



Regional Development Strategies in New Growth Center Around Barsela Special Economic Zone (SEZ), Southwest Aceh Regency

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Abstract

Aceh Province has significant regional disparities, especially in the Southwest (Barsela). However, this region is strategically located, prompting the government to develop a strategic area that is the Barsela Special Economic Zone (SEZ) in Southwest Aceh Regency, which is located in Babahrot District, with Kuala Batee District as the closest hinterland. These two districts have the highest poverty rates in the regency, making the SEZ a potential catalyst for new growth center. This study aims to determine priority villages as new growth centers and regional development strategies using scalogram, gravity, network analysis, AHP-TOPSIS, and SWOT methods. Scalogram analysis shows that most villages around the Barsela SEZ have low regional development, with 54% in Hierarchy III, 29% in Hierarchy II, and 17% in Hierarchy I. Gravity analysis indicates low to moderate regional interactions, with NTIAD below 4,000,000 interaction units. Road network centrality is also generally low, with only four villages classified as high, based on Degree Centrality (0.31), Closeness Centrality (0.26), and Betweenness Centrality (0.43). Based on AHP-TOPSIS, Pante Rakyat Village is prioritized as a new growth center due to its high regional development, strong attractiveness, and good spatial centrality. The main development strategy is the Turnaround Strategy, which focuses on utilizing opportunities and addressing weaknesses. This research is expected to support spatial planning around the Barsela SEZ and contribute to Southwest Aceh Regency and Aceh Province government policies.

Keywords: network centrality, new growth center, regional connectivity, regional development, Special Economic Zone (SEZ).

1. Introduction

Regional development is very important in improving the welfare of the community. Indonesia is an island nation that has a variety of potential natural resources in its various regions, but economic disparities between regions are still a challenge (Judijanto et al., 2024). The government implemented a policy instrument by establishing a strategic area, namely the Special Economic Zone (SEZ) in several regions (Darmastuti, 2018; Junias, 2018; Suryani & Febriani, 2020). SEZ development, accompanied by infrastructure expansion and economic diversification, is critical for boosting regional income and reducing poverty (Hasan, 2021; Viska et al., 2024). Achieving equitable growth requires an integrated approach that involves community participation, inter-regional cooperation, and effective governance (Kuswandi, 2012).

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This aligns with the concept of regional development outlined by Anwar (2001) in Rustiadi et al. (2011), emphasizing equity, economic efficiency, and sustainability. The government and stakeholders, within the framework of good governance, have the responsibility to achieve optimal growth based on the resource potential of each region according to its capacity. The purpose of regional development is to encourage growth in the socio-economic sector of society, reduce regional inequality, and manage environmental sustainability (Setiowati & Buchori, 2023).

Studies have shown that SEZ can significantly impact regional economies. Zhao & Qu (2024) found that SEZ in India boosted non-agricultural employment and attracted migration. In contrast, Rodriguez-Pose et al. (2022) found that SEZ in Africa, such as those in Nigeria, Zambia, and Tanzania, failed to generate optimal benefits due to inadequate policy planning and weak institutional coordination. The success of SEZ largely depends on a well-structured framework, including clear government-private sector roles, strategic regulations, and adequate infrastructure (Zeng, 2016). A significant difference between SEZ in Indonesia and those in other countries is in infrastructure quality, human resource capabilities, government involvement, and the availability of supporting industries. Compared to well-established SEZ in China and Malaysia, Indonesia's SEZ face challenges in integrating local economies and supply chain linkages, which are crucial for maximizing economic spillovers (Wahyuni et al., 2013; Steenbergen & Sutton, 2017). The SEZ will become a new center of activity that will absorb a lot of labor, thus affecting the increase in human movement or activity. This is a development opportunity for areas around it to grow simultaneously to reduce regional imbalances (Muhtar et al., 2021). Therefore, this study adopts a strategic planning approach to optimize SEZ benefits. Unlike previous studies that primarily assessed SEZ success based on post-establishment economic performance, this research aims to identify potential growth centers in areas around the SEZ before full operationalization. Although various methods exist for identifying growth centers, research specifically addressing new growth centers in areas around the SEZ remains scarce. This study focuses on developing regional strategies for villages with growth potential, ensuring their optimal preparation to support SEZ development.

Aceh Province has the highest poverty rate in Sumatra at 14.45% in 2023 (BPS, 2024). Regional disparities in Aceh remain significant, with an average Williamson Index of 0.424 (Noezula, 2023). The Aceh Long-Term Development Plan (RPJP) 2012-2032 divides the province into four development zones, these are WP1 (Banda Aceh and surroundings) with a highly developed area, WP2 (East Coast) with a low level of development, WP3 (Central Mountains) with a medium level of development, and WP4 (West Coast) with a low level of development. To resolve this issue, the Aceh government plans to establish the Barsela SEZ in Babahrot District, Southwest Aceh Regency, as a regional economic driver. However, Southwest Aceh remains below the provincial poverty average. Based on Bappenas (2021), the highest concentration of poor populations in the regency is in Susoh (56% of 24,888 people), Kuala Batee (57% of 21,665 people), and Babahrot (58% of 21,171 people) districts. Therefore, the Barsela SEZ is expected to enhance economic opportunities and improve community welfare in these areas.

The Barsela SEZ location in Surin Bay, Babahrot District, is strategically positioned along the Meulaboh-Medan national road, with access to international markets via the Indian Ocean and connectivity to nearby districts. The proposed SEZ will adopt a halal industrial concept, supported by an international-scale port. Planned industries include premium Gayo coffee, cocoa processing, rice storage, palm oil refining, fisheries processing, and a smelter. The development is guided by the National Master Plan (KP 725/2014) and the Environmental Feasibility Decree (660/1376/2015). The Southwest Aceh government has allocated 745 hectares for the initial SEZ design, incorporating it into the 2023-2043 Spatial Plan (RTRW). The plan also includes a spatial structure plan with a provincial ring road from Gayo Lues District that crosses the Barsela SEZ location and has begun construction in recent years (Musrafiyan, 2021). Research has shown that SEZ can generate economic spillover effects. Galle et al. (2022) found that SEZ influence local economic development within a 10 km radius. However, Babahrot's existing activity centers are 20-40 km away from the SEZ, whereas Kuala Batee, a potential hinterland, is closer (20-30 km). Given their proximity and high poverty levels, these two districts were chosen as study locations to assess their potential as new growth centers.

The establishment of the Barsela SEZ and the development of the provincial ring road are expected to enhance accessibility, connectivity, and regional interaction, leading to the emergence of new growth centers. The central place theory (Christaller, 1933) suggests that regional growth depends on service specialization and demand from areas around it. The growth pole concept (Perroux, 1950) states that economic activity tends to concentrate around a core area, with its influence diminishing outward. The spread effect (Myrdal, 1957) highlights the spatial impact of economic centers on regions around them. Improved accessibility to the Barsela SEZ is likely to influence regional development patterns, as observed by Muslim et al. (2023), who found that transportation networks shape urban expansion.

Several methods exist to determine new growth centers, including scalogram and gravity analysis (Taufiqurrachman, 2024; Putra et al., 2023; Febrianto & Santoso, 2022). However, Spatial Network Analysis (SNA) is crucial in identifying growth centers. The SNA can measure the centrality of an area, in a regional context, centrality measures describe the geographic position, accessibility, and influence of the surrounding environment or region. The centrality of a region can be measured based on the number of interspatial flows through it. Irwin & Hughes (1992) states that the more a region is traversed by flows from other regions, the higher the centrality of the region. SNA has been used in various studies, such as identifying tourist village locations (Darmawan et al., 2021), analyzing road network changes (Afrianto et al., 2022), and measuring transportation accessibility (Kezia et al., 2021). However, existing studies primarily

focus on infrastructure and transportation linkages rather than identifying growth centers in regional planning. This study introduces a novel approach by applying SNA to assess network centrality as an indicator for identifying potential growth centers based on road network structures.

The purpose of this study is to analyze the level of regional development in each village around the Barsela SEZ, identify inter-regional interaction and spatial centrality of these villages, determine the priority of new growth centers, and develop regional development strategies for villages that have the potential to become new growth centers. The findings of this study are expected to provide recommendations for regional planning around the Barsela SEZ, thereby reducing disparity in Aceh, particularly in Southwest Aceh Regency. By knowing which villages are potential priority growth centers, governments can design targeted interventions to maximize Barsela SEZ benefits and increase socio-economic impacts for the hinterland region.

2. Methods

2.1. Study Area

The study area was 35 villages which are divided into 14 villages in Babahrot district and 21 villages in Kuala Batee district, Southwest Aceh Regency, Aceh Province. The data used includes primary and secondary sources. Primary data were obtained from questionnaires and interviews with 10 key persons, including government officials, academics, regional planners, and village leaders. Secondary data were sourced from local government agencies and included data on the number of facilities, regional accessibility, population, social characteristics, SHP files of administrative boundaries and spatial structure, and regional planning documents. The methods used in this research include the scalogram, gravity model, network centrality, AHP-TOPSIS, and SWOT analysis. The tool used in this research is a laptop that has ArcGIS, QGIS, Expert Choice, and Microsoft Office Software installed. The study area map can be seen in Figure 1.

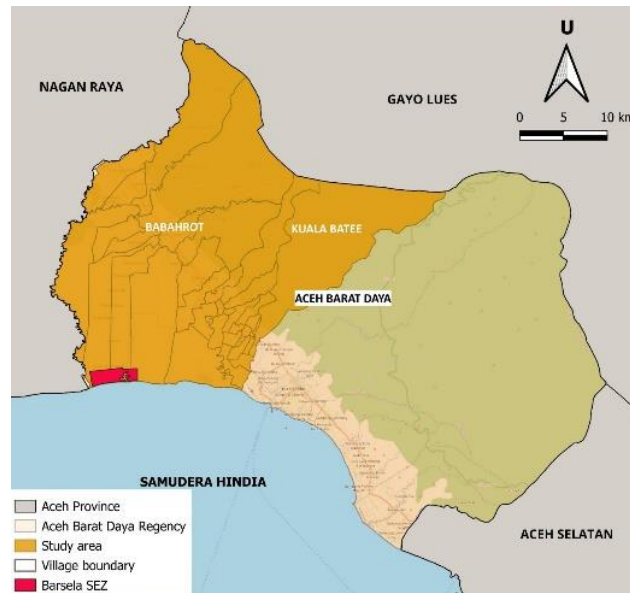


Figure 1. Study area map
(Author's analysis, 2023)

2.2 Determination of New Growth Centers Around the Barsela SEZ

2.2.1 Analysis of Regional Development Level

Analysis of the level of regional development was carried out using scalogram analysis to determine the hierarchy of regional centers (Sitorus, 2014). The data used came from the Village Potential (PODES) data in 2021 (Table 1). Scalogram analysis was conducted using Microsoft Excel with the following steps:

- 1) Selection (filtering) of statistical data in each village.
- 2) Calculate the weight of the characterization index (see Equation 1).

$$I_{ij} = \frac{X_{ijn}}{X_{ijp}} \quad (1)$$

where: I_{ij} = the weight of the characterization index; X_{ij} = the data value of the i^{th} region of the j^{th} variable; $I = 1, 2$, n denotes the number of regions; $J = 1, 2$, p denotes the number of all characterization variables.

- 3) Standardize the index calculated in stage 2 (see Equation 2).

$$Y_{ij} = \frac{X_{ij} - (\text{Min } X_j)}{s_j} \quad (2)$$

where: Y_{ij} = new variable for the i^{th} region and the j^{th} feature; X_{ij} = a number of features for the i^{th} region and the j^{th} feature; $\text{Min}(X_j)$ = minimum value of the index on the j^{th} feature; S_j = standard deviation of the IP of all regions.

- 4) Determining the Village Development Index (IPD) (see Equation 3).

$$IP = \sum_{i=1}^P Y_{ij} \quad (3)$$

- 5) Determining the village hierarchy based on the IPD average and IPD standard deviation.

Table 1: Facility type variables used in the scaling analysis

Indicator	Variable	Unit
Accessibility	Distance from village to regency capital, distance from the village to the district capital, distance from village to Barsela SEZ location, distance from the village to nearest national road, travel time from village to regency capital, distance from the village to the district capital, travel time from village to Barsela SEZ location, travel time from village to nearest national road	Km Minute
Education Facilities	PAUD/TK, SD/MI, SMP/MTSN, SMA/SMK/MA	Unit
Economic Facilities	Facilities Industries, markets, food stalls, grocery stores, government commercial banks	Unit
Public Facilities	Mosque, prayer room, function building, public open space, PDAM network	Unit
Health Facilities	Health center, auxiliary health center, village health post, posyandu	Unit
Social Factors	Population size, percentage of poor people, percentage of uninhabitable houses, number of disaster-prone types	Lives, percent

Source: Author's analysis

2.2.2 Interregional Interaction Analysis

Analysis of inter-regional interactions can be done with the Gravity Model, which is an analogy of Newton's Law of Physics of Gravity. The Gravity Model can determine the growth center system by determining the central growth center and the buffer zone for other growth centers (Febrianto & Santoso, 2022). Mathematically, the gravity model is formulated in Equation (4), and the Total Value of Inter-Village Interaction (NTIAD) is shown in Equation (5).

$$T_{ij} = \frac{P_i \times P_j}{d_{ij}^2} \quad (4)$$

where: T_{12} = interaction between regions 1 and 2 (Interaction Unit); P_1 = population of region 1; P_2 = population of region 2; d_{12} = distance between region 1 and region 2 (km); k = constant value 1.

$$NTIAD = \sum_1^n T_{ij} \quad (5)$$

2.2.3 Spatial Centrality Analysis

Spatial Network Analysis (SNA) can be used to measure accessibility, flow, or efficiency, but many also consider SNA as a measure of centrality (Cooper & Chiaradia, 2020). SNA in this study was conducted with network centrality analysis to determine the centrality of a region. Freeman et al. (1991) explained that this method can measure how central a point (node) is to other points on a road network. This analysis was carried out with the Grass Plugin in QGIS Software. There are three indicators used in this analysis (Rose et al., 2024), namely (1) Degree Centrality which is a centrality analysis to assess a point (node) connected to several road networks (lines). The more the point is connected to the road network, the more central the point (see Equation 6) (2) Closeness which is an analysis of the centrality of its distance, namely based on the ease of access from the point to other points (see Equation 7) (3) Betweenness Centrality is a centrality analysis where the more central a point is, the more it is passed to other points (see Equation 8).

$$C_D = \frac{n}{N-1} \quad (6)$$

where: C_D = degree centrality; n = total number of nodes directly connected to the node; N = the total number of nodes in the network.

$$C_C = \frac{N-1}{\sum_{j=1, j \neq i}^N d_{ij}} \quad (7)$$

where: C_C = closeness centrality; N = the total number of the nodes in the network; d_{ij} = the shortest distance between nodes i and j .

$$C_B = \sum_{j < k} \frac{r_{jk(i)}}{r_{jk}} \quad (8)$$

where: C_B = betweenness centrality; $r_{jk(i)}$ = The total number of shortest paths from node j to node k that pass through node i ; r_{jk} = The total number of shortest paths from node j to node k .

2.2.4 Determination of Village as New Growth Centers

Determination of new growth centers around the Barsela SEZ area using the AHP (Analytic Hierarchy Process)-TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) method. One of the weaknesses of TOPSIS is that it requires initial weights to process further data (Leksono, 2015). Therefore, to overcome this shortcoming, the AHP method was used. The AHP approach uses pairwise comparisons using Expert Choice 11 software, where each element at the bottom layer is compared with the item just above it (Chaube et al., 2024). The stages of data analysis with TOPSIS are (1) building a decision matrix (2) normalizing the decision matrix (3) creating weights on the normalized decision matrix (4) determining the positive ideal solution and negative ideal solution (5) calculating separation (6) calculating the relative closeness to the ideal solution (7) ranking alternatives.

- 1) Determine the normalized decision matrix.
- 2) Calculating the positive ideal solution matrix and negative ideal solution matrix.
- 3) Calculating the distance between the weighted values of each alternative to the positive ideal solution (see Equation 9) and the negative ideal solution (see Equation 10).

$$D_i^+ = \sqrt{\sum_{j=1}^n [y_{ij}^+ - y_{ij}]^2} \quad (9)$$

$$D_i^- = \sqrt{\sum_{j=1}^n [y_{ij} - y_{ij}^-]^2} \quad (10)$$

where: D_i^+ = distance between alternative (A_i) positive ideal solution; D_i^- = distance between alternatives (A_i) negative ideal solution; $i = 1, 2, \dots, m$

- 4) Calculate the preference value for each alternative (see Equation 11).

$$V_i = \frac{D_i^-}{D_i^- + D_i^+} \quad (11)$$

where: V_i = preference.

2.3 Drafting Regional Development Strategies for New Growth Centers Around the Barsela SEZ

Strategy development using the SWOT (Strengths, Weaknesses, Opportunities, Threats) method which is used for effective and efficient strategic planning by identifying and evaluating strengths, weaknesses, opportunities, and threats in an organization (Benzaghta et al., 2021). SWOT will be carried out by analyzing internal (IFAS) and external (EFAS) strategic factors. The stages of SWOT analysis are (1) the internal and external factors of this strategy development are obtained from literature studies and in-depth interviews (2) determining the rating value with the criteria of value 1 (very weak), value 2 (rather weak), value 3 (strong) and value 4 (very strong) by interviewing five key person (3) determining the weight (4) determining the score from the results of multiplying the weight with the rating (4) determine the strategy to be used by making a swot quadrant with the difference point of the strength and weakness scores as the x-axis and the difference of the opportunity and threat scores as the y-axis (5) compile a SWOT strategy matrix.

3. Result and Discussion

3.1. New Growth Centers Around the Barsela SEZ

3.1.1 Regional Development Level

The results of the scalogram analysis of the 35 villages around the Barsela SEZ show a large gap in the level of regional development (Figure 2). Most villages are in Hierarchy 3 with a low level of development (54%) with an IPD range of 15.93 to 31.47, followed by villages in Hierarchy 2 with a medium level of development (29%) with an IPD range of 32.69 to 38.54, and only 6 villages in Hierarchy 1 (17%) showing high development with an IPD range of 39.74 to 48.75. Limited infrastructure, accessibility, and socioeconomic conditions are the main factors hindering the development of villages in Hierarchy 3. Geographical factors and the poverty status of Babahrot and Kuala Batee Districts also influence the development of the regions in these two districts, thus affecting their level of development. The villages in Hierarchy 1, Krueng Panto Village, Pasar Kuta Bahagia Village, Lung Geulumpang Village, Lhok Gajah Village, Pante Rakyat Village, and Alue Padee Village, although relatively small in number, show potential as new growth centers. Of these 6 villages, only 1 village from Babahrot District, Pante Rakyat Village, has the largest population of 3,286 people and relatively complete facilities compared to other villages, with 15 types of facilities, while the other villages are from Kuala Batee district. This could be due to geographical factors, such as the location of the area being closer to the capital city. A strategic location and proximity to the center of government or service centers will encourage the improvement of supporting facilities and infrastructure in an area (Noviyanti et al., 2020).

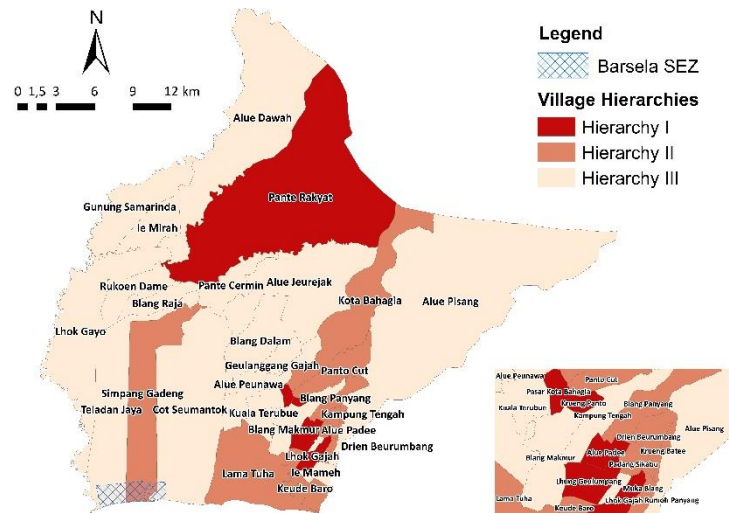


Figure 2. Village hierarchy around Barsela SEZ (Author's analysis, 2023)

Krueng Panto Village only has 10 types of facilities but is in Hierarchy 1 because this village has a small population of only 841 people and has a low poverty percentage of only 8.8% compared to other villages around the Barsela SEZ with an average of 16.38%. The other villages in the Hierarchy are nearby, so the level of regional development in these villages can influence each other. This is in line with Waldo Tobler's law which states that objects that are close together in space tend to have more in common, so geographical proximity is an important factor in regional development (Chen et al., 2023; Lim & Han, 2023). When observed in villages in Hierarchy 3 with an IPD range of 15.93 to 31.47, several villages have a high number of facilities such as Le Mirah Village with 13 types of facilities, Gunung Samarinda Village with 11 types of facilities, but the level of regional development is low. This is strongly influenced by the accessibility of these villages, which are farther to the district capital, reaching 30 km and 35 km, and to the location of the Barsela SEZ, reaching 43.5 km and 37.5 km. These two villages also have more types of disaster prone than other villages, namely 3 types which include landslides, floods, and forest fires. As Pravitasari et al. (2021) state disasters are a major challenge in the development of an area, so areas that have many disaster-prone areas tend to be difficult to develop.

3.1.2 Interregional Interaction

Interactions between villages can be identified through the number of trips made from one village to another. The closer the distance between villages, the stronger the interaction, and vice versa. In this study, the number of trips is assumed to be the total population due to data limitations. Villages with the highest interaction with NTIAD greater than 8,000,000 interaction units are Pasar Kuta Bahagia Village (9,181,482), Pante Rakyat Village (8,552,306), and Padang Sikabu Village (8,447,314) (Figure 3). This value shows that the interaction of these villages with other villages around the Barsela SEZ is very strong, this is because the distance between villages is very close compared to other villages and has a high population as an object of movement.

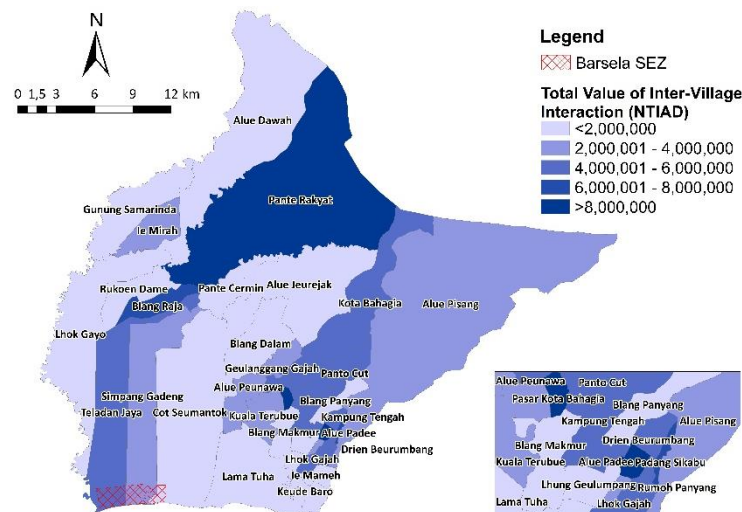


Figure 3. Inter-village interaction around Barsela SEZ (Author's analysis, 2023)

The level of regional interaction in the villages around the Barsela SEZ, based on the attractiveness of the region, is still mostly classified as low to medium with NTIAD of less than 4,000,000 interaction units. Most of the villages in Kuala Batee district have NTIAD above the average (3,618,680 interaction units), namely 13 villages, and only 3 villages from Babahrot district, namely Pante Rakyat, Blang Raja, and Teladan Jaya. This is because the area of villages in Kuala Batee district is relatively smaller than the area in Babahrot district, which affects the proximity of distance between villages. Villages with proximity will tend to have higher regional connectivity compared to villages that are far apart. Villages that have the potential to become growth centers are villages that have high interaction or attractiveness because they will develop faster than other villages (Optari, 2021, Mujio et al., 2023).

The villages in the Barsela SEZ area have a relatively low interaction value, except for Teladan Jaya village. This is because the value of interaction between Teladan Jaya and Pante Rakyat village is very large. The villages with the smallest NTIAD are Lama Tuha Village (185,790), Keude Baro Village (649,783), and Gunung Samarinda Village (884,346), this is due to their distance from other villages so their interaction with various villages around the Barsela SEZ is very weak. The NTIAD value also illustrates the level of connectivity in the area. Connectivity can be defined as the ease with which people, materials, and information can move from one location to another, triggering and generating connections between individuals, goods, and regions (Staeheli, 2012). Connectivity plays a crucial role in facilitating interactions that may develop between regions in an activity (Glasson & Marshall, 2007). Based on this, villages with high NTIAD values have great potential as new growth centers due to strong connectivity and interaction. Conversely, villages with low NTIAD scores require improved connectivity to support equitable regional growth around the Barsela SEZ. According to Buonocore et al. (2023), strengthening regional connectivity is essential for enhancing interactions and generating new growth opportunities around SEZ.

3.1.3 Spatial Centrality

Spatial centrality analysis in this study measures the strategic position of villages based on three components of the road network (Figure 4). This research uses the road network included in the spatial structure plan of the 2023-2043 Southwest Aceh District RTRW around the Barsela SEZ. The results of the Degree Centrality (Dc) analysis show that the road network around the Barsela SEZ only has a maximum of four roads that are directly connected to a point (node). The total number of nodes in the entire road network studied is 461 nodes. The Dc index of nodes directly connected to 1 road is 0.002174, with 2 roads is 0.004348, with 3 roads is 0.006522, and with 4 roads is 0.008696. The Dc index of a village is the sum of all the values of the nodes in that village. Pante Rakyat Village has the highest Dc index at 0.1044, followed by Pasar Kuta Bahagia Village (0.0609) and le Mirah Village (0.0587). This indicates that these villages have several nodes that are directly connected to many roads, thus playing an important role in accessibility around the Barsela SEZ. Meanwhile, the village with the lowest Dc index is Lama Tuha Village with a Dc index of 0.0087, followed by Rukoen Dame Village and Krueng Batee Village with a Dc index of 0.0109.

The results of the Closeness Centrality (Cc) analysis show a variety of indices between 0 and 385. Most nodes have a Cc index between 0-80, indicating low closeness between nodes, while only a few nodes have a higher Cc index (80-385), indicating higher closeness. The Cc index of a village is the sum of all the values of the nodes in that village. Pante Rakyat village has the highest Cc index (1,500), followed by Teladan Jaya (934) and Blang Dalam (688), while the village with the lowest Cc index is Blang Panyang (57), followed by Muka Blang (66) and Lhung Geulumpang (74). The results of the Betweenness Centrality (Bc) analysis show that the Bc index of each road network node around the Barsela SEZ varies depending on its strategic position. Nodes that are frequently passed through and connect several other nodes have higher Bc values because they function as bridges between parts of the network. Most of the nodes on the road network around the Barsela SEZ have a low Betweenness Centrality (Bc) index (0-8), which means that these nodes are less traveled and do not serve as major links between parts of the network. Only a few nodes have a higher Bc index (8-136). Simpang Gadeng village has the highest Bc index (442), indicating its very strategic role as a key link between areas, followed by Cot Seumantok village (170) and Teladan Jaya village (146). Meanwhile, villages with a low Bc index, such as Lhok Gajah Village, Muka Blang Village, and Lama Tuha Village, show limited accessibility and are less connected to other areas.

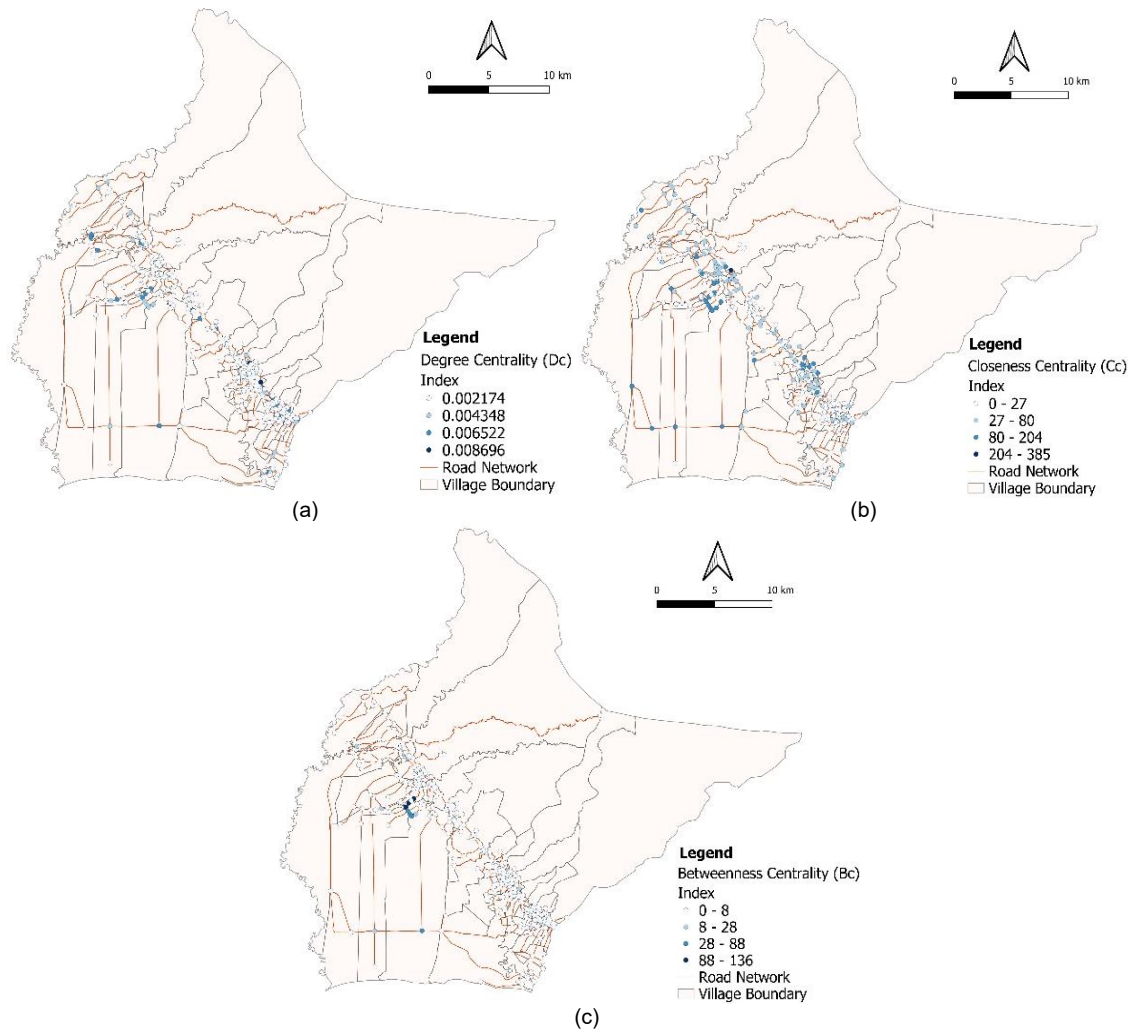


Figure 4. The centrality of the road network around the Barsela SEZ (a) Degree Centrality (Dc) (b) Closeness Centrality (Cc) (c) Betweenness Centrality (Bc) (Author's analysis, 2023)

Determining the level of the centrality of the road network in villages around the Barsela SEZ uses a weighting approach, as each component has a different function. The weighting was performed using Pairwise Comparison analysis based on the results presented in Section 3.1.4 of this paper, which resulted weight of Degree Centrality (0.058), Closeness Centrality (0.049), and Betweenness Centrality (0.08). The weights were then normalized, resulting in the final weights, Degree Centrality (0.31), Closeness Centrality (0.26), and Betweenness Centrality (0.43). These final weights are used to determine the level of centrality using TOPSIS analysis, with the centrality results divided into three categories: high, medium, and low (Figure 5).

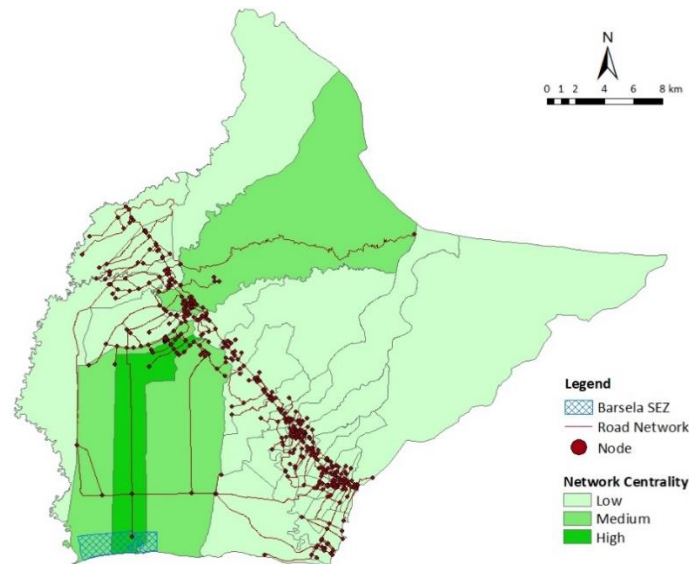


Figure 5. Road Network Centrality around Barsela SEZ
(Author's analysis, 2023)

Based on the combination of these three components, there are 4 villages with high road network centrality, namely Simpang Gadeng, Cot Seumantok, Teladan Jaya, and Pante Rakyat. Simpang Gadeng, Cot Seumantok, and Teladan Jaya are villages that are the location of the Barsela SEZ so they have high road network centrality because these villages are directly connected or closer to the main transportation routes that lead to the Barsela SEZ. This can also occur because, in this analysis, the road network plan that leads to the Barsela SEZ is used. Whereas Pante Rakyat Village has a provincial road network that is directly connected to Gayo Lues Regency and a provincial road plan that leads to the Barsela SEZ, this village has high centrality due to good connectivity and accessibility to other areas.

A total of 14 villages with moderate road network centrality are Alue Dawah, le Mirah, Pasar Kuta Bahagia, Blang Dalam, Kota Bahagia, Pante Cermin, Blang Raja, Geulanggang Gajah, Kampung Tengah, Gunung Samarinda, Panto Cut, Keude Baro, Alue Jeurejak, and Padang Sikabu, while 17 other villages have low centrality. Although some villages are located on national roads, others are located far from the main roads and therefore experience limited accessibility. The lack of road infrastructure in some villages, such as Lama Tuha Village and Lhok Gayo Village, has a significant impact on the level of centrality of the road network. This is in line with research by Nuryadin and Anjani (2023) which shows that road transportation network infrastructure has a significant influence on the economic growth of a region so that improving road networks in isolated areas can open up opportunities for more equitable regional development in marginalized villages.

3.1.4 Prioritizing New Growth Centers

AHP results from pairwise comparison for determining new growth centers, the weight of each factor is Regional Hierarchy (0.498), regional attractiveness (0.315), then from the spatial centrality factor betweenness centrality (0.80), degree centrality (0.58), and closeness centrality (0.49) with consistency ratio is 0.02, and smaller than 0.1. This value indicates that the results of respondents' answers to pairwise comparisons are consistent. After obtaining the weights for each factor, TOPSIS analysis was carried out with the result that Pante Rakyat Village was prioritized as a new growth center. From several components that have been analyzed previously, Pante Rakyat Village excels in several factors, namely a high level of regional development, regional attractiveness, and spatial centrality. The results of the ranking of new growth centers around the Barsela SEZ are in Table 2.

Table 2: Prioritization of villages as new growth centers around Barsela SEZ

Village	Preference	Rank	Village	Preference	Rank
Pante Rakyat	0,649	1	Muka Blang	0,321	19
Pasar Kuta Bahagia	0,647	2	Alue Pisang	0,318	20
Padang Sikabu	0,573	3	Lama Tuha	0,299	21
Krueng Panto	0,535	4	Kuala Turubue	0,294	22
Krueng Batee	0,493	5	Alue Peunawa	0,280	23
Alue Padee	0,491	6	Pante Cermin	0,269	24
Simpang Gadeng	0,482	7	Keude Baro	0,251	25
Panto Cut	0,472	8	Cot Seumantok	0,244	26
Blang Raja	0,470	9	le Mirah	0,243	27
Lhok Gajah	0,464	10	Alue Jeurejak	0,239	28
Kota Bahagia	0,455	11	le Mameh	0,226	29
Drien Berumbang	0,450	12	Alue Dawah	0,215	30
Kampung Tengah	0,440	13	Blang Makmur	0,214	31
Teladan Jaya	0,431	14	Rukoen Dame	0,194	32

Village	Preference	Rank	Village	Preference	Rank
Geulanggang Gajah	0,417	15	Blang Dalam	0,168	33
Rumoh Panyang	0,409	16	Lhok Gayo	0,115	34
Lhung Geulumpang	0,384	17	Gunung Samarinda	0,100	35
Blang Panyang	0,336	18			

Source: Author's analysis

The lower-ranked villages, such as Gunung Samarinda and Lhok Gayo, do not currently meet the criteria for growth centers. However, with the planned construction of a road connecting these villages to the Barsela SEZ, the potential for these villages to develop in the future is wide open. Improved road infrastructure, as part of physical development, can significantly boost regional development (Noviyanti et al., 2020). Pante Rakyat Village, on the other hand, is considered ideal to be a growth center, as the ideal regional center not only functions as a transition point between transportation modes, but also as a convenient place for social activities, living, and working. Such a growth center should be well-connected with the areas around it and provide a variety of facilities needed by the community, such as housing, public spaces, and areas for work and shopping (Junyent et al., 2024).

3.2 Regional Development Strategies for New Growth Centers Around the Barsela SEZ

3.2.1 Internal Factor Analysis Summary (IFAS) and External Factor Analysis Summary (EFAS)

The IFAS matrix is used to analyze internal factors including strengths and weaknesses that are considered to have an important influence in Pante Rakyat Village (Table 3).

Table 3: Internal Factor Analysis Summary (IFAS) result

Internal Factors	Rating	Weight	Score
Strengths			
1. Promotional Local Activity Center (PKLp) of the regency	3	0.09	0.26
2. Agricultural land for food, plantations, and iron ore mining	3.8	0.11	0.42
3. Nature tourism attraction	2.6	0.08	0.20
4. Strategic location on national and provincial roads	3.4	0.10	0.34
5. Relatively complete facilities	3.4	0.10	0.34
Weaknesses			
1. Limited health, clean water, and sanitation facilities	3.8	0.11	0.42
2. Flooding that affects settlements and agricultural land	3.6	0.11	0.38
3. Low quality of human resources (HR)	3.4	0.10	0.34
4. Inadequate agricultural infrastructure	3.2	0.09	0.30
5. Lack of technology and information support	3.8	0.11	0.42
Total of IFAS			3.44

Source: Author's analysis

Based on the results of the IFAS analysis, the main strength factor in the regional development strategy in Pante Rakyat Village as a new growth center is the availability of agricultural land for food, plantations, and iron ore mining with a rating of 3.8, weight 0.11, and score 0.42, this shows that the availability of natural resources such as agricultural land, plantations, and iron ore mines has a strong influence on regional development in Pante Rakyat Village. The weak factors are limited health, clean water and sanitation facilities, and lack of technology and information support which are constraining factors on regional development in Pante Rakyat Village with a rating of 3.8, weight of 0.11, and score of 0.42.

The EFAS matrix is used to analyze external factors including opportunities and threats that are considered to have an important influence in Pante Rakyat Village (Table 4). Based on the results of the IFAS analysis, the opportunity factor that has a major influence is the expansion of the agricultural products market with a rating of 3.8, a weight of 0.12, and a score of 0.45, this shows that the agricultural products obtained from Pante Rakyat Village have the opportunity to be marketed outside the region. Meanwhile, the biggest threat factor is environmental damage due to mining activities with a rating of 4, a weight of 0.13, and a score of 0.50. This shows that with increasing mining activities, there is a big threat to the environment in Pante Rakyat Village.

Table 4: External Factor Analysis Summary (EFAS) Result

External Factors	Rating	Weight	Score
Opportunities			
1. Trade center of South West Region	3.4	0.11	0.36
2. Equal distribution of the regency population	3	0.09	0.28
3. Development of iron ore industry as SEZ supply	3.2	0.10	0.32
4. Development of village tourism and creative industries	3.4	0.11	0.36
5. Expansion of the agricultural products market	3.8	0.12	0.45
Threats			
1. Environmental damage due to mining activities	4	0.13	0.50
2. Increasingly competitive human resource competition	3.2	0.08	0.32
3. Changes in social order and local culture	2.6	0.08	0.21
4. Land conversion due to population growth	3	0.09	0.28

External Factors	Rating	Weight	Score
5. Increased prices of goods and services in the village	2.4	0.08	0.18
Total EFAS			3.27

Source: Author's analysis

Based on Figure 6, the main strategy used for regional development in Pante Rakyat Village as a new growth center around the Barsela SEZ is the turnaround strategy (Quadrant III). This strategy also called The WO (Weakness-Opportunity) strategy aims to reduce weaknesses and take advantage of opportunities.

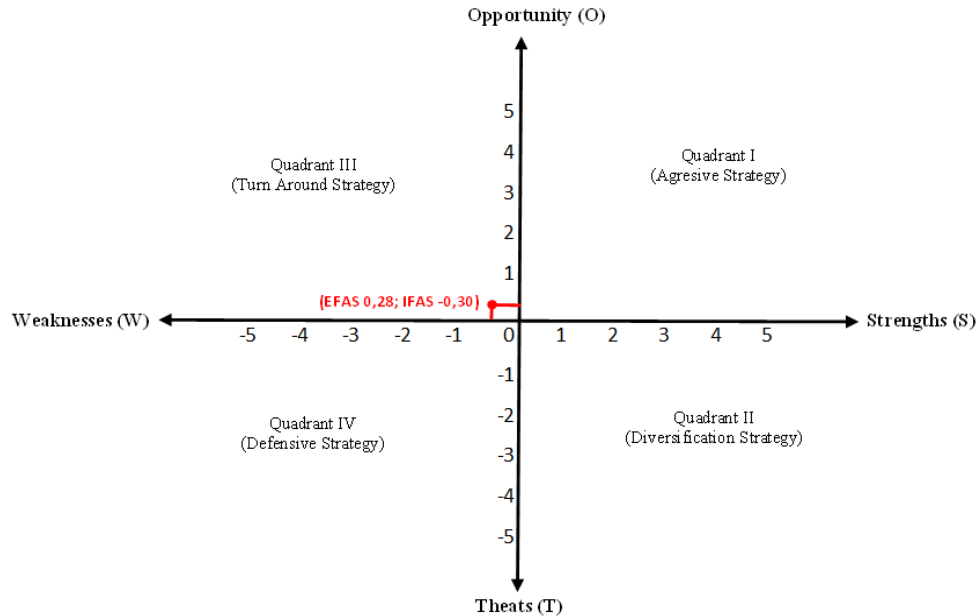


Figure 6. SWOT Quadrant
(Author's analysis, 2023)

4. Regional Development Strategies in Pante Rakyat Village as a new growth center around the Barsela SEZ

The regional development strategy for the new growth center of Pante Rakyat Village is based on the evaluation of internal and external factors. Based on these factors, a SWOT matrix was prepared, as shown in Table 5. Based on the results of the SWOT quadrant, the regional development strategy at the new growth center is in Quadrant III, so the main strategy used for regional development at the new growth center around the Barsela SEZ is a turnaround strategy or W-O (Weakness-Opportunity) strategy. This strategy focuses on reducing weaknesses and utilizing opportunities through improving health facilities, clean water, and sanitation, as well as adding agricultural infrastructure to support quality of life and market expansion, increasing flood resilience through sustainable land management, to make this region a trade center for the South West region and support equitable distribution of the population from the district capital, improving the quality of human resources through training in the creative industry and tourism development, and strengthening digitalization to improve competence and expand market networks.

Pante Rakyat Village has great potential to become a new growth center to encourage regional economic growth, although it has weaknesses such as limited infrastructure, so this needs to be improved to make Pante Rakyat Village a service center for villages around it. Infrastructure development that not only meets basic needs but also creates new emerging growth centers, has the potential to encourage the emergence of new cities or new settlements (Purmawan et al., 2024). Pante Rakyat Village is one of the areas with a very high threat of flooding and erosion due to the Krueng Babahrot watershed and has a fairly diverse topography with slopes from 0° to greater than 45° and altitudes of up to 1,000 meters above sea level. The northern part of the village is an area that is the road to the Gayo Lues highlands, while the southern part is lowland. Flooding often affects settlements as well as agricultural land and plantations. Therefore, flood mitigation efforts need to be designed with integrated and sustainable watershed management, appropriate land use, riverbank security, rehabilitation of water catchment areas, and flood simulation models to determine flood potential. Better management of agricultural infrastructure and drainage systems should also be a priority, given the impact of flooding on settlements and agricultural land, which is a major challenge in regional development (Pravitasari et al., 2021).

Another weakness that needs to be improved is the low quality of human resources, which can be addressed by improving education and training based on local industrial and agricultural needs. Investment in education and training is key to increasing the productivity of human resources and improving community welfare (Siregar et al., 2024). The impact of global changes, such as digitalization and renewable energy transition, is also important in maintaining the relevance of the Barsela SEZ regional development strategy in the future, such as encouraging the use of environmentally friendly energy in the industrial sector,

integrating digital technology that can support the efficiency of public services, encouraging technology-based business development, and increasing the competitiveness of the local workforce through digital training. In strengthening the competitiveness of Pante Rakyat Village in the midst of regional competition, it is necessary to apply digital technology-based regional development, such as the implementation of the smart village concept that can improve the efficiency of public services, such as population data management, natural resource management, and digital promotion of local potential. Meanwhile, GIS integration enables better monitoring of land use and disaster risk mitigation. Technological innovation also opens up new opportunities in marketing local products in national and international markets through digital platforms, as well as increasing investment attractiveness and expanding market networks.

Table 5: SWOT matrix result

		Strengths (S)	Weaknesses (W)
		1. Promotional Local Activity Center (PKLp) of the regency 2. Agricultural land for food, plantations, and iron ore mining 3. Nature tourism attraction 4. Strategic location on National and Provincial Roads 5. Relatively complete facilities	1. Limited health, clean water, and sanitation facilities 2. Flooding that affects settlements and agricultural land 3. Low quality of human resources (HR) 4. Inadequate agricultural infrastructure 5. Lack of technology and information support
IFAS			
	EFAS		
Opportunity (O)		S-O Strategy	W-O Strategy
1. Trade center of South West Region 2. Equal distribution of the regency population 3. Development of iron ore industry as SEZ supply 4. Development of village tourism and creative industries 5. Market expansion of agricultural products		1. Optimize PKLp and strategic locations to support the South West Region trade center, and expand agricultural markets to strengthen the local economy (S1, S4, O1, O5) 2. Develop agricultural land, plantations, and iron ore mines to supply SEZs and support the natural tourism sector (S2, S3, O3) 3. Utilize relatively complete facilities to support trade, tourism, and creative industries to even out population distribution in the regency (S5, O2, O4)	1. Utilize government financing programs to build sanitation infrastructure, reorganize irregular areas, and support SDGs targets (W1, W2, O1, O3) 2. Address open defecation behavior through education based on new sanitation technologies that can also improve public health (W3, O4, O5). 3. Strengthening stakeholder collaboration to build livable houses while encouraging community participation in supporting sanitation (W4, W5, O2).
Threats (T)		S-T strategy	W-T Strategy
1. Environmental damage due to mining activities 2. Increasingly competitive human resource competition 3. Changes in social order and local culture 4. Land conversion due to population growth 5. Rising prices of goods and services in the village		1. Use strategic locations and available land to design spatial layouts that are resilient to flood risks and the impacts of urbanization (S1, S2, T1, T2). 2. Utilize the potential of natural resources and ecotourism to reduce the impact of urbanization and attract developers to invest in the area (S3, T1, T4). 3. Integrate local wisdom and government support to strengthen enforcement of environmental management rules despite potential reductions in financing (S4, S5, T3, T5).	1. Improve health, clean water, and sanitation facilities through cooperation with the government to reduce the impact of environmental damage and the threat of land conversion (W1, T1, T4). 2. Develop agricultural infrastructure to reduce the impact of flooding and support food security amidst increasingly competitive HR competition (W2, W4, T2). 3. Improve the quality of human resources through training and education to deal with local social and cultural changes and utilize technology and information for efficiency in overcoming rising prices of goods and services (W3, W5, T3, T5).

Source: Author's analysis

Villages with low levels of regional development and limited accessibility also require special attention, such as improving infrastructure and developing various business sectors that have the potential to encourage regional progress. Sustainable and balanced regional development also needs to be carried out through the equitable distribution of government programs to develop local potential in villages around it. Cross-village collaboration through coordination forums and strengthening local governance are also urgently needed so that the community can be involved in the planning and development process of the region. Through the application of appropriate strategies, the Barsela SEZ and new growth centers can provide a spread effect to areas around them that were previously less developed for inclusive and sustainable regional development.

5. Conclusion

The conclusions of this study show that most villages around the Barsela SEZ are in Hierarchy III, with a low level of regional development (54%), while 10 villages are in Hierarchy II with a medium level of development (29%), and only 6 villages are in Hierarchy I with a high level of development (17%). The villages with the potential to become new growth centers are Krueng Panto, Pasar Kuta Bahagia, Lung Geulumpang, Lhok Gajah, Pante Rakyat, and Alue Padee, with Pante Rakyat being the only village from Babahrot District, while the others are from Kuala Batee District. The level of regional interaction in these

villages is mostly low to moderate, with NTIAD values under 4,000,000, although Pasar Kuta Bahagia, Pante Rakyat, and Padang Sikabu have the highest interactions. Road network centrality is generally low, with only four villages Simpang Gadeng, Cot Seumantok, Teladan Jaya, and Pante Rakyat showing high centrality. Pante Rakyat has the highest Degree Centrality and Closeness Centrality indices, highlighting its importance in accessibility and proximity to other nodes, while Simpang Gadeng has the highest Betweenness Centrality, making it a key strategic link. Based on these findings, Pante Rakyat is prioritized as a new growth center, with the Turnaround Strategy (WO strategy) recommended for its regional development, focusing on leveraging opportunities to address existing weaknesses. This strategy can be used by policy makers for regional planning to maximize the benefits of the Barsela SEZ.

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