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ANALYSIS OF VILLAGE DEVELOPMENT IN PESISIR BARAT REGENCY USING THE SCALOGRAM APPROACH, CENTRALIZATION INDEX, AND TOPSIS METHOD

Royiv Agmadeni[1]*, I Wayan Suparta[2], Arivina Ratih Yulihar Taher[3]
[1.2.3]University of Lampung, Indonesia
Corresponding Author:
royiv.agmadeni@gmail.com

Abstract
Village development plays a crucial role in driving regional economic growth. The implementation of the Village Law has accelerated development in rural areas, though inequality remains a major challenge. One way to address this issue is by identifying growth center villages through comprehensive analysis. This study uses a descriptive-analytical approach covering 116 villages in Pesisir Barat Regency. The objective is to identify villages that act as growth centers and hinterlands, helping to highlight areas with high development intensity. Three methods are used: scalogram analysis, centralization index, and the TOPSIS method. Scalogram analysis identified 6 growth center villages and 6 hinterland villages. The centralization index revealed 4 service center villages and 3 hinterland villages, with most villages classified as very underdeveloped in terms of facilities. Using the TOPSIS method, the study found that only 7% of villages had high development intensity, while the majority had moderate levels. These findings emphasize the need for a more balanced distribution and improvement of village facilities, particularly those that can stimulate broader economic impacts.

Keywords: Pesisir Barat Regency Village, Scalogram Analysis, TOPSIS Method, Growth Center.

1. Introduction

Particularly in the fields of agriculture, tourism, and fisheries, Pesisir Barat Regency is one of the regions in Lampung Province that possesses abundant natural resources. However, like many other regions in Indonesia, Pesisir Barat Regency faces various challenges in achieving equitable development. This is reflected in Presidential Regulation of the Republic of Indonesia No. 105 of 2021 on the National Strategy for Accelerating the Development of Disadvantaged Regions for 2020-2024 which classifies Pesisir Barat Regency as one of the underdeveloped regions in Indonesia. According to data published by Statistics Indonesia (BPS), the poverty rate in disadvantaged regions in 2023 reached 24.29%. In addition to the high percentage of impoverished residents, another major issue faced by disadvantaged regions is the development disparity among villages, which often hinders regional progress and impacts the overall quality of life of the people. This challenge is especially significant in areas with specific geographical and socio-economic constraints, making rural development a crucial factor in accelerating economic growth and improving community welfare.

Located in a coastal region, Pesisir Barat Regency has various opportunities that can be leveraged to improve the well-being of its population, particularly in rural areas. However, the lack of development planning based on comprehensive data and analysis often results in these opportunities not being fully utilized. According to (Muslim et al., 2023), villages should not only serve as stabilizers or dynamic agents within the

government bureaucracy but should also play an integrative role in spatial functions, particularly in creating growth centers. The enactment of the Village Law Law of the Republic of Indonesia No. 6 of 2014 on Villages, (2014). The enactment of the Village Law Law of the Republic of Indonesia No. 6 of 2014 on Villages has had a significant impact on rural development, making it a strategic factor that contributes to both regional and national development. Research by Agustina & Yahya, (2022) indicates that rural development plays a crucial role in significantly reducing poverty in Indonesia. Therefore, rural development is a necessary and strategic step in advancing regional development.

Another issue that arises in rural development is the increasing disparity in infrastructure and facilities among villages, leading to the emergence of underdeveloped villages those with limited access to essential development-supporting facilities compared to more advanced villages. This situation highlights the need for effective spatial planning to help alleviate underdeveloped villages, fostering growth centers and regional development so that these villages can progress and reach the same level as more developed ones Mutu'ali, (2003). One approach to enhancing regional development is through area-based development strategies, which enable regions to address various challenges in development. For villages, regional development is essential to promoting growth, ensuring equitable development, and reducing poverty. According to Rondinelli (as cited in Muslim et al., 2023), the concept of regional development consists of three key components: the establishment of growth centers, the integration of spatial functions, and the implementation of effective decentralization.

In general, there are two approaches to explaining the concept of a growth center: the functional approach and the geographical approach. Functionally, a growth center refers to a concentrated business or industrial area with dynamic interrelated elements that drive economic development both within the center itself and in its surrounding areas (hinterland). Geographically, a growth center is characterized by the presence of extensive facilities that enhance accessibility and improve community well-being, making the area attractive for businesses and economic activities (Tarigan, 2016). Several studies have examined the identification of growth centers in different regions. For example, a study conducted by (Marhamah et al., 2023) analyzed sub-district-level growth centers in Gorontalo Regency using the scalogram analysis method, centralization index, and gravity model. The findings identified Limboto sub-district as a potential growth center. However, the study also indicated that Limboto faced challenges in development due to its proximity to Gorontalo City, which attracted more people and economic activity.

A similar study by Veri Listyo et al., (2023), focused on the potential development of village-based growth centers in Kulon Progo Regency but with a different analytical dimension. Their research found that out of 88 villages in the regency, 17 villages were suitable to become growth centers, while 33 villages served as hinterlands. Another study with a similar dimension, conducted by (Suparyanto et al., 2023), concluded that villages designated as growth centers tend to develop more rapidly compared to their surrounding villages.

Based on the literature review above and the current conditions in Pesisir Barat Regency, this study seeks to explore village development in the region by employing several analytical approaches capable of deeply examining spatial and temporal data. In this context, scalogram analysis and the centralization index can be used to identify villages that can be categorized as growth centers and hinterland villages in Pesisir Barat

Regency. In the long term, this classification is expected to contribute to economic growth and create a spread effect on surrounding villages. Additionally, the TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) method offers a systematic evaluation framework to determine villages with high, medium, and low development quality. This classification is based on several criteria, including the Village Development Index score, population size, distance of the village from the capital of Pesisir Barat Regency, the centralization index of each village, and the availability of essential facilities. By integrating three approaches Scalogram Analysis, Centralization Index, and TOPSIS this study aims to provide a more comprehensive understanding of both the potential and challenges in village development within Pesisir Barat Regency. The findings are expected to serve as a valuable reference for policymakers in formulating data-driven village development strategies. Ultimately, this study aspires to contribute to economic growth in Pesisir Barat Regency, enhance overall development quality, and reduce development disparities among villages in the region.

2. Theoretical Background

2.1 Growth Centers

Regional economic growth is influenced by geography, natural resources, and interaction with surrounding areas (Mutu'ali, 2003). Growth centers are strategic areas that stimulate development through the trickle-down effect (Hirschman in Adhitya et al., n.d.). Two main impacts emerge: the Spread Effect, which promotes balanced development, and the Backwash Effect, which may drain resources from peripheral areas. Effective growth centers exhibit four characteristics Tarigan, (2016) strong internal linkages, multiplier effects, geographic concentration, and a stimulative influence on surrounding areas. According to Harahap, (2009), growth centers are structured hierarchically into:

1) Primary (First Order): main regional hubs,
2) Secondary (Second Order): sub-regional development centers,
3) Tertiary (Third Order): local service centers.

2.2 Central Place Theory.

Developed by Christaller Central Place Theory explains the hierarchical distribution of service centers based on population size, income, and spatial reach. Larger centers serve broader areas, while smaller ones serve nearby communities(Riszi Indah Dewi Shara, 2018; Setiono, 2011). This theory informs urban planning and ensures efficient resource and service allocation.

2.3 Village Concept.

Villages are legal, self-governing communities Kartohadikoesoemo, (1984) characterized by four aspects: morphology, population size, economy, and governance (Sapari Imam Asy'ari, 1993). Understanding these elements aids in planning sustainable rural development.

2.4 Multi-Criteria Decision Making (MCDM).

MCDM is a structured method for evaluating options based on multiple criteria (Jaya et al., 2020). It includes MADM (choosing among alternatives) and MODM (optimizing multiple objectives). MCDM supports complex decision-making in areas like planning, economics, and resource management (Mardani et al., 2016).

3. Methods

3.1 Research Design

This study examines 116 villages in Pesisir Barat Regency, Lampung Province, focusing on various factors that influence village development. The research utilizes data on the quantity and availability of essential facilities in each village, including healthcare, social, economic, and educational infrastructure. Additionally, key demographic and resilience indicators, such as population size, the Social Resilience Index, the Economic Resilience Index, and the Ecological/Environmental Resilience Index, are incorporated to provide a comprehensive evaluation of village conditions.

The study relies on secondary data sources, primarily from the Central Bureau of Statistics (BPS of Pesisir Barat Regency, 2024) and the Ministry of Villages, Development of Disadvantaged Regions, and Transmigration of the Republic of Indonesia. To analyze and interpret the data, this research employs a descriptive analysis method alongside ArcGIS software, which facilitates the visualization of spatial distribution patterns among villages. Additionally, quantitative analysis techniques are integrated to strengthen the study's findings and enhance the accuracy of the conclusions.

3.2 Scalogram Analysis

Nuraeni et al., (2017) categorize facilities within a study area into four primary groups based on their shared characteristics: social, educational, healthcare, and economic facilities. Through scalogram analysis, regions that act as growth centers can be identified by assessing the distribution and availability of economic infrastructure, places of worship, educational institutions, and healthcare services (Sitepu & Rahmawati, 2022).
His study applies scalogram analysis to identify villages that function as growth centers and those classified as hinterlands in Pesisir Barat Regency. The analysis is based on a classification framework consisting of four main categories of facilities: education, healthcare, social, and economic. These categories are further broken down into 21 specific facility types, including: kindergarten, elementary school, junior high school, senior high school, vocational high school, private higher education institution, hospital, polyclinic, community health center, pharmacy, mosque and prayer room, church, temple, vihara, hotel, inn, bank, market, cooperative, minimarket, and restaurant. These facility indicators serve as benchmarks for assessing the development level of each village and form the foundation of the scalogram analysis. The data utilized in this study are sourced from the (BPS Pesisir Barat Regency, 2024)

In scalogram analysis, the availability of facilities in each village is represented using a binary system: "1" signifies the presence of a facility, while "0" indicates its absence (Wahyudin, 2022). The next stage involves establishing the village hierarchy in Pesisir Barat Regency through Sturges' method, which classifies villages into different levels to identify those serving as growth centers and their corresponding hinterlands.
To determine the number of hierarchy or strata levels in the scalogram analysis, the following formula is applied (Safira et al., 2023; Wahyudin, 2022):

$$Number\ of\ Strata = 1 + 3{,}33\ LOG\ N$$

Explanation:
n = The number of villages in Pesisir Barat Regency.
The next step is to determine the class interval using the following formula:

$$Class\ Interval = \frac{Ph-Qh}{r}$$

Explanation:
Ph = Highest number of facilities.

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Qh = Lowest number of facilities.
r = Number of strata.

Once the interval results are determined, villages are classified into hierarchical categories. Villages that fall into Hierarchy I or II are identified as potential growth centers, indicating their capability to drive regional development (Wahyudin, 2022). Meanwhile, those classified under Hierarchy III and IV are considered hinterland areas, supporting but not leading economic expansion (Nuraeni et al., 2017; Sitepu & Rahmawati, 2022; Wahyudin, 2022). Villages in Hierarchy V are categorized as underdeveloped, while those in Hierarchy VI and beyond are classified as highly underdeveloped, requiring significant developmental intervention (Wahyudin, 2022). To assess the reliability of the scalogram analysis, the next step involves calculating the Coefficient of Reproducibility (COR), which ensures the accuracy of the classification. The COR is determined using the following formula:

$$COR = 1 - \sum_{Nh*Kh} e$$

Explanation:
e = Number of errors.
Nh = Total subjects analyzed.
Kh = Total facilities analyzed.
The coefficient is considered valid if it falls within the range of 0.9–1 (Priyadi & Atmadji, 2017; Suparyanto et al., 2023; Wahyudin, 2022).

3.3 Marshall Centrality Index

The strategic value of a region can be assessed based on its geographical location, accessibility to essential facilities, and transportation networks. One effective approach for this evaluation is the centrality index. According to Riszi Indah Dewi Shara, (2018), a region's position within the centrality hierarchy is largely determined by the number and variety of facilities it possesses.

The Marshall Centrality Index analysis is employed to classify districts or cities based on their level of centrality. The calculation follows this formula:

$$C=\frac{f1}{T}$$

Where:
C = Weight of a facility
f1 = Combined centrality value, set at 100
T = Total number of facilities in each village in Pesisir Barat Regency

The weighting results indicate that the higher the assigned weight, the greater the potential for the villages to become growth centers.

3.4 TOPSIS Method

Currently, multi-criteria decision-making methods are widely applied across various fields. One of the methods used to address multi-criteria decision-making problems is the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). Yoon and Hwang introduced this method in 1981 as a technique for solving multi-criteria problems, which later became known as the TOPSIS Method (Jaya et al., 2020; Tzeng & Huang, 2011; Yon-Zhou, 2013).

The TOPSIS method provides a solution by evaluating multiple possible alternatives and comparing them. Yoon and Hwang developed TOPSIS based on the principle that the selected alternative should have the shortest distance from the positive ideal solution

and the farthest distance from the negative ideal solution. This assessment is conducted from a geometric perspective using Euclidean distance to determine the relative closeness of an alternative to the optimal solution (Tzeng & Huang, 2011).
The following are the steps involved in conducting an analysis using the TOPSIS method (Kung et al., 2025):

3.4.1 Constructing the Decision Matrix

The decision matrix is created based on a set of alternatives, $D=\{A_k|k=1,...,n\}$, and a set of criteria, $E=\{E_j|\ j=1,...,m$ where $X=\{x_{kj}|\ k=1,...,n;\ j=1,...,m\}$ represents the set of performance ratings, and $w=\{w_j|\ j=1,...,m\}$ denotes the set of weights.

3.4.2 Normalizing the Decision Matrix

Once the matrix is structured, the next step is to normalize it using the following formula:

$$R_{de}(x)=\frac{Xde}{\sqrt{\sum_{e=1}^{k} X^2\, de}},\quad d = 1....., n;\ e= 1.....,m.$$

3.4.3 Weighted Normalization Matrix

The weighted normalization matrix is calculated using the following formula:

$$v_{de}(x) = w_e\, r_{de}(x),\quad d = 1....., n;\ e= 1.....,m.$$

3.4.4 Determining the Positive and Negative Ideal Solution Matrix Values

Calculating the positive and negative ideal solution matrix values using the following formula:

$$SIP = Z^+ = \{v1^+(x), v2^+(x),....., ve^+(x),..... vm^+(x)\}$$
$$=\{(\max v_{de}(x)\ |\ e \in E_1), (\min v_{de}(x)\ |\ e \in E_2)\ |\ d = 1...., n$$
$$SIN = Z^- = \{v1^-(x), v2^-(x),....., ve^-(x),..... vm^-(x)\}$$
$$=\{(\min v_{de}(x)\ |\ e \in E_1), (\max v_{de}(x)\ |\ e \in E_2)\ |\ d = 1...., n$$

3.4.5 Calculating the Euclidean Distance or Separation of SIP and SIN

Computing the Euclidean separation or distance of the positive ideal solution and negative ideal solution using the following formula:

$$G_d^+ = \sqrt{\sum_e^m [v_{de}(x) - v_e^+(x)]^2},\ d = 1....., n$$
$$G_d^- = \sqrt{\sum_e^m [v_{de}(x) - v_e^-(x)]^2},\ d = 1....., n$$

After obtaining the Euclidean distance, the next step is to calculate the ideal preference proximity.

3.4.6 Preference Value for the Ideal Solution.

To determine the preference value for the solution, the following formula is used:

$$H_d^+ = G_d^-/(G_d^+ + G_d^-),\ d = 1....., n.$$

The value of H_d represents the development level based on selected criteria for villages in Pesisir Barat Regency. The next step in this research is to classify the quality of village development following the guidelines from previous studies (Latuconsina et al., 2018). The classification includes high, moderate, and low categories, allowing for easier interpretation:

1) Villages with high development can be prioritized as growth centers.
2) Villages with moderate development meet standard development criteria but require optimization.

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3) Villages with low development require significant attention to improve their conditions.

The classification is determined based on interval ranges, as presented in the table below.

Table 2. Village Development Status Based on TOPSIS Results

No.	Interval Formula	Village Development Criteria
1	X<dM- 1SDh	Low
2	dM - 1SDh <= X < dM + 1SDh	Moderate
3	dM + 1SDh <= X	High

Where: dM = The average of all TOPSIS preference values, SDh = Standard deviation.

4. Results and Discussion

4.1 Scalogram Analysis

Sukirno, (1976),stated that the nodal region concept is the most efficient and ideal approach for analyzing a region's economy. A nodal region refers to an area with a central economic function. This method helps identify both growth centers and their supporting regions**,** providing a clearer understanding of regional development and assisting in determining priority areas for development (Sudarya et al., 2013). This study employs Scalogram Analysis to evaluate the development potential of villages in Pesisir Barat Regency**.** The analysis is based on 21 types of facilities, encompassing social, economic, educational, and health facilities, with a total of 1,007 facility units. The main objective of this analysis is to assess the development progress of each village and classify them into: Growth centers, which have strong development potential. Hinterland villages, which serve as supporting areas for growth centers. The following table presents the Scalogram Analysis results, identifying villages that function as growth centers and those that act as hinterland**s** in Pesisir Barat Regency**.**

Table 3. Results of Scalogram Analysis: Hierarchy of Growth Center Villages and Hinterlands in Pesisir Barat Regency.

No.	District Name	Village Name	Population	Hierarchy
1	Pesisir Tengah	Kampung Jawa	2393	1
2	Pesisir Selatan	Biha	3512	1
3	Ngambur	Negeri Ratu Ngambur	2747	1
4	Pesisir Tengah	Seray	2528	2
5	Pesisir Tengah	Rawas	3400	2
6	Ngaras	Sukarame	1506	2
7	Lemong	Penengahan	2.020	3
8	Ngambur	Sumber Agung	2.590	3
9	Ngambur	Gedung Cahya Kuningan	3.537	3
10	Bangkunat	Penyandingan	1.983	3
11	Pesisir Selatan	Marang	6.046	4
12	Bangkunat	Pagar Bukit	4.969	4

Source: Processed data using MS Excel

Based on the Scalogram Analysis results presented in the table, three villages fall into Hierarchy 1, namely Kampung Jawa in Pesisir Tengah District, Biha in Pesisir Selatan District, and Negeri Ratu Ngambur in Ngambur District. Meanwhile, villages categorized under Hierarchy 2 include Seray and Rawas in Pesisir Tengah District, as well as Sukarame in Ngaras District. Both Hierarchy 1 and 2 represent growth center villages. A total of six villages are classified as hinterlands, distributed across Hierarchy 3 and 4.

Villages in Hierarchy 3 include Penengahan in Lemong District, Sumber Agung and Gedung Cahaya Kuningan in Ngambur District, and Penyandingan in Bangkunat District. Meanwhile, Hierarchy 4 consists of Marang in Pesisir Selatan District and Pagar Bukit in Bangkunat District.

The highest-ranked villages are primarily located near the capital of Pesisir Barat Regency, giving them better accessibility compared to other villages. The Scalogram Analysis results provide valuable insights for balanced regional development by identifying villages with growth center potential. The presence of these growth centers is expected to create a spread effect, stimulating economic development in surrounding areas. In addition to improving and equalizing infrastructure development, such as economic, health, and educational facilities, efforts should also focus on enhancing human resources (HR) within these villages. Strengthening local capacity and skills will help accelerate economic growth in the region.

4.2 Centralization Index Results

The more comprehensive and abundant the facilities available in a region, the higher its centralization index and hierarchical level, increasing its potential to become a growth center. In this study, the Marshall Centrality Index plays a crucial role in assessing a region's feasibility as a service center. This index helps identify areas with strong potential for growth and service provision. The following formula is used to determine the hierarchy/strata levels in the centralization index analysis (Wahyudin, 2022):
The number of hierarchies is determined using the following formula: = 1 + 3,33 log n
Explanation:
n = Total number of villages in Pesisir Barat Regency
Calculation:
Number of Hierarchies/Strata = 1+3,33 log 116
Number of Hierarchies/Strata = 1+6,87
Number of Hierarchies/Strata = 7,87 ≈ 8
After determining that the total number of hierarchies/strata for villages in Pesisir Barat Regency is 8, the next step is to calculate the class interval using the following formula:

$$\text{Class Interval} = \frac{Ph-Qh}{r}$$

Explanation:
Ph = Highest number of facilities
Qh = Lowest number of facilities
R = Total number of strata
Calculation:
Class Interval = (161,726-0,182)/8=20,193.

The calculated class interval is 20.193. After determining this value, the hierarchical classification is established. Villages categorized under Hierarchy I and II are considered suitable as growth centers (Wahyudin, 2022). Villages in Hierarchy III and IV are classified as hinterlands (Nuraeni et al., 2017; Wahyudin, 2022). Hierarchy V is categorized as underdeveloped areas, while Hierarchy VI and beyond fall under the severely underdeveloped category (Wahyudin, 2022). Thus, a region qualifies as a service center if it belongs to Hierarchy I or II: Hierarchy I has a class interval ranging from 141.5338 to 161.7269. Hierarchy II has a class interval ranging from 121.3408 to 141.5338. For a clearer understanding, the classification of villages from Hierarchy I to IV is presented in the table below.

Table 4. Centralization Index Results of Villages in Pesisir Barat Regency.

No	District	Village Name	Population	Centralization Index	Hierarchy
1	Pesisir Tengah	Seray	2528	161,7268672	1
2	Ngambur	Negeri Ratu Ngambur	2747	153,904962	1
3	Ngambur	Sumber Agung	2.590	147,285135	1
4	Pesisir Selatan	Marang	6.046	139,7341665	2
5	Pesisir Tengah	Rawas	3400	114,6504461	3
6	Krui Selatan	Way Suluh	1121	108,0871857	3
7	Pesisir Tengah	Kampung Jawa	2393	100,1275898	4

Source: Processed data using MS Excel

The calculations in the table above are based on the number and presence of facilities available in each village within Pesisir Barat Regency. The more comprehensive and numerous a village's facilities are, the higher its hierarchy level, making it a benchmark for assessing the village's development.

From the table, four villages fall under Hierarchy I and II, meaning they serve as facility centers. Functionally, these villages play a crucial role as hubs for health services, education, and economic activities in Pesisir Barat Regency. These villages include:

1) Seray (Pesisir Tengah District)
2) Negeri Ratu Ngambur (Ngambur District)
3) Sumber Agung (Ngambur District)
4) Marang (Pesisir Selatan District)

Meanwhile, villages categorized under Hierarchy III and IV are considered hinterland villages. These villages support basic needs for the growth center villages and rely heavily on their facilities, especially in healthcare, economy, and education. From the table, the hinterland villages (Hierarchy III and IV) include:

1) Rawas (Pesisir Tengah District)
2) Way Suluh (Krui Selatan District)
3) Kampung Jawa (Pesisir Tengah District)

This study highlights differences in identifying growth centers and hinterlands when comparing the Scalogram Analysis and Centralization Index methods. The discrepancy arises because:

1) Scalogram Analysis is based solely on the presence of facilities in a village.
2) The Centralization Index, on the other hand, considers both the presence and quantity of facilities.

The visual differences can be seen in the Figure below.

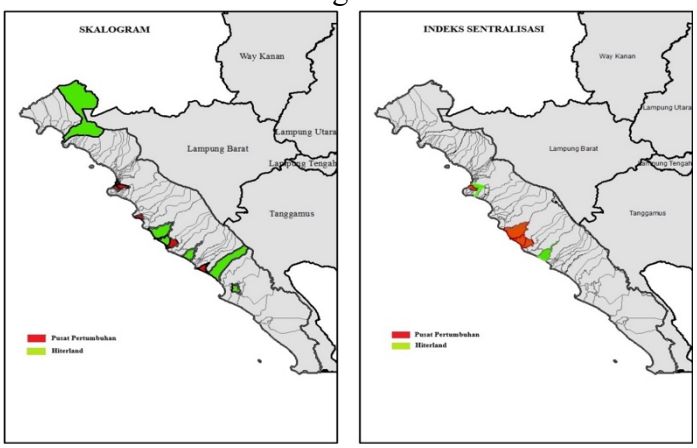

Figure 1. Comparison of Scalogram Analysis and Centralization Index Results
Source: Mapped and Analyzed with ArcGIS software.

The image above clearly illustrates the comparison of village distribution, distinguishing between growth centers and hinterland villages. Growth center villages are marked in red, while hinterland villages are marked in green. Based on the Scalogram Analysis, the distribution of growth center and hinterland villages appears more scattered. However, according to the Centralization Index Analysis, these villages are more concentrated in specific areas. An interesting finding emerges when combining both analyses. Two villages Seray and Negeri Ratu Ngambur stand out as both growth centers and service centers. These villages possess a comprehensive range of facilities, which contributes to their centralization potential. In contrast, Sumber Agung (Ngambur District) and Marang (Pesisir Selatan District) qualify as service centers based on the Centralization Index, yet their facilities are insufficient for them to be classified as growth centers.

Similarly, Kampung Jawa and Rawas (both in Pesisir Tengah District) meet the facility requirements to be considered growth centers. However, their facilities are not sufficient for them to serve as service centers, likely because they are directly adjacent to the capital of Pesisir Barat Regency. A concise and comprehensive comparison of the two analytical methods is presented in the table below.

Table 5. Comparison of Villages Based on Scalogram and Centralization Analysis

Scalogram Analysis			Centralization Index Analysis		
Description	Villages	Percentage	Description	Villages	Percentage
Hierarchy 1&2	6	5%	Hierarchy 1&2	4	3%
Hierarchy 3&4	6	5%	Hierarchy 3&4	3	3%
Hierarchy 5&6	43	37%	Hierarchy 5&6	5	4%
Hierarchy 7&8	61	53%	Hierarchy 7&8	104	90%

Source: Processed data using MS Excel

Based on the table above, the results of the Scalogram Analysis indicate that 6 villages, or 5% of the 116 villages in Pesisir Barat Regency, are classified as growth centers. Meanwhile, according to the Centralization Index Analysis, only 4 villages, or 3% of the total, are identified as growth centers. For hinterland villages, the Scalogram Analysis identifies 6 villages (5% of the total), whereas the Centralization Index Analysis categorizes only 3 villages (3%) as hinterlands. In terms of underdeveloped villages, the Scalogram Analysis classifies 43 villages (37% of the total) as underdeveloped, while the Centralization Index Analysis identifies only 5 villages (4%) in this category. Regarding the classification of highly underdeveloped villages, the Scalogram Analysis finds that 61 villages (53%) fall into this category, whereas the Centralization Index Analysis categorizes 104 villages (90%) as highly underdeveloped. These findings suggest that the majority of villages in Pesisir Barat Regency are still classified as highly underdeveloped, highlighting the urgent need for targeted development efforts in the region.

4.3 TOPSIS Method Results.

In the TOPSIS method, one of the most critical aspects is the weighting of criteria. In this study, the criteria weights were determined using the Entropy method for each factor considered. The assigned weights for each criterion are as follows: Population size: 0.107, Distance from the village to the regency capital: 0.332, Scalogram score: 0.075, Social Resilience Index (IKS): 0.002, Economic Resilience Index (IKE): 0.011, Environmental Resilience Index (IKL): 0.006, Centralization Index: 0.463. Table 6 and Figure 2 present the TOPSIS assessment results for villages in Pesisir Barat Regency. Table 6 categorizes villages based on their development quality high, medium, or low using multiple criteria,

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including population size, distance to the regency capital, Scalogram results, Centralization Index results, and the indices of environmental, social, and economic resilience.

Table 6. TOPSIS Assessment of Villages in Pesisir Barat Regency

Status	Range	Number of Villages	Percentage
High	0,4849-0,9071	8	7%
Moderate	0,1541-0,4021	101	87%
Low	0,0263-0,1259	7	6%

Source: Processed data using MS Excel.

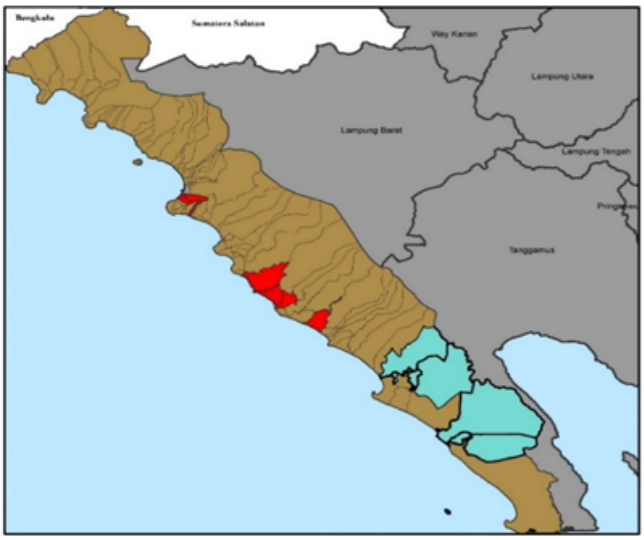

Figure 2. Map of TOPSIS Evaluation Results for Villages in Pesisir Barat Regency
Source: Mapped and Analyzed with ArcGIS software

As shown in Figure 2, the majority of villages in Pesisir Barat Regency fall into the moderate development category (indicated in brown). Villages with high development levels (indicated in red) are concentrated around the regency's capital and central areas. Seray Village (rank 1), Marang Village (rank 2), and Way Suluh Village (rank 6) are the top-ranking villages, all located near the regency's capital. In the central region, Negeri Ratu Ngambur Village (rank 3), Sumber Agung Village (rank 4), Rawas Village (rank 5), Kampung Jawa Village (rank 7), and Gedung Cahaya Kuning Village (rank 8) also demonstrate high development levels. In total, eight villages represent the top tier of development. Conversely, villages with the lowest development levels (indicated in blue) are concentrated in Bengkunat District, including Suka Marga, Pemerihan, Pagar Bukit Induk, Bandar Dalam, Tanjung Kemala, Way Tias, and Siring Gading Villages.

The assessment results presented in Table 6 indicate that out of 116 villages:

1) 8 villages (7%) exhibit high development levels,
2) 101 villages (87%) fall into the moderate development category, and
3) 7 villages (6%) are classified as having low development levels.

This data highlights significant disparities in rural development, particularly in access to facilities and services. The predominance of villages with moderate development and the limited number of highly developed villages suggest ongoing challenges in achieving equitable growth. Several factors may contribute to these disparities, including geographical constraints, political considerations, budget allocation, and inadequate development planning. These issues can hinder the optimal use of development funds, preventing many villages from reaching their full potential.

5. Conclusion

This study aimed to analyze the spatial development patterns and identify strategic growth centers in Pesisir Barat Regency, Indonesia, through an integrated analysis of facility availability, centrality, and multi-criteria development performance. The findings reveal a pronounced disparity in regional development, with the majority of villages classified as highly underdeveloped in terms of basic infrastructure and service provision. This underscores a critical need for targeted infrastructure investment and strategic spatial planning to foster equitable growth.

The integrated application of scalogram analysis, centralization index, and the TOPSIS method yielded several key insights that directly address the research objectives. First, the analysis successfully identified Seray Village (Pesisir Tengah District) and Negeri Ratu Ngambur Village (Ngambur District) as dual-nuclei growth centers. These villages exhibit not only high centrality and service capacity but also superior overall development quality, making them optimal candidates for prioritized investment. Second, the case of Seray Village demonstrates the tangible spread effect, where development investment in a growth center positively influences neighboring areas, validating central place theory in this context. Third, a significant development gap persists across the regency, with most villages lagging in the moderate category. This gap is strongly associated with insufficient infrastructure investment from conventional local government channels. Conversely, fourth, initiatives funded through the Village Fund (*Dana Desa*) program have shown greater effectiveness in directly improving village-level development outcomes, suggesting that decentralized, community-driven funding mechanisms are a potent tool for local development.

This research reinforces and refines central place theory by empirically demonstrating the hierarchy of settlements and the identification of growth centers in a developing region. The successful integration of scalogram, centrality index, and TOPSIS provides a replicable methodological framework for regional planning studies elsewhere.

Practically, the findings offer clear, actionable guidance for policymakers in Pesisir Barat Regency and similar regions. A two-pronged investment strategy is recommended: (1) Concentrated investment in the identified growth centers (Seray and Negeri Ratu Ngambur) to maximize agglomeration and spread effects, and (2) Strengthened support for the Village Fund program to address basic infrastructure gaps in underdeveloped villages directly. This approach balances efficiency (growth through centers) with equity (direct village support).

This study is primarily cross-sectional and based on facility availability and administrative data. Future research should incorporate longitudinal data to track development dynamics over time and include socio-economic variables (e.g., poverty rates, economic activity) to build a more holistic development index. Furthermore, spatial interaction models or gravity models could be employed to quantify the strength and reach of the spread effect from the identified growth centers more precisely. Finally, qualitative case studies on the implementation of the Village Fund program could provide deeper insights into the factors that make decentralized funding effective.

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