Spatial Structure Evaluation of Pekalongan Regency

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ABSTRACT

Pekalongan Regency is a strategic area of Central Java Province on the North Coast experiencing spatial and physical changes. This research aims to evaluate the existing spatial structure of Pekalongan Regency with the spatial structure of Pekalongan Regency in development planning documents with a quantitative descriptive approach using Analysis of Scalogram, Analysisi of Centrality Index, and analysis of Kernel Density then comparing it with the Regional Spatial Planning (RTRW) of Pekalongan Regency for 2011 – 2031. The result is that based on Analysis of Scalogram, the local activity center of Pekalongan Regency with city order I is Kedungwuni District and Kajen District, this is different from the RTRW of Pekalongan Regency for 2011-2031 which mentions Kedungwuni district as the center of local promotional activity for order 2. Then by using analysis of Marshal Centrality Index, it is also known that the local activity center of Pekalongan Regency is in two districts, namely Kajen district and Kedungwuni district, which is different from the determination of the Pekalongan Regency Spatial Planning (RTRW) in 2011 - 2031. By using analysis of Kernel Density, it is known that Kedugwuni District, Buaran District and Wiradesa District, is the center of local activity with order I. The conclusion is that the Spatial Structure in the Spatial Document Planning (RTRW) of Pekalongan Regency for 2011 - 2031 needs to be revised because there is a shift in the spatial structure based on the results of the analysis above so that development in Pekalongan Regency is appropriate according to planning.

1. INTRODUCTION

Spatial structure is the arrangement of residential centers and the network system of infrastructure and facilities. The function of this spatial structure is to support socio-economic activities of the community which hierarchically have functional relationships in regional, provincial and national systems. Spatial structure is part of regional spatial planning. Besides spatial structure, there are also spatial patterns, both of which are an inseparable part of regional spatial planning.

Regional spatial planning aims to achieve quality space utilization. For this reason, control is needed through monitoring and controlling activities regarding space use. As stated in Spatial Planning Law Number 24 of 1992, supervision of space utilization is carried out in the form of reporting, monitoring and evaluation. Through monitoring and evaluation activities, the suitability of space utilization in accordance with the designated functions can be realized. Spatial Planning outlines that the implementation of development at the central and regional levels must be in accordance with the spatial planning plans that have been determined. Thus, the use of space, including the structure of the space, should be in accordance with the spatial plan.

Various regional government obstacles in realizing district/city regional development in accordance with the district/city spatial planning plan are caused by factors such as; operational, administrative techniques and market development demands. This tendency for deviation can occur because the spatial planning product does not pay enough attention to aspects of implementation (space utilization) or conversely, space utilization does not pay enough attention to the spatial planning that has been prepared. For this reason, it is very important to carry out an

evaluation activity on existing spatial planning products to see whether the spatial planning products are running in accordance with their use or whether deviations have occurred. This evaluation activity places greater emphasis on monitoring deviations from space utilization which is part of the space utilization monitoring activities in controlling space utilization in accordance with the mandate stated in the Spatial Planning Law No. 24 of 1992.

Pekalongan Regency is a strategic area and is one of 35 districts/cities in Central Java Province which is located in the western Pantura area along the north coast of the Java Sea which extends to the south with Kajen City as the central government capital. It is felt that the current spatial structure has changed so that the new spatial structure will determine the direction of development in the future.

2. METHOD

Research regarding the evaluation of spatial structures in Pekalongan Regency is research that uses deductive methods with a quantitative approach. The quantitative approach involves the process of collecting, analyzing, interpreting data, and writing up research results (Creswell, 2009). The spatial structure evaluation was carried out by comparing the spatial structure in the Pekalongan Regency RTRW for 2011 - 2031 with the current spatial structure as a result of spatial analysis. To find out the current spatial structure, several data analyzes were carried out. The data analyzed is population data, facilities and infrastructure which are processed using several analytical techniques including scalogram analysis and centrality index analysis. and kernel density analysis with the help of ArcGIS 10.4 software. The spatial structure resulting from scalogram analysis, centrality index analysis and kernel density analysis was then compared with the spatial structure in the RTRW of Pekalongan Regency for 2011 - 2031 so that the gap in the spatial structure of Pekalongan Regency was known. The spatial structure of the analysis results above can be used as input and recommendations for the spatial planning and development process of Pekalongan Regency.

3. RESULT AND DISCUSSION

Spatial Structure in Pekalongan Regency RTRW 2011 – 2031.

Based on the Pekalongan Regency RTRW 2011 – 2031, the following are the directions for the Pekalongan Regency service function plan:

Table 1. Hierarchy of Spatial Structure Based on Pekalongan Regency RTRW 2011-2031 Hierarchy Village/District

PKLp (Local Activity Centre "Promotion")	Kedungwuni Sub-district
PKL (Local Activity Centre)	Kajen sub-district, Wiradesa sub-district
PPK (Area Service Centre)	Doro sub-district, Sragi sub-district
PPL (Neighbourhood Service Centre)	Legokkalong Village, Karanganyar Subdistrict, Siwalan Village, Wonokerto Kulon Village, Wonokerto Subdistrict, Kaibahan Village, Kesesi Subdistrict, Bojongminggir Village, Bojong Subdistrict, Wonoyoso Village, Buaran Subdistrict, Rowokembu Village, Wonopringgo Subdistrict, Pacar Village, Tirto Sub-district, Kalirejo Village, Talun Sub-district, Karangdadap Village, Karangdadap Sub-district, Paninggaran Village, Kandangserang Village, Kandangserang Sub-district, Yosorejo Village, Petungkriyono Sub-district and Lebakbarang Village, Lebakbarang Sub-district.

Based on the RTRW of Pekalongan Regency, the direction of the city structure in Pekalongan Regency is that "Promotional" PKL Urban consists of Kedungwuni District; and Urban PPK consisting of Doro and Sragi Districts. Meanwhile, the direction for the rural system in Pekalongan Regency is PPL which covers 14 sub-districts. The functions of each activity center in Pekalongan Regency are

explained as follows:

1. The "Promotional" Local Activity Center (PKL) Urban Area, namely Kedungwuni Urban Area.

    It Has a development function, namely; as a sub-district scale government center, development of social and economic services, development of settlements, trade and service areas, development of transportation centers, development of educational areas and development of large, medium, small and micro industrial activities.

2. Local Activity Center (PKL) Urban Areas, namely Kajen and Wiradesa Urban Areas.

    It has a development function, namely as a district government center, settlement center, education center, district scale social and economic service center, regional transportation center, tourism development, urban settlement development center, trade and services center, large, medium, small and micro industry and development. food crop farming.

3. Regional Service Center (PPK) Urban Area: Doro and Sragi Urban Areas.

    It has a function as a sub-district scale government center, development of social and economic services, development of settlements, development of trade and service activities, development of plantation and horticultural crops, development of food crops, development of water tourism and fishing activities, development of community forest plantations, development of agro-industry, activity center transportation, development of medium, small and micro industries.

4. Rural Area Environmental Service Center (PPL)

    These consist of Legokkalong Village, Karanganyar District, Siwalan Village, Siwalan District, Wonokerto Kulon Village, Wonokerto District, Kaibahan Village, Kesesi District, Bojongminggir Village, Bojong District, Wonoyoso Village, Buaran District, Rowokembu Village, Wonopringgo District, Pacar Village, Tirto District, Kalirejo Village, Talun District, Village Karangdadap, Karangdadap District, Paninggaran Village, Paninggaran District, Kandangserang Village, Kandangserang District, Yosorejo Village, Petungkriyono District and Lebakbarang Village, Lebakbarang District. Has a function to serve inter- village scale activities. Meanwhile, the development of rural areas includes rural development based on the basic potential they have, developing rural areas as agropolitan development areas, developing village centers from the hamlet level to the village center in a hierarchical manner, empowering rural communities, maintaining the quality of the local environment and the areas it supports, conserving resources. nature, preserving local cultural heritage, maintaining Sustainable Food Preservation Land areas for food security, and maintaining balanced rural-urban development.
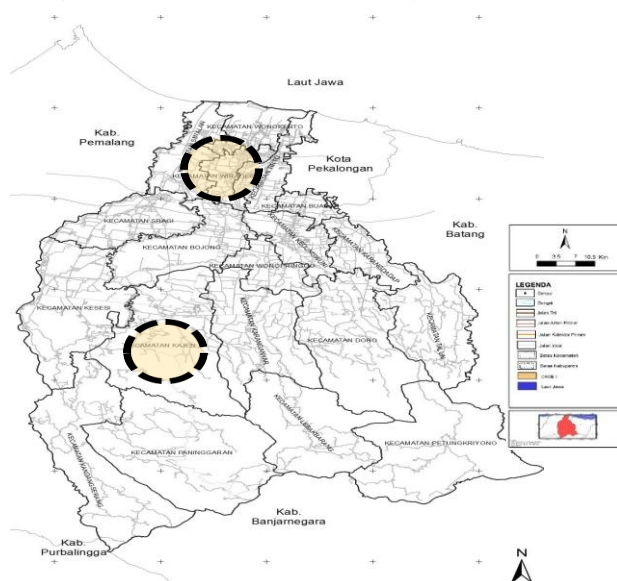

Figure 1.
Pekalongan Regency RTRW Spatial Structure Map 2011-2031 Source: Development Planning Agency of Pekalongan Regency

3.1. Evaluation of Spatial Structure

Evaluation of the spatial structure of Pekalongan Regency was carried out using several analysis techniques, namely scalogram analysis, centrality index analysis and kernel density analysis.

1) Analysis of Scalogram

Scalogram analysis is a method for measuring the level of urbanism or hierarchy of an area. Blakely & Leigh (1998) stated that in scalogram analysis the function is as an indicator of the functioning of a region as a growth center based on its facilities. In this analysis, identify the distribution of functions of social and economic service facilities as well as the hierarchy of development centers and development infrastructure. These facilities show regional differentiation and centrality, so that the more and more diverse types of facilities a region has, the higher the tendency for centralization, so that it has the potential to become a center of growth. The scalogram method provides a hierarchy or ranking order of regions based on the type and number of development infrastructure units from the most to the fewest, so that development center areas can be determined (Muta'ali, 2015) and the growth center of a region (Hasibuan, 2007).

In this research, the use of scalogram analysis is not only for facilities and infrastructure but is also used to create a hierarchy of population density. Population scalogram analysis was carried out by creating a hierarchy based on population data in 2019. The following are the results of the population scalogram analysis in Pekalongan Regency.

Tabel 2.

Scalogram Results Based on Population

Order	District
I	Kedungwuni Sub-district
II	Tirto sub-district
III	Kecamatan Kajen, Kesesi, Sragi, Bojong, Buaran, Wiradesa, and Wonokerto
IV	Kandangserang, Paninggaran, Doro, Karanganyar, Siwalan, Wonopringgo and Karangdadap sub-districts
V	Lebakbarang, Petungkriyono and Talun sub-districts

Based on the results of the scalogram analysis, the population in Pekalongan Regency is divided into 5 (five) orders, including 1 (one) sub-district which is in order I, namely Kedungwuni sub-district, and 1 (one) sub-district which is in order II, namely Tirto sub-district. There are 7 (seven) sub-districts in order III, 7 (seven) sub-districts in order IV, and in order V there are 3 (three) sub-districts, namely Lebakbarang, Petungkriyono and Talun sub-districts. Order I shows that the Kedungwuni area is the area with the largest population, and order V shows that the area is an area that is not densely populated. By entering data on the number and distribution of facilities in Pekalongan Regency, the results of the scalogram analysis of infrastructure in Pekalongan Regency are as follows.

Table 3.

Scalogram Analysis Results of Pekalongan Regency Infrastructure Facilities

No	District	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	Total	Hierarchy
	Weighting	14	7	5	4	4	4	13	6	3	5	2	1	12	5	5	2	1	1	2	1	1	1	1	100	
1	Kedungwuni	56	63	75	0	0	0	13	48	93	40	74	35	14	5	10	4	11	4	6	99	65	2	0	717	1
2	Kajen	28	70	100	0	4	0	13	24	21	40	100	27	14	0	10	6	15	4	0	117	62	1	1	657	1
3	Kesesi	28	14	30	0	0	0	0	30	15	20	84	31	0	0	10	6	16	2	2	111	48	0	0	447	3
4	wiradesa	28	35	90	8	0	0	0	30	18	20	50	19	0	0	5	4	9	5	4	67	47	2	0	441	3
5	Bojong	14	28	5	0	0	0	0	18	3	25	78	23	0	5	10	8	15	4	4	98	49	0	0	387	3
6	Sragi	28	14	25	0	0	4	0	18	9	25	62	20	0	0	10	6	12	4	6	97	32	2	0	374	4
7	Doro	28	14	20	0	4	0	0	18	9	20	62	22	0	10	10	6	5	4	4	74	54	0	0	364	4

No	District	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	Total	Hierarchy
	Weighting	14	7	5	4	4	4	13	6	3	5	2	1	12	5	5	2	1	1	2	1	1	1	1	100	
8	Wonopringgo	14	28	10	0	0	0	13	12	42	25	50	15	0	0	5	6	6	3	0	80	35	0	0	344	4
9	Tirto	14	0	55	0	0	0	13	6	30	15	40	22	0	0	10	10	11	3	0	85	25	0	0	339	4
10	Karanganyar	14	21	25	0	0	0	0	18	12	15	62	21	0	0	5	6	6	0	4	80	46	2	0	337	4
11	Paninggaran	28	7	20	0	0	0	0	12	21	25	52	7	0	0	5	4	13	1	0	66	62	0	0	323	4
12	Kandangserang	14	0	10	0	4	0	0	6	0	30	56	10	0	0	5	8	9	0	0	68	51	0	0	271	4
13	Buaran	14	21	35	0	0	0	0	18	15	15	30	18	0	0	5	2	6	2	0	54	24	0	0	259	5
14	Siwalan	0	14	20	0	0	0	0	6	6	15	50	16	0	0	5	6	7	0	2	58	26	0	2	233	5
15	Wonokerto	28	7	5	0	0	0	0	6	12	20	42	13	0	0	10	4	7	0	0	46	26	0	0	226	5
16	Talun	0	7	5	0	0	0	0	12	0	15	44	16	0	0	5	4	9	0	0	60	42	1	0	220	5
17	Karangdadap	14	0	10	0	0	0	0	6	6	15	28	8	0	0	5	4	6	2	0	62	19	1	0	186	5
18	Petungkriyono	0	0	0	0	0	0	0	6	3	20	44	3	0	0	5	2	9	0	0	37	38	2	0	169	5
19	Lebakbarang	14	0	10	0	0	0	0	6	0	15	32	2	0	0	5	4	9	0	0	34	22	0	0	153	5

Description: A = Market, B = Supermarket, C = Bank, D = Hotel, E = Terminal, F = Station, G = University, H = Senior High School, I = Islamic boarding school, J = Junior High School, K = Elementary, L = Kindergarten, M = Hospital, N= Private clinic, O= Puskesmas, P=Pustu, Q=Village clinic, R=Doctor's practice, S=Posyandu, T=Pharmacy, U=Mosque, V=Church, W=Pura..

The table below shows the order distribution of the results of the scalogram analysis of infrastructure facilities in Pekalongan Regency:

Table 4. Scalogram Results Based on Infrastructure Facilities

Order	District
I	Kedungwuni Sub-district
II	-
III	Kecamatan Kajen, Kesesi, Sragi, Bojong, Buaran, Wiradesa, and Wonokerto
IV	Kandangserang, Paninggaran, Doro, Karanganyar, Siwalan, Wonopringgo and Karangdadap sub-districts
V	Kecamatan Buaran, Talun, Siwalan, Wonokerto, Karangdadap, Petungkriyono, Lebakbarang

Based on the results of the scalogram analysis of infrastructure facilities in Pekalongan Regency, it can be divided into 5 (five) orders. The selection of facilities and infrastructure is based on the scale of service and type of service so that in our calculations we use weighting. High weight is given to facilities that have a wide scale of services and types of services that influence regional development. The facilities and infrastructure used as analysis material are:sarana ekonomi meliputi pasar dan swalayan, bank, hotel, terminal, dan stasiun:

1. Educational facilities include university, Senior High Schol, Junior High School, Islamic Boarding School;, and kindergarden.
2. Health facilities include hospitals, private clinics, community health centers, supporting community health centers, village polyclinics, doctor's practices, Posyandu and pharmacies;
3. Worship facilities include mosques, churches and temples.

Based on the results of the scalogram analysis of infrastructure facilities in Pekalongan Regency, namely order I numbering 2 sub-districts, namely Kedungwuni and Kajen sub-districts, order II there are none, order III numbering 3 (three) sub-districts, order IV numbering 6 (six) sub-districts and order V numbering 7 (seven) sub-districts. Order I shows that the Kedungwuni and Kajen sub-districts are areas that have very complete facilities and infrastructure available in large numbers, and order V shows that these areas are areas that have very poor availability of facilities with

minimal numbers. The distribution of regional groups in Pekalongan Regency based on the analysis results shows that the average is in the low order (4 and 5) so that many regions lack the availability of facilities and infrastructure for regional development. Apart from that, the results obtained were that there were no areas located in order 2, this shows that there is inequality and inequality in the number and types of services, so planning is needed in regional development.

When compared with the RTRW, Kedungwuni sub-district is included as a PKLp location, while the results based on scalogram analysis show that Kedungwuni sub-district has changed to PKL, along with Kajen sub-district. Wiradesa District, based on the RTRW of Pekalongan Regency, is designated as a PKL area, so its position is below Kedungwuni District for the availability of infrastructure.
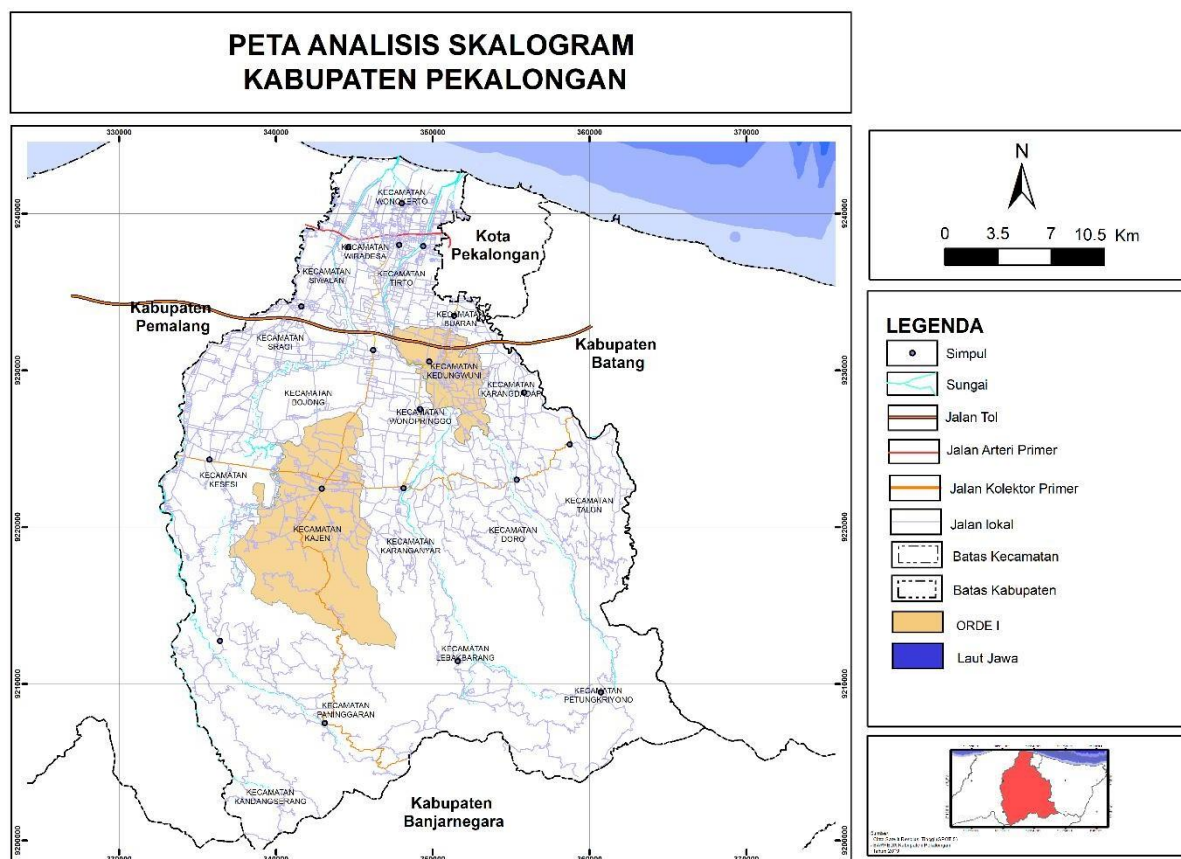

Figure 2.
Map of Scalogram Analysis of Pekalongan Regency Source: result of analysis, 2022

2) Analysis of Marshal Centrality Index

The marshal centrality index analysis aims to see the number of existing facilities, how many types of service functions are available, and the number of residents served in these facilities. According to Muta'ali (2015), the difference between Scalogram analysis and the Centrality Index is that in this tool an assessment is carried out based on the weight of each existing function, so it is also called a weighted centrality index.
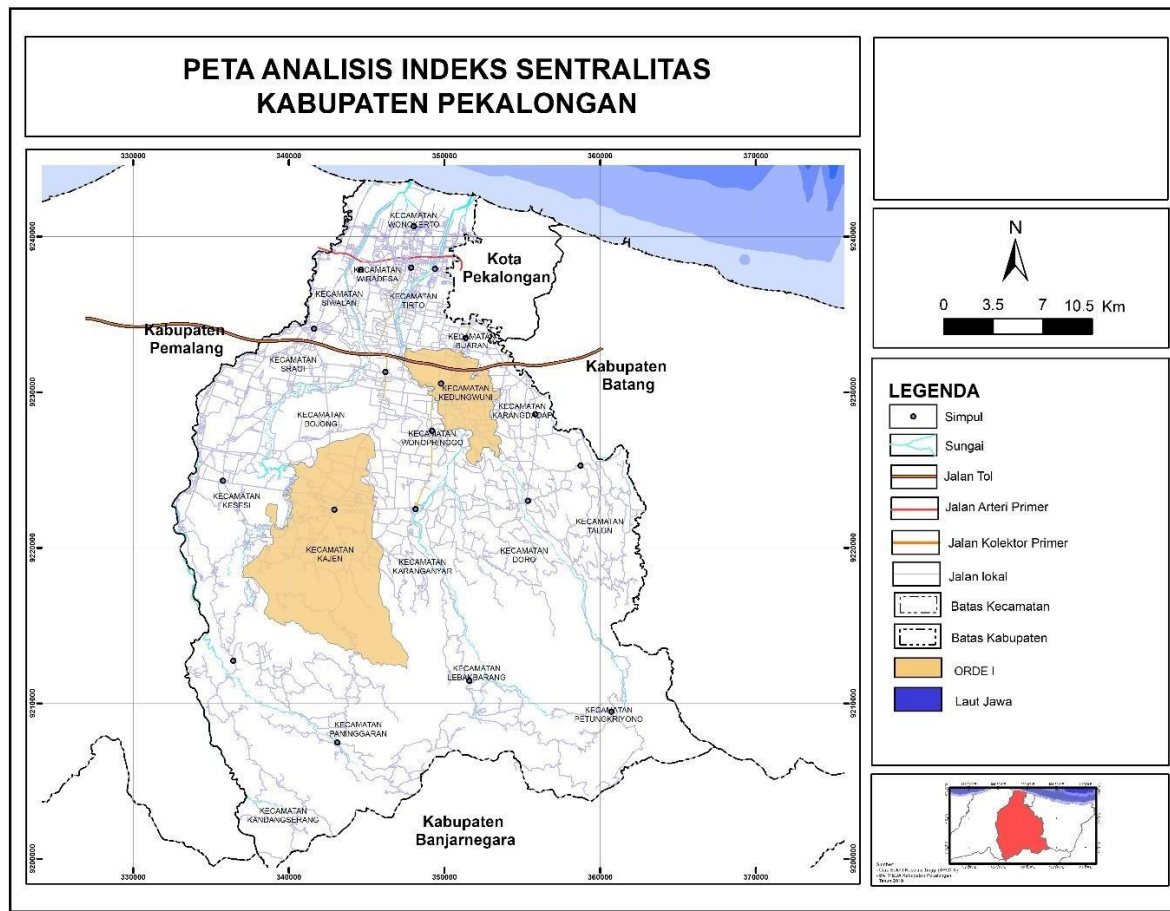
Figure 3.
Map of Centrality Index Analysis of Pekalongan Regency

Based on the results of the marshall centrality index analysis of trade facilities, educational facilities, health facilities, worship facilities and other commercial facilities in Pekalongan Regency, the results showed that there are 2 (two) sub-districts included in order I, namely Kedungwuni and Kajen sub-districts. Kedungwuni sub-district is the most densely populated area, while Kajen sub-district is the capital of Pekalongan Regency and is the center of growth and development. In order II there are 2 sub-districts, namely Wiradesa and Sragi sub-districts, in order III there is 1 (one), in order IV there are 6 (six) sub-districts, and in order V there are 8 (eight) sub-districts. Based on the results of the Marshall centrality index, it can be concluded that population density influences the availability of facilities and infrastructure in Pekalongan Regency. Areas that are densely populated have a high centrality index, and areas that are less densely populated have a low centrality index.

3) Analysis of Kernel Density

Kernel density is a non-parametric statistical formula for estimating density that can be applied in ArcGIS 9.3. In a spatial context, kernel density is widely used to analyze density distribution patterns in an area, one of which is population density, distribution of infrastructure facilities intensity. Kernel density calculations produce a picture of the distribution of density around point or line features, thus areas (polygons) which are known to be areas with a certain volume (volume in this case is the population) need to be transformed into point form and are based on rasters. It should be understood that Kernel density is not limited to just knowing the distribution of population density. There are many things that can be analyzed with the help of these calculations in the context of regional and urban planning. The distribution of density in built-up areas, housing, or even related to the distribution of potential crime locations, distribution of facilities, or

congestion by measuring the utility level of using a particular network (line) can also be analyzed through kernel density calculations.
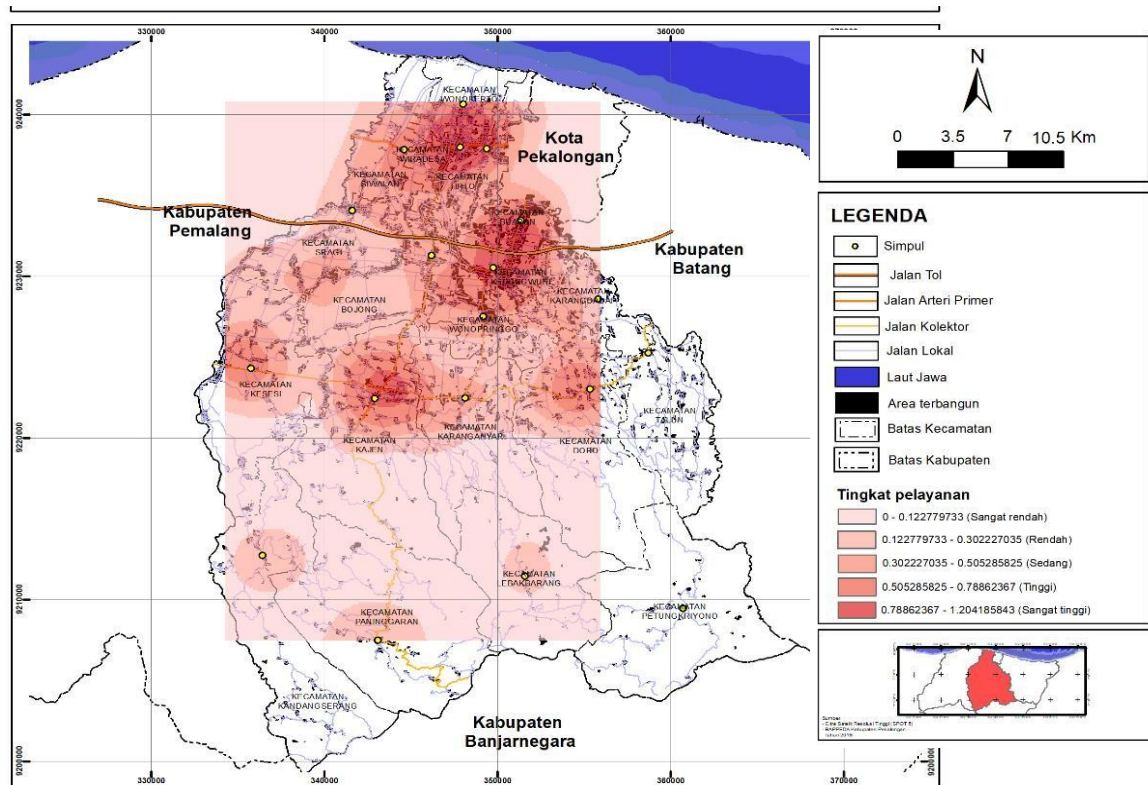

Figure 4.
Map of Kernel Density Analysis of Pekalongan Regency

In the map above, it can be seen that the results of the analysis using kernel density show that there is growth around the Kedungwuni, Buaran and Wiradesa sub-districts. The distribution of density in built-up areas, housing, or even related to the distribution of potential crime locations, distribution of facilities, or congestion is reflected in the three sub-districts. This is because the sub-district is located in a strategic position, namely close to the city of Pekalongan, so that economic activities run well.

4. CONCLUSION

Based on the Pekalongan Regency RTRW, the direction of the city structure in Pekalongan Regency is that the "Promotional" PKL Urban consists of Kedungwuni District and the PPK Urban consists of Doro and Sragi Districts. Based on the results of evaluating the spatial structure using scalogram analysis, the Marshall Centrality Index showed that the highest urban level (order 1) was Kedungwuni District and Kajen District, while order 2 was Wiradesa District and Sragi District. Apart from that, the results of the evaluation using kernel

density analysis showed that the PKW urban areas included Kedungwuni, Buaran and Wiradesa sub-districts. PKL urban areas are Kajen District, PPK urban areas are Doro, Sragi and Bojong Districts. Thus, there are differences in the evaluation results with the directions from the Pekalongan Regency RTRW. This is due to an increase in population and an increase in economic activities in communities around the city area. Wiradesa District, which was originally in the RTRW, was a street vendor, so based on the evaluation it could become a Promotional Street Vendor. and Bojong sub-district, which was originally only PPL, could become PPK together with Doro and Sragi sub-districts.

The results of the spatial structure evaluation obtained through scalogram analysis, marshal centrality index analysis and kernel density analysis show changes in the spatial structure that have

been mandated in the 2011-2031 Pekalongan Regency RTRW. Therefore, the Government needs to review the 2011-2031 RTRW again and make adjustments, especially in the direction of its spatial structure. This is necessary so that development planning can be in line with the dynamics that are occurring and development planning can proceed as expected.

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