system, ensuring more equitable and equitable regional development. Urban development in Indonesia is experiencing rapid dynamics in line with increasing rates of urbanization, population growth, and the expansion of economic activity. Data from the Central Statistics Agency (BPS) shows that in 2023, approximately 57.6% of Indonesia's population lived in urban areas, and this figure is projected to increase to 67% by 2045. Population growth in urban areas places significant pressure on the availability of basic infrastructure and public services such as housing, education, health, and transportation. One of the biggest challenges in this context is how spatial planning

systems and development policies can regulate the distribution of residential service centers so that equitable development can be achieved sustainably.

The Urban and Rural Area Statistics results published by the Central Statistics Agency (2023) show that the disparity in the provision of public facilities between urban areas in Indonesia remains relatively high. Approximately 64.2% of educational facilities and 70.5% of healthcare facilities are concentrated in the city center, while the suburbs have a much lower proportion of these facilities. This condition is consistent with the national trend of increasing urbanization, from approximately 50% of the population living in urban areas in 2010 to 57% in 2020, and is projected to reach nearly 67% by 2035. This increase reflects a shift in population concentration from rural to urban areas due to job opportunities, growth in the service and industrial sectors, and the availability of public services in cities.

To address the pressure on services resulting from urbanization and the unequal distribution of these facilities, a spatial planning mechanism is needed that can structuredly control the distribution of activity centers. In the context of regional and urban planning, this mechanism is realized through a system of settlement service centers.

The settlement service center system essentially refers to the arrangement of spatial structures based on a hierarchy of activity centers, consisting of primary, secondary, and tertiary service centers according to their scale and service reach. This concept is rooted in the central place theory, which explains that service facilities and activities tend to form a tiered pattern based on thresholds and service ranges. In the context of spatial planning policy, the settlement service center system serves as an instrument for distributing facilities proportionally across regions, ensuring that each region has relatively equal access to basic services.

Locally, Kupang City, as the capital of East Nusa Tenggara (NTT) Province, is the center of government, economic, educational, and socio-cultural activities in eastern Indonesia. As a destination for urbanization and regional migration, Kupang City should have a settlement service center system that functions in a balanced manner across sub-districts, as directed in the Kupang City Spatial Plan (RTRW) for 2011-2031, established through Kupang City Regional Regulation Number 11 of 2011 concerning the Kupang City Spatial Plan for 2011-2031. This RTRW emphasizes the development of tiered service centers to reduce the concentration of activities in the city center and improve access to services in outlying areas.

According to the publication "Kupang City in Figures" published by the Central Statistics Agency (BPS), the population of Kupang City shows an annual increase. In 2020, the population was recorded at 442,758, increasing to 455,847 in 2021 and 468,913 in 2022. In 2023, the population was recorded at 466,632, spread across six sub-districts: Alak, Maulafa, Oebobo, Kota Raja, Kelapa Lima, and Kota Lama. This population increase indicates a dynamic growth that has a direct impact on the increasing need for residential services at the city level.

Economically, centers of trade and service activities also show spatial concentration in several core sub-districts. Formal economic activity is concentrated in Oebobo, Kelapa Lima, and Kota Raja, which are home to shopping centers, large markets, and modern service areas, such as Lippo Plaza Kupang and Transmart

Kupang, as well as major traditional markets like Pasar Oeba. This concentration of economic facilities allows the city center to function as a primary service center, while the outlying districts are still dominated by local-scale activities. This imbalance leads to unequal access to economic opportunities and reinforces the dependence of outlying areas on the city center.

The unequal distribution of health, education, and economic facilities also influences the dynamics of residential behavior and daily mobility. The concentration of services in certain areas drives movement toward the city center, increasing the burden on infrastructure, and reinforcing the tendency for activity to be concentrated. This phenomenon aligns with Walter Christaller's Central Place Theory, which explains that service facilities form a hierarchical structure, and centers with more comprehensive functions attract population movement from surrounding areas. Furthermore, from the perspective of location and accessibility theory developed by William Alonso, access to activity centers and public facilities is a crucial factor influencing location choices and urban development patterns. Although residential decisions are influenced by various social, economic, and individual preference factors, the distribution of public facilities remains a crucial spatial determinant in shaping spatial structure. Thus, spatial inequality is not solely a technical issue of facility provision but also relates to the effectiveness of the service system in shaping a hierarchical and balanced urban spatial structure.

Empirical findings indicate that the main service centers are still dominated by a few sub-districts with relatively complete facilities, while other sub-districts experience limited basic services. This situation indicates a mismatch between the direction of spatial planning policy and the reality of service distribution on the ground. This imbalance reflects not only differences in facility availability but also indicates that the settlement service center system is not functioning optimally in creating a balanced service structure.

Thus, the issue of service distribution in Kupang City not only reflects spatial inequality but also demonstrates the limitations of the implementation of the 2011-2031 Kupang City Spatial Plan (RTRW) in operationalizing the settlement service center system as an instrument for controlling regional development. This situation emphasizes the importance of a comprehensive analysis to assess the relationship between the service center structure and the effectiveness of spatial planning policies to support sustainable and equitable urban development. Furthermore, such an analysis also serves to identify discrepancies between planned and realized regional development, assess the spatial implications of the distribution of public facilities, and provide a scientific basis for formulating more adaptive, inclusive, participatory, and empirically data-driven spatial planning strategies to support improved public service quality and balanced development across regions in Kupang City.

With these considerations in mind, this study was conducted to address the limitations of previous studies, which, although they had identified the hierarchy of service centers and the level of facility equity, had not explicitly evaluated the relationship between the established service structure and the consistency of RTRW implementation as a spatial control instrument in Kupang City. This study used an approach that integrates spatial analysis with spatial policy evaluation, emphasizing

the importance of consistency between the planning process, plan content, and its implementation. Through this approach, the study is expected to provide a more precise understanding of the extent to which the equity of the settlement service system reflects the effectiveness of spatial policy in accordance with the vision and direction of the 2011-2031 RTRW.

II. RESEARCH METHODS

This research is a descriptive quantitative study aimed at describing and analyzing the settlement service center system and the effectiveness of spatial planning policies based on numerical and spatial data. This type of research was chosen because it focuses on providing an objective picture of the distribution of public facilities between sub-districts and assessing their compliance with the Kupang City Spatial Plan (RTRW) 2011-2031. The analysis was conducted systematically and accurately on spatial phenomena and public services.

The research employed a quantitative approach with descriptive and evaluative spatial analysis methods. The quantitative approach was chosen because this research focuses on objectively measuring the condition of the settlement service center system based on numerical and spatial data. Meanwhile, descriptive and evaluative spatial analysis methods were chosen to describe the distribution patterns of public facilities between sub-districts and assess their compliance with the Kupang City Spatial Plan (RTRW) 2011-2031. The analytical techniques used included a scalogram for the service hierarchy and the Hansen gravity model for regional accessibility. The analysis results were evaluated against the RTRW to assess the equity of settlement services.

The type of data used in this study is quantitative, numeric, and can be measured objectively. This data is used to describe the condition of the settlement service center system and assess the effectiveness of spatial planning policies in Kupang City.

Data collection in this study was conducted using several techniques to obtain complete, accurate, and relevant data for the research objectives. Data collection techniques used included observation, interviews, recording, and documentation.

Data Analysis Techniques Using Scalogram Analysis Scalogram analysis is a method used to assess a region's ability to provide services to its residents. Gravity Model Analysis and Hansen Potential Analysis Gravity model analysis is used to measure the level of interaction between settlement service centers based on the size or attractiveness of an area (such as the number of facilities and population) and the distance between sub-districts. The analysis of the effectiveness of spatial planning policies was conducted using an evaluative approach, namely by comparing policy directives in the Kupang City Spatial Plan 2011-2031 with actual conditions on the ground based on the results of spatial analysis.

III. RESULTS AND DISCUSSION

Table 1
Results of Scalogram Analysis in Kupang City

Subdistrict	Population (People)	Number of Facilities	Error	Orde
Maulafa	112939	15	0	Orde I
Oebobo	105939	14	0	Orde II
King City	60178	14	2	Orde II
Old City	78529	14	2	Orde II
Alak	89014	13	4	Orde III
Five Coconuts	36138	12	2	Orde IV

Source: Processed data, 2026

Table 2
Gravity Analysis of Kupang City 2025

District of Origin	District of Destination	Population of Origin	Population of Destination	Distance	Distance ²	Interaction
Alak	Maulafa	89014	112939	13	169	59486107,37
	Oebobo	89014	105936	15	225	41910164,91
	King Ciy	89014	60178	10	100	53566844,92
	Five Coconuts	89014	78529	16	256	27305392,21
	Old City	89014	36138	9	81	39713431,26
Maulafa	Oebobo	112939	105936	5	25	478572236,16
	King City	112939	60178	4	16	424777696,38
	Five Coconuts	112939	78529	12	144	61590185,63
	Old City	112939	36138	10	100	40813895,82
Oebobo	King City	105936	60178	8	64	99609634,50
	Five Coconuts	105936	78529	7	49	169776492,73
	Old City	105936	36138	10	100	38283151,68
King City	Five Coconuts	60178	78529	11	121	39055522,00
	Old City	60178	36138	7	49	44381889,06
Five Coconuts	Old city	78529	36138	10	100	28378810,02

2026 Source: Processed data, 2026

Distribution Patterns and Hierarchy of Settlement Service Centers

The distribution pattern of residential service centers in Kupang City shows a tendency to be concentrated in certain areas, particularly the Maulafa and Oebobo Districts. Based on the results of the scalogram analysis, these two areas have a higher level of facility completeness than other districts, thus occupying the top of the service hierarchy. However, this position is influenced not only by the number of available facilities but also by the quality of services offered by each area. This quality of service

encompasses the capacity of facilities to serve the community, the level of regional accessibility, the intensity of economic and social activity, the reach of services, and the ability of facilities to effectively meet community needs. This condition indicates that the residential service system in Kupang City has formed a hierarchical structure, with some areas playing a more dominant role as service centers than others. This finding aligns with Sjafrizal's view that urban development is strongly influenced by the distribution of economic activity and the intensity of interaction between regions, which then form service centers (Sjafrizal, 2012). Thus, the existence of service centers is not only determined by administrative provisions in spatial planning but also by the dynamics of economic activity, population mobility, and the quality of services that develop empirically in the field.

From the perspective of the Central Place Theory proposed by Christaller (1933), a center with more complete facilities and better service quality will have a wider service reach because it is able to serve the needs of the surrounding community. This theory explains that a service center will develop according to the level of completeness of its facilities, accessibility, and intensity of economic activity. This condition is evident in the Maulafa and Oebobo sub-districts, which have a greater concentration of educational, health, trade, and service facilities than other sub-districts. The high level of completeness of these facilities is supported by relatively high service quality, such as the presence of a hospital with a large service capacity, more comprehensive educational facilities, good regional accessibility, and growing trade and service activities. These conditions make these two sub-districts have a stronger service appeal, making them centers of community activity in Kupang City.

Maulafa sub-district demonstrates the most adequate service quality as a primary service center due to its relatively comprehensive educational and health service capacity, rapid residential development, and a high population. Furthermore, good regional accessibility leads to a more rapid increase in the intensity of public services compared to other sub-districts. The presence of hospitals, educational facilities from elementary to higher education, and the growth of trade and service activities indicate that Maulafa has relatively strong service capabilities and is able to serve the community on a broader scale. On the other hand, Oebobo District has developed as a very strong secondary service center, supported by a concentration of trade, services, education, and healthcare activities with high service intensity. High community mobility and regional connectivity have resulted in Oebobo having adequate service quality to support urban service functions in Kupang City.

However, the service structure established in Kupang City does not fully reflect a balanced hierarchical pattern, as reflected in the polycentric principle of modern regional planning. Theoretically, a service center system should be able to create a relatively equitable distribution of services across regions through the division of functions between primary and secondary centers. However, research results indicate that facilities and service quality still tend to be concentrated in certain areas, particularly in the core urban area. This condition indicates a tendency towards centralization, where certain regions develop much faster than others. Parr (2002) calls this condition an imbalance in service structure, namely a situation where the

distribution of facilities, service quality, and economic activities are more concentrated in certain centers, thus giving rise to spatial inequality between regions.

The concentration of services in Maulafa and Oebobo can also be explained through Gunnar Myrdal's (1957) theory of cumulative causation. According to Myrdal, developed areas will continue to attract investment, population, infrastructure, and new facilities, strengthening their position as growth centers. Conversely, less developed areas will increasingly fall behind due to their lower economic attractiveness. This phenomenon is evident in Kupang City, where Maulafa and Oebobo have experienced faster facility development and improved service quality than other sub-districts. High accessibility, residential development, commercial activity, and the concentration of public services have led to these two areas continuously strengthening their function as primary service centers. In this context, the development of service centers occurs not only due to spatial planning policies but also due to a cumulative process of spatial strengthening.

Furthermore, the centrality index theory proposed by Berry and Garrison (1958) also supports the findings of this study. This concept explains that areas with a better number, type of facilities, and quality of services will have a higher level of centrality, thus playing a dominant role in the service system. The research results show that Maulafa District has a very high level of completeness of facilities, particularly in education and residential areas, while Oebobo is developing as a center for trade, services, and healthcare. This condition causes these two areas to have a greater influence on the spatial structure of Kupang City than other districts.

This research finding also aligns with previous empirical research. Meilani et al.'s (2025) study on the residential service center system in Kupang City showed that Maulafa and Oebobo Districts are primary service centers with a COR value of 0.888889, which is below the ideal standard of ≥ 0.9 . This value indicates that the distribution of service facilities in Kupang City is not yet fully equitable. Patrik et al.'s (2021) study in Bitung City also found that the city center has a much higher level of interaction and service provision than the outskirts, resulting in a tendency towards centralized spatial planning. Similar findings were also obtained by Utari (2015) in Yogyakarta City, which showed that areas with high centrality tend to have a higher concentration of education and health facilities than other areas. The similarity of these research results suggests that spatial inequality in urban service systems is a common phenomenon across developing cities.

Empirically, the dominance of services in Maulafa and Oebobo is evident not only in the high number of available facilities, but also in the quality of services provided in both areas. Maulafa District has approximately 211 facilities, covering education, health, places of worship, and economic facilities. This area is rapidly developing as a residential and educational area, with a relatively high number of schools: 34 elementary schools, 16 junior high schools, and 13 senior high schools/vocational schools. Furthermore, the presence of hospitals and the development of new residential areas indicate that Maulafa has a strong service capacity to support community needs. Meanwhile, Oebobo District has approximately 194 facilities and is developing as a center for economic, trade, service, and government activities. The presence of strategic facilities such as Citra Bangsa

University Kupang, Muhammadiyah University Kupang, and Prof. Dr. W. Z. Johannes Kupang Regional General Hospital strengthens Oebobo's role as the primary service center in Kupang City. The high concentration of these facilities indicates that the two sub-districts have a much greater capacity and quality of service than other sub-districts.

Field observations further support these findings. Service activities and community mobility appear to be more concentrated in the Maulafa and Oebobo sub-districts than in other areas. Oebobo sub-district exhibits high levels of economic and social activity, characterized by dense traffic, a concentration of shops, trade activities, and high levels of community mobility to educational and health facilities. This situation indicates that Oebobo serves as an urban activity center serving residents from various sub-districts. On the other hand, Maulafa sub-district exhibits very rapid residential development, with increasing housing development and educational activities. The high intensity of social and educational activities in this area demonstrates its role as a new growth center and a key buffer zone for the development of Kupang City. This indicates that the quality of services in these two areas is sufficient to support their function as primary service centers within the spatial structure of Kupang City.

Conversely, sub-districts lower in the service hierarchy still exhibit significant limitations in service quality. Alak sub-district has approximately 179 facilities, but the quality of these services is still limited to basic services and certain economic facilities, particularly markets and large-scale trade facilities. The uneven population distribution and relatively limited regional accessibility have resulted in underdeveloped service coverage.

The presence of Ben Mboi Central General Hospital in Alak District demonstrates that this region actually has significant strategic health service potential within the Kupang City service structure. The presence of this regional-scale hospital has significantly impacted the quality of health services in Alak District, particularly in providing referral health services for residents of Kupang City and other areas in East Nusa Tenggara Province. This demonstrates that although Alak District is lower in the service hierarchy than Maulafa and Oebobo, it still boasts facilities with high service capacity that serve a broader community.

However, the presence of Ben Mboi Hospital has not yet fully established Alak District as a primary service center. This is because a region's service structure is not solely determined by the presence of a single large facility but is also influenced by the concentration and integration of other facilities, such as education, trade, and services, as well as the overall accessibility of the region. Compared to Maulafa and Oebobo, which have a more diverse concentration of facilities and more intensive urban activity, Alak District still shows limitations in other service sectors, resulting in under-development of its service functions.

In terms of service quality, the presence of Ben Mboi Hospital demonstrates that Alak District has a significant health service capacity within the Kupang City service system. The hospital has the potential to increase the attractiveness of regional services because it can provide health services on a larger scale than basic health facilities such as community health centers or clinics. Furthermore, the presence of this

hospital can also encourage the development of other supporting activities such as health services, trade, transportation, and housing in the surrounding area. From a spatial perspective, this condition indicates that Alak District has the potential to develop as a supporting health service center for Kupang City.

However, observations indicate that the development of service quality in Alak District still faces several limitations, particularly related to regional accessibility, uneven distribution of service facilities, and a lower intensity of urban activity compared to the city's core areas. Alak's large area means that service coverage between areas is not fully optimized. Consequently, despite having strategic health facilities, the overall influence of Alak District's services is still not as strong as that of districts with higher service hierarchies.

Thus, the presence of Ben Mboi Hospital demonstrates that Alak District has strategic and high-quality health care facilities, but the overall capacity of the region is still insufficient to make it a primary service center in Kupang City. This situation demonstrates that the quality of regional services is not solely determined by the presence of a single superior facility, but also by the integration of other facilities, accessibility, intensity of economic activity, and the region's ability to establish a sustainable concentration of services.

Kelapa Lima District has approximately 137 facilities, but does not yet have advanced health facilities such as hospitals, so public health services remain dependent on the central area. This situation indicates that the distribution of facilities and service quality between districts is uneven and still exhibits significant spatial disparities. This finding can also be explained through the core-periphery concept proposed by Friedmann (1966). Within this concept, core areas tend to have a higher concentration of facilities, investment, and economic activity than peripheral areas. As a result, peripheral areas become dependent on core areas to meet their public service needs. This situation is evident in Kupang City, where low-level sub-districts still have a high level of dependence on Maulafa and Oebobo as their primary service centers. This dependence is evident in the high daily mobility of residents to the city center to access education, health, trade, and service facilities.

From the perspective of location theory and central hierarchy, this condition also indicates that the distribution of facilities and service quality in Kupang City do not fully adhere to the principle of spatial efficiency as explained by Haggett (1965), namely minimizing movement costs and maximizing service efficiency across spaces. The concentration of facilities in certain areas forces residents in peripheral areas to undertake greater mobility to obtain basic services. As a result, service accessibility becomes unequal across sub-districts and has the potential to exacerbate spatial inequality in the city's structure.

Thus, the results of the study indicate that the distribution pattern and hierarchy of residential service centers in Kupang City have formed a hierarchical service structure, but it is not yet fully balanced. The concentration of facilities and service quality is still dominant in Maulafa and Oebobo Districts, while other districts still have limited facilities, service quality, and a fairly high level of dependence on the central area. This condition indicates that the residential service system in Kupang City still tends to be centralized and does not fully reflect the principle of equal service

distribution as directed in the concept of modern regional planning and the Kupang City Spatial Plan 2011–2031.

Level of Connectivity and Accessibility Between Service Centers

The gravity analysis results indicate that the level of inter-regional connectivity in Kupang City is significantly influenced by population size, distance between sub-districts, and the concentration of service facilities. The highest interaction occurs between Maulafa and Oebobo Sub-districts, indicating that these two areas serve as primary interaction centers in Kupang City's service system. This finding aligns with the gravity model developed by Walter Isard (1960), which explains that the intensity of inter-regional interaction is directly proportional to population size and inversely proportional to distance between regions. In this context, the larger the population and the closer the distance between regions, the higher the level of interaction.

Empirically, the gravity calculation results show that the interaction value between Maulafa and Oebobo Sub-districts reaches 478,572,236.16, the highest compared to other sub-district pairs. These high values are influenced by the large population of 112,939 in Maulafa District and 105,936 in Oebobo District, as well as the relatively close distance between the two areas, approximately 5 km. Furthermore, the high concentration of educational, health, trade, and service facilities in both areas strengthens the intensity of functional relationships between the sub-districts. High interaction also occurs between Maulafa District and Kota Raja District, with 424,777,696.38, and between Oebobo and Kelapa Lima, with 169,776,492.73. This condition indicates that the core area of Kupang City has much stronger spatial relationships than other areas.

From a location theory perspective, Hoover and Giarratani (1984) explain that areas with high accessibility tend to be more attractive to economic and social activities. This concept is clearly evident in Maulafa and Oebobo Districts, which have developed as centers of community mobility in Kupang City. High accessibility makes these two areas strategic locations for the development of residential, commercial, educational, and public services. Thus, the relationship between accessibility and activity concentration indicates that the development of service centers is influenced not only by the number of facilities but also by the ease of access between regions.

This condition is also relevant to Hansen's (1959) accessibility potential theory, which emphasizes that the level of accessibility of a region is determined by the ease of reaching service centers from other regions. According to Hansen, regions with easier access to various facilities will have a higher level of interaction than regions with lower accessibility. In the context of Kupang City, Maulafa and Oebobo have relatively strategic positions within the city's service network, making them more easily accessible to residents from various sub-districts. Consequently, these two regions have developed as service centers with a higher intensity of interaction compared to other sub-districts.

Field observations further support these findings. Public mobility to the Maulafa and Oebobo sub-districts appears very high, especially during rush hour. Traffic from the outskirts to the city center appears congested on the routes connecting the Alak, Kelapa Lima, and Kota Lama sub-districts with the Oebobo and Maulafa

areas. Most residents travel daily to access the education, health, trade, and service facilities concentrated in these areas. This high mobility indicates that these two sub-districts function as primary activity centers, serving the needs of residents from various areas of Kupang City.

This situation demonstrates a close relationship between the service center system and population mobility patterns. Haggett (1965) explained that the spatial organization of regions aims to minimize movement costs and increase the efficiency of services across spatial boundaries. However, in practice, the service system in Kupang City is not yet fully efficient because most activities are still concentrated in certain centers. Consequently, residents from the outskirts must undertake greater mobility to access basic services. This situation indicates that the distribution of services has not been able to create balanced accessibility across sub-districts.

Furthermore, the research results also indicate a discrepancy between administrative boundaries and the service reach of facilities. One example is the location of Siloam Kupang Hospital, which is administratively located in Oebobo District, but is spatially closer and more accessible to residents of Kelapa Lima District. This situation indicates that public service patterns in practice are more influenced by geographic proximity and road networks than by administrative boundaries. This finding reinforces Hansen's (1959) concept of accessibility, which asserts that ease of access is a primary factor in determining the level of service facility utilization. Thus, service effectiveness is determined not only by the facility's administrative location, but also by its spatial connectivity and ease of public access to that facility.

Although functional relationships between regions have been established, interaction patterns still show strong concentration in certain areas. Districts with low levels of interaction, such as Kelapa Lima and Kota Lama, show limited accessibility and connectivity compared to the city core. This is evident in the interaction value between Kelapa Lima and Kota Lama, which is only 28,378,810.02, the lowest value in the gravity analysis. This low level of interaction indicates that service connections between outlying areas are still relatively weak and underdeveloped.

This condition can be explained through the concept of uneven accessibility proposed by Rodrigue (2020), namely the inequality in accessibility resulting from differences in the quality of transportation networks, distribution of facilities, and the level of connectivity between regions. In the context of Kupang City, the central area has much better accessibility than the outlying areas, resulting in greater concentration of economic activity and services in the city center. Conversely, areas with low accessibility tend to experience limited interaction and dependence on primary service centers. On the ground, residents in certain areas still have to travel longer distances to access educational, health, and commercial facilities. This situation results in increased travel time, travel costs, and increased dependence on the central area.

In addition to being influenced by the distribution of facilities, inequality in interregional interactions is also related to the condition of transportation infrastructure. Litman (2013) explains that the quality of the transportation network significantly determines the level of service efficiency and regional mobility. Uneven road infrastructure and limited transportation facilities can weaken the connectivity

between service centers and hinder equitable regional development. In the context of Kupang City, several outlying areas still have lower-quality road access than the city center, resulting in less-than-optimal public mobility. This condition tends to result in the distribution of services and economic activity remaining concentrated in areas with high accessibility.

Research by Patrik et al. (2021) in Bitung City found that the city center has the highest level of gravitational interaction compared to outlying areas, resulting in a more centralized service pattern. Research by Sendi et al. (2019) in Samosir Regency also showed that limited transportation access results in weak and uneven connectivity between service centers. Furthermore, research by Yuliani et al. (2023) in Manado City found that the concentration of facilities in the city center results in lower levels of accessibility and service delivery in outlying areas. The similarity of these results indicates that unequal interaction and accessibility are common issues in Indonesia's urban service systems, particularly in cities where regional growth is still concentrated in core areas.

In addition to being influenced by population size and distance between regions, high levels of gravitational interaction also indicate the influence of the quality of service facilities in each sub-district. Areas with facilities with greater service capacity, a more comprehensive range of services, and more adequate service quality tend to attract more interaction than areas with limited service. This is evident in the Maulafa and Oebobo sub-districts, which not only have a greater number of facilities but are also supported by the presence of strategic facilities such as hospitals, universities, shopping centers, and service areas that can serve the community on a city-wide scale. Conversely, several other sub-districts still have limited advanced service facilities, requiring residents to travel to the central area to obtain certain services. This indicates that service quality influences the intensity of inter-regional connectivity and strengthens the function of certain sub-districts as primary service centers in Kupang City.

Although Alak District has a lower level of interaction than Maulafa and Oebobo, the presence of the Ben Mboi Kupang Central General Hospital (RSUP) significantly impacts the health services in the region. This hospital has a referral health service capacity, serving residents not only from Kupang City but also from other regions in East Nusa Tenggara Province. This situation demonstrates that the quality of certain facilities can improve the service function of a region, even though the overall level of facility concentration and interaction is still lower than that of the city's main service center.

Thus, the level of interconnectedness and accessibility between service centers in Kupang City indicates that functional relationships between regions have been established, but remain unbalanced. Regional interaction remains concentrated in Maulafa and Oebobo Districts as the main service centers, while other areas still have relatively lower levels of connectivity and accessibility. This situation indicates that the regional service system in Kupang City is not yet fully efficient and still faces challenges in achieving equitable accessibility and balanced interaction between districts, as directed in the Kupang City Spatial Plan (RTRW) for 2011-2031.

Room Service Center System and Spatial Planning Policy Effectiveness

The settlement service center system in Kupang City demonstrates that empirically, inter-regional service development has not fully developed in a balanced manner, as directed in the Kupang City Spatial Plan (RTRW) for 2011–2031. Normatively, the RTRW establishes a polycentric spatial structure through the division of functions between the City Service Center (PPK) and the City Service Sub-Center (SPPK), with Oebobo District as the main center of city services.

The research results do not indicate a change in the function of the service center normatively, but rather illustrate the level of development and completeness of service facilities across sub-districts based on empirical conditions on the ground. In this context, the results of the scalogram analysis indicate that several sub-districts, particularly Maulafa, have a relatively high level of facility completeness and intensity of service activities compared to other areas. This condition indicates the dynamics of service development, which in practice evolves according to accessibility, settlement growth, and the concentration of regional economic activity.

This condition reflects an implementation gap, namely the gap between the direction of service development planned in spatial planning policies and the dynamics of regional development empirically on the ground (Hill & Hupe, 2002). From a policy effectiveness perspective, Van Meter and Van Horn (1975) explained that the success of policy implementation is influenced by the consistency of policy objectives, resources, communication between implementers, and the implementation environment. Therefore, the effectiveness of the RTRW is measured not only by the existence of a normative spatial structure, but also by the extent to which the distribution of facilities and service development between regions can develop in accordance with the planned direction of service equity.

Empirically, the results of the scalogram analysis indicate that Maulafa District has the highest level of facility completeness, with a total of approximately 211 facilities, placing it in Order I. Meanwhile, Oebobo District is in Order II, despite being normatively designated as a PPK in the RTRW. The scalogram results indicate the empirical level of facility completeness, not the normative change in the function of service centers as stipulated in the RTRW. However, these results indicate that service development in Kupang City tends to shift the concentration of activities toward areas with higher growth capacity, particularly in terms of accessibility, residential development, and economic activity. This finding aligns with Sjafrizal's (2012) view that the development of service centers is strongly influenced by the intensity of economic activity and interregional interactions, allowing service centers to develop dynamically following the concentration of community activity.

Furthermore, the Coefficient of Reproducibility (COR) value of 0.88889, which is below the standard of feasibility (≥ 0.9), indicates that the settlement service system in Kupang City has not yet established a fully consistent hierarchical pattern. According to Rushton (1969), a low COR value indicates irregularity in the distribution of service facilities, resulting in an underdeveloped service hierarchy. This condition is evident in the persistence of sub-districts with limited facilities, despite being designated as sub-service centers in the RTRW (Regional Spatial Plan). In other words, while the formal service structure has been established, functionally

it has not yet been able to create equitable service distribution across regions. This finding also supports the research of Meilani et al. (2025), which shows that the service center system in Kupang City remains centralized and does not fully support equitable distribution of public facilities across sub-districts.

The gravity analysis also shows that regional interaction remains concentrated in certain sub-districts, particularly between Maulafa and Oebobo, which have the highest interaction value compared to other sub-district pairs. This high level of interaction is influenced by the large population, proximity, and high concentration of educational, health, trade, and service facilities in these two areas. In the theory of spatial gravity, Hansen (1959) explains that areas with high levels of accessibility will have greater interaction attraction than other areas. This condition indicates that the development of service centers in Kupang City is more influenced by accessibility and activity concentration factors than by the spatial structure guidelines planned in the RTRW. As a result, other sub-districts such as Alak, Kelapa Lima, and Kota Lama remain highly dependent on the central area to meet public service needs.

In addition to the distribution of facilities, the effectiveness of the service center system is also influenced by the quality of services available in each area. Maulafa and Oebobo sub-districts not only have a greater number of facilities but are also supported by more adequate service capacity, such as the presence of referral hospitals, universities, trade centers, and service facilities with city-scale service coverage. In contrast, several other sub-districts still have limited advanced service facilities, leaving residents dependent on the central area. This situation demonstrates that service disparities in Kupang City exist not only in the quantity of facilities, but also in the quality and capacity of services between regions.

The concentration of facility development in certain areas indicates that development in Kupang City still tends to follow a centralized growth pattern. Various strategic facilities, such as universities, hospitals, trade centers, and services, are developing more rapidly in Maulafa and Oebobo Sub-districts, while other areas develop more slowly. This situation aligns with Myrdal's (1957) theory of cumulative causation, which explains that developed areas will continue to attract investment and new facilities, while other areas become increasingly left behind due to weak economic attractiveness and accessibility. This phenomenon also demonstrates the backwash effect, as described by Hirschman (1958), where growth centers absorb resources and activities from surrounding areas, thereby reinforcing spatial disparities between regions. In the context of Kupang City, developed sub-districts are becoming increasingly dominant in the service system, while sub-districts with limited facilities remain dependent on the main center to meet the needs of their residents.

Although Alak District has not yet developed into a major service center, the presence of the Ben Mboi Central General Hospital (RSUP) in Kupang demonstrates that this area is beginning to assume a strategic service function, particularly in the health sector. The hospital has a regional reach, serving the public not only in Kupang City but also in various regions across East Nusa Tenggara Province. This situation demonstrates that the presence of facilities with high-quality services can enhance the service function of a region, even though the overall concentration of facilities and

economic activity is still lower than in Maulafa and Oebobo. Therefore, the development of strategic facilities in non-central areas has the potential to support equitable service distribution and strengthen a more balanced spatial structure.

On the other hand, this empirical situation indicates that the polycentric concept outlined in the RTRW has not been optimally implemented. Formally, several service centers are designated within the city's spatial structure, but functionally, service activities remain concentrated in specific areas. This situation indicates a pseudo-polycentric structure, as explained by Davoudi (2003), a situation where an area administratively has many service centers, but in reality, interactions and activities remain concentrated in one or two dominant areas. This phenomenon indicates that the establishment of new service centers in the RTRW has not been fully followed by the equitable strengthening of facilities, infrastructure, and regional connectivity.

In addition to implementation factors, the effectiveness of spatial planning policies is also influenced by the weak synchronization between spatial planning and sectoral development implementation. In practice, the development of public facilities and infrastructure tends to be directed towards areas that are already developed and have high levels of activity because they are considered more economically efficient and easier to access. As a result, sub-districts, which are normatively designated as sub-service centers, do not receive adequate facility strengthening to develop as alternative centers. This finding aligns with research by Dewi and Rahman (2022), which shows that the discrepancy between the RTRW and actual development is generally caused by weak institutional coordination and suboptimal integration between development sectors.

Overall, the settlement service center system in Kupang City demonstrates that the effectiveness of spatial planning policies is still suboptimal in achieving equitable service distribution across regions. Although the service center structure is normatively planned in the RTRW, its implementation has not been able to direct the distribution of facilities and regional interaction in a balanced manner. The concentration of facilities and activities in certain sub-districts continues to cause spatial disparities, making the Kupang City Spatial Plan (RTRW) less effective as a regional development control instrument. This situation highlights the need to strengthen the implementation of spatial planning policies through equitable distribution of facility development, increased regional connectivity, and synchronized sectoral development.

Therefore, the implementation of the Kupang City Spatial Plan (RTRW) needs to be directed at strengthening secondary service centers through the construction of strategic facilities, improving the quality of public services, equitable distribution of transportation infrastructure, and strengthening inter-regional connectivity. Developing educational, health, and commercial facilities in sub-districts with lower service hierarchies is crucial to reduce community dependence on the central region and support the creation of a more balanced and polycentric spatial structure.

IV. CONCLUSION

Based on the results of research on scalogram analysis, gravity analysis, and the effectiveness of spatial planning policies in Kupang City, the following conclusions can be drawn:

1. The distribution and hierarchy of residential service centers in Kupang City still show regional disparities. Public service facilities are more concentrated in certain sub-districts, particularly Oebobo, Maulafa, Kota Raja, and Kota Lama, which have more advanced facilities and therefore serve as primary service centers. Meanwhile, Alak and Kelapa Lima sub-districts experience lower levels of service due to limited facilities. This situation indicates an unequal distribution of services across sub-districts.
2. The level of interconnectedness and accessibility between regions in Kupang City is still dominated by connections with the main service center. Subdistricts with limited facilities still rely on the central region to meet their educational, healthcare, and economic needs. This indicates that the regional service system is not yet fully integrated and that equitable access to services is still suboptimal.
3. The effectiveness of spatial planning policy implementation in Kupang City has not been optimal. Although the 2011-2031 Kupang City Spatial Plan (RTRW) directs the development of service centers in a tiered and equitable manner, conditions on the ground indicate that there is still an imbalance in the distribution of facilities and the concentration of services in certain areas. Therefore, the implementation of spatial planning policy has not fully achieved equitable service distribution and balanced spatial structure between regions.

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