

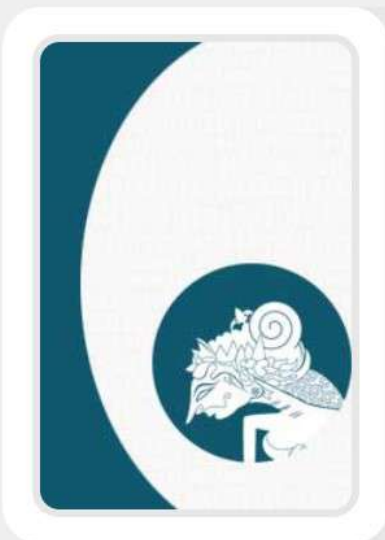
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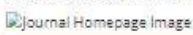
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Endrawati Fatimah^{1*}, Aris Choirul Anwar²

¹Urban and Regional Planning Department, Faculty of Landscape Architecture and Environmental Technology, Universitas Trisakti, Indonesia

²Urban and Regional Development Institute, Indonesia

Abstract. Urbanization defines as a spatial and socio-economic transformation process from rural to urban areas. While urban sprawl is the process of propagation of the appearance of urban physical characteristics from the inner city toward the urban fringe area. Pekalongan City has grown from a small town to a medium-sized city with a population of 300,000 people. This study aims to identify the phenomenon of urban sprawl in Pekalongan City and its surroundings (Pekalongan and Batang Regency) and identify the urban environment quality based on the condition of the public services availability in these urban areas. The data used in this study were the 2019 Village Potential (PODES) from the Central Agency on Statistics (BPS) and a digital base map from the Geospatial Information Agency (BIG). The urban-rural classification scoring from the BPS was used to identify urban areas as the method in this study. The results showed that 111 out of 285 villages in Pekalongan Regency and 63 out of 248 villages in Batang Regency could already be classified as urban areas and formed an urban agglomeration with Pekalongan City. This study also showed that the environmental quality in urban areas with urban sprawl phenomenon has met the standards and criteria for urban public services compared to other areas.

Keywords: Pekalongan; Urban Development; Urban Sprawl

[Judul: Fenomena Urban Sprawl di Kota Pekalongan dan Sekitarnya] *Urbanisasi dapat dimaknai sebagai proses transformasi dari pedesaan menjadi perkotaan. Sedangkan urban sprawl dikenal sebagai proses perambatan yang menunjukkan ciri-ciri fisik Kawasan perkotaan dari Kawasan pinggiran akibat perkembangan pusat kota. Kota Pekalongan telah berkembang dari kota kecil menjadi kota menengah dengan penduduk mencapai 300.000 jiwa. Penelitian ini bertujuan untuk mengidentifikasi fenomena urban sprawl di Kota Pekalongan dan sekitarnya (Kabupaten Pekalongan dan Kabupaten Batang) serta mengidentifikasi kualitas lingkungan perkotaan berdasarkan kondisi ketersediaan pelayanan publik di kawasan perkotaan tersebut. Data yang digunakan adalah Potensi Desa (PODES) 2019 dari Badan Pusat Statistik (BPS) dan peta dasar digital dari Badan Informasi Geospasial (BIG). Metode yang digunakan untuk mengidentifikasi kawasan perkotaan adalah skoring klasifikasi perkotaan pedesaan dari BPS. Hasil penelitian menunjukkan bahwa sebanyak 111 dari 285 desa di Kabupaten Pekalongan dan 63 dari 248 desa di Kabupaten Batang sudah dapat diklasifikasikan sebagai kawasan perkotaan serta membentuk aglomerasi perkotaan dengan Kota Pekalongan. Kajian ini juga menunjukkan bahwa kualitas lingkungan di kawasan perkotaan yang mengalami urban sprawl sudah memenuhi standar dan kriteria pelayanan publik perkotaan dibandingkan dengan kawasan lainnya.*

Kata Kunci: Perkembangan Perkotaan; Pekalongan; Urban Sprawl.

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1. INTRODUCTION

Urbanization is a rapid transformation process from rural to urban settlements, whose existence is globally observed, especially in Indonesia. Based on several previous studies, the global urban

population has increased five times between 1950–2018, from 751 million to 4.2 billion. The urban population in Indonesia increased rapidly from 30 to 100 million between 1971 and 2015. By 2018, the urbanization rate had reached 54.7% of the total population (Indonesia National Statistics Agency,

2022). This urbanization rate indicated that the urban population in Indonesia is larger than the rural.

The growth of the urban population had consequences for urban compaction and expansion. Urban compaction is the densification and mixed land use to intensify the metropolitan areas (Gopal & Nair, 2014). Burgess (2000), called the urban compaction a driven increase of developed areas and population densities to intensify urban economic, social, and cultural activities resulting in an impact to change the city size, the spatial formations, and the housing system. This impact was beneficial to achieve environmental, social, and global sustainability derived from the concentration of urban functions (Burgess, 2000; Gopal & Nair, 2014). Based on those criteria, urban compaction characteristics were high population density, mixed land uses, and urban function intensification.

As a concept, urban compaction has increased socioeconomic liveability. However, good public transport, access to the inner-city, solid waste management, affordable housing, and public services need to be supported (Bibri, Krogstie, & Kärrholm, 2020; Gopal & Nair, 2014). Based on this concept, improving the quality of civilization needs to be evaluated through urbanization. Furthermore, infrastructure levels and public services capacity also should be analyzed further. These conditions were subsequently evaluated comprehensively based on economic, social, and environmental sustainability (Chen, Zhang, Liu, & Zhang, 2014).

Urbanization and rapid urban growth in Java, studied by Firman (2017), essentially showed that the development was uncontrolled, leading to a massive expansion at the fringe area. It had raised urban agglomeration and new small towns. It also caused remarkable improvement in the existing metropolitan development and surroundings (Firman, 2017; Wirawan & Tambunan, 2018).

Urbanization has been long discussed from academic and policy perspectives and prioritized internationally because of its severe impacts on the global environment, such as land consumption and degradation, air pollution, clean water scarcity,

poverty, social segregation, and disaster vulnerability (Chen et al., 2014; Cochechi & Petrisor, 2023; Kötter, 2004). Urbanization also caused problems in the inner city, such as inadequate public facilities to meet basic needs, including housing, clean water, educational and health infrastructures, and open spaces. Attempting to provide residents with housing and improve living conditions was part of the development pressure for high urbanization (Jones & Mulyana, 2015).

In addition to those studies, rapid urbanization also has resulted in the urban sprawl phenomenon pressuring uncontrolled land expansion (Habibi & Asadi, 2011; Kötter, 2004; Polidoro, de Lollo, & Barros, 2012; Sinha, 2018; Turok & McGranahan, 2013). Urban sprawl phenomenon has direct effects on (1) the land conversion of non-urban areas, (2) increasing traffic volume, and (3) marginalization of the indigenous communities. Regardless of the urban sprawl effect, the inner city condition has worsened due to unable meeting the basic needs that the resident has been growing and spreading. This condition could cause more chaotic and complex environmental problems (Habibi & Asadi, 2011; Kötter, 2004; Polidoro et al., 2012; Turok & McGranahan, 2013).

This study aims to identify urban areas development in Pekalongan City and its surrounding (Pekalongan and Batang Regency) on the Northern Coast of Java Island, Indonesia, and to analyze the public services conditions in the urban area. Pekalongan City and its surroundings were selected due to the rapid urban development pressure on the Northern Coast, which has been the main route of economic activity in Java since the Dutch colonial period.

2. DATA AND METHODS

The data used in this study were the 2019 Village Potential (PODES) from the Central Agency on

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*Email: endrawati@trisakti.ac.id

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Statistics (BPS) and a digital base map from the Geospatial Information Agency (BIG).

The unit analysis was Kelurahan (urban village) or Desa (village), the smallest administrative area in a

city and regency. Urban areas were classified using urban and rural village criteria set by the BPS. This classification used the scoring method by the BPS focused on three criteria, as shown in Table 1.

Table 1. Criteria, Classification, and Scores of Urban–Rural Village

Criteria	Sub Criteria	Classification	Score
Population Density per sq. km	-	< 500	1
		500 -1,249	2
		1,250 – 2,499	3
		2,450 – 3,999	4
		4,000 – 5,999	5
		6,000 – 7,499	6
		7,500 – 8,499	7
		>8,500	8
Percentage of Household working in the Agricultural sector	-	>70	1
		50.00 - 69.99	2
		30.00 – 49.99	3
		20.00 – 29.99	4
		15.00 – 19.99	5
		10.00 – 14.99	6
		5.00 – 9.99	7
		<5.00	8
Accessibility to Urban Facility	1. Kindergarten	• Available on location or within ≤ 2.5 km	1
	2. Secondary School	• Available within >2.5 km	0
	3. High School		
	4. Traditional or Permanent Market	• Available on location or within ≤ 2 km	1
	5. Shops	• Available within >2 km	0
	6. Hospital	• Available on location or within ≤ 5 km	1
		• Available within >5 km	0
	7. Hotel/Billiard pool	• Available	1
	Hall/Discotique/Massage Parlors/Salon	• Not Available	0
8. Percentage of household access to telephone	• ≥8.00	1	
	• <8.00	0	
9. Percentage of household access to electricity	• ≥90.00	1	
	• <90.00	0	

Source: Indonesia National Central Statistics Agency (2020)

This study calculates scores for each village in the study area, then classify it into the urban village or rural village categories. Based on the BPS criteria, a village can achieve a maximum score of 25 and a minimum score of 2. The cut point used to determine urban village is 9. Villages with a score of 9 or more are classified as urban villages, while villages with a score of less than 9 are classified as rural villages (Firmansyah & Wahyuni, 2022; Indonesia National Central Statistics Agency, 2020). The spread of the urban sprawl phenomenon was described by mapping each village's scoring and classification. Then, the superimpose method

compared the urban sprawl phenomenon map with the village's administrative status. The results showed new village criteria, namely (1) Urban Kelurahan, (2) Rural Kelurahan, (3) Urban Desa, and (4) Rural Desa. Based on the results, the conditions of the public facilities were identified for each village using the regulation standards.

3. RESULT AND DISCUSSION

Pekalongan City is located on the Northern Coast of Java and has 27 Kelurahan in an area of 45.25 sq. km. Pekalongan Regency is located southwest of

Pekalongan City, with 23 Kelurahan and 272 Desa in an 836.1 sq. km. Meanwhile, Batang Regency is located east of Pekalongan City with 13 Kelurahan

and 239 Desa in an area of 788.6 sq. km. Figure 1 shows the study area based on the administrative status.

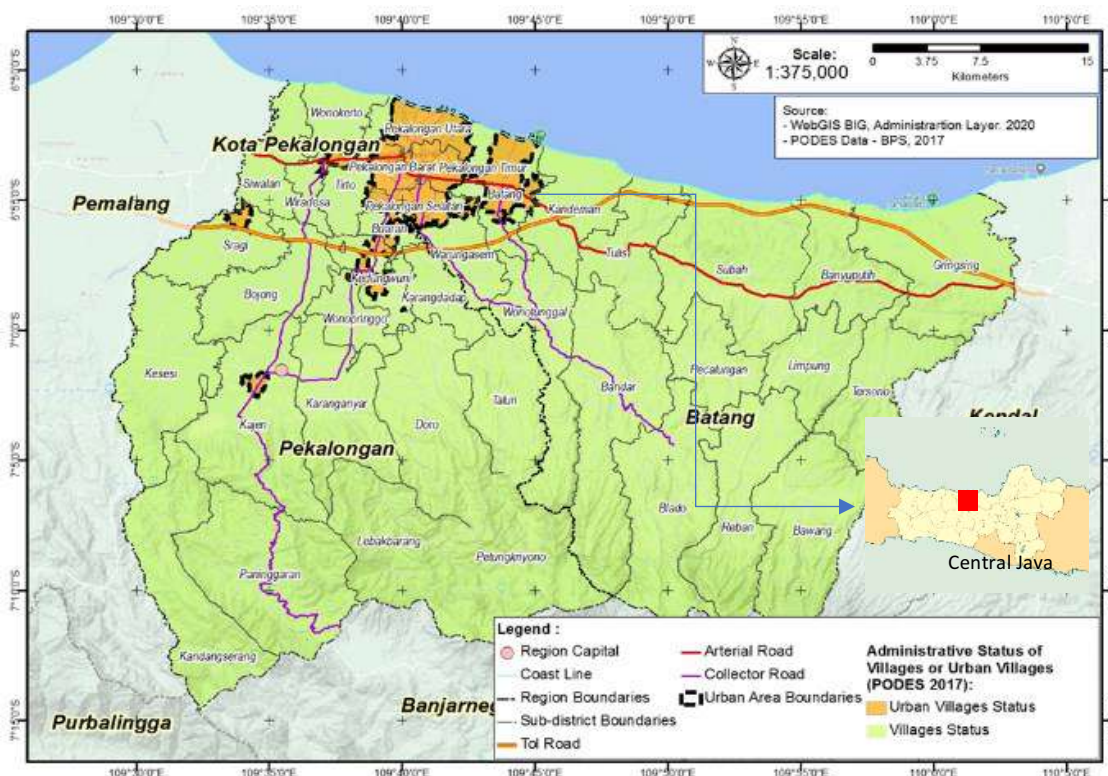


Figure 1. Study Area Based on the Subdistrict Administrative Status
 Source: Indonesia National Central Statistics Agency (2020) and Analysis, 2021

Analysis using BPS criteria and superimpose method has different results in the urban-rural classification regarding the distribution of urban villages, as indicated in Figure 2. Based on Figure 2, the urban sprawl phenomenon is spread in all directions and extends beyond the inner city, primarily following highway, arterial, and collector roads. The urban agglomeration in Pekalongan City and its surroundings was also significantly expanded.

Compare to Figure 1, Figure 2 shows the transformation of some villages (Desa) in Pemasang, Batang, and Pekalongan regencies from rural villages to urban villages. These phenomena indicate that urban sprawl have occurred in Pekalongan city. Figure 2 also shows that urban areas in Pekalongan City and its surroundings have expanded in a concentric and linear model, as shown in Figure 3. The concentric model expands in Pekalongan City with the capital district as the center. The linear model expands west and east of

Pekalongan City, following the primary road network at northern Pekalongan and Batang Regencies. As it is known that this study area is one of the strategic areas passed by the corridor belt that connects two metropolitan areas on an international and national scale, namely the National Strategic Area of Jabodetabekpunjur and Kedungsepur. This corridor belt is currently connected to the highway and will also be connected to the Jakarta-Surabaya Semi-High Speed Rail Mega Project. This linear model aligns with the axial theory initiated by Babcock in 1932, which states that transportation networks have a vital role in influencing cities' spatial development (Yunus, 2010). Areas along transportation routes have high mobility, so physical development will be faster than areas between transportation routes (Nasukha & Herwangi, 2019; Yunus, 2010). Table 2 shows the comparative analysis of the Desa and Kelurahan classification regarding the administrative status and rural-urban criteria.

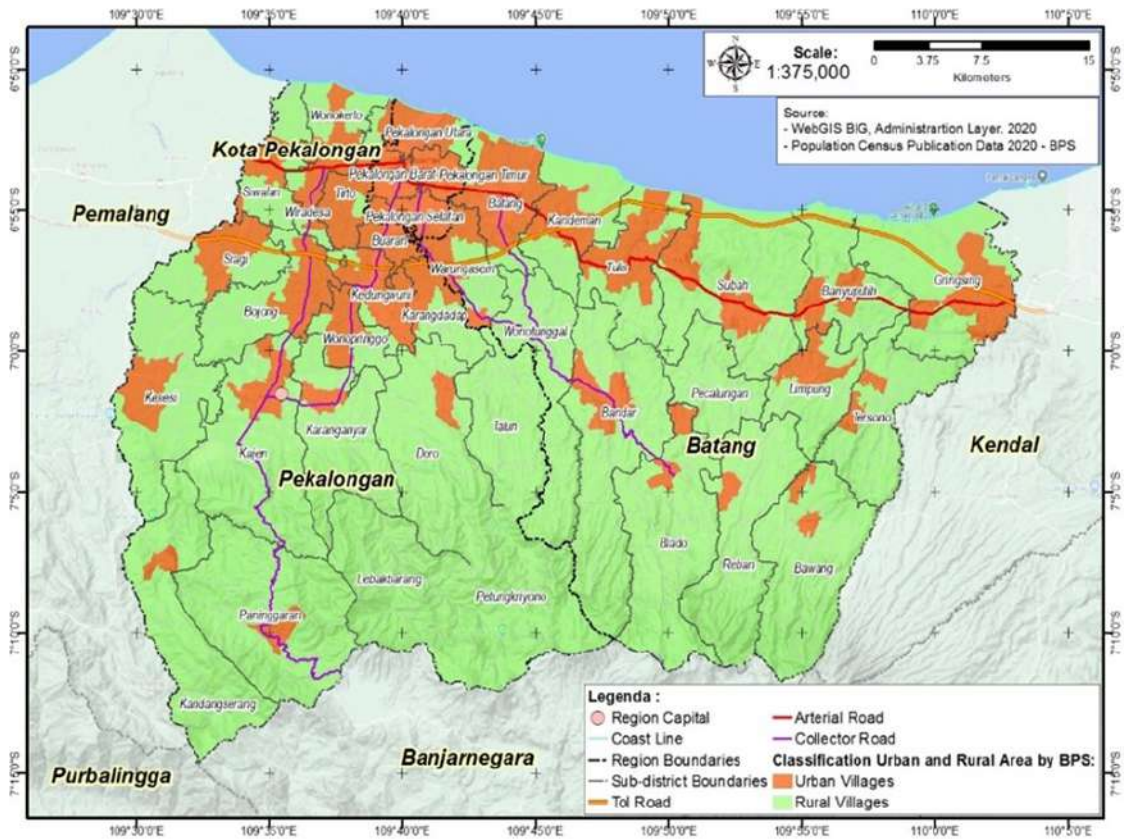


Figure 2. Urban and Rural Villages based on the Classification Criteria
Source: Indonesia National Central Statistics Agency (2020) and Analysis, 2021

Table 2. Comparison of Urban-Rural Areas between Administrative Status and BPS Classification Criteria

City/ Regency	Administrative Status				Urban -Rural Classification using The Central Statistics Agency's (BPS) Criteria			
	Number of Desa	Number of Kelurahan	Rural Area (hectares)	Urban Area (hectares)	Number of Rural Village	Number of Urban Village	Rural Area (ha)	Urban Area (ha)
Pekalongan City	-	27		4.588	1	26	354	4.234
Pekalongan Regency	272	13	87.937	1.451	174	111	73.150	16.238
Batang Regency	239	9	83.824	1.790	176	72	68.983	16.630
Total	511	49	171.761	7.829	351	209	142.488	37.102

Table 2 shows the result of urban-rural villages classification in Pekalongan City and each regency. It can be seen that some of Desa has transformed into urban areas, and the Kelurahan remains in rural characteristics. One of the 27 Kelurahan in Pekalongan City classifies as a rural village occupying 354 Ha, or about 7.7% of the area, as shown in Figure 3. The rural village of Pekalongan City lies in the northern area and is inhabited by residents working as fishermen or fishpond owners (Central Statistics Agency of Pekalongan City, 2021;

Mardiansyah & Rahayu, 2020). Meanwhile, almost 100 Desa in Pekalongan Regency and 63 Desa in Batang Regency transformed into urban settlements. The urban sprawl observed in those regencies occupied about 30,000 ha, wider than Pekalongan City.

Based on the BPS, the population growth rate of Pekalongan City is low; it was less than 1% from 2000 to 2020. The population and population densities in 2000 and 2020 were 261,745/307,150

people/Ha and 5,784/6,787 people/Ha (BPS Kota Pekalongan, 2021). In comparison, the population growth rate of Pekalongan and Batang Regencies was 1,53% and 1.24%, respectively (Central Statistics Agency of Batang Regency, 2021; Central Statistics Agency of Pekalongan Regency, 2021).

The population density of Pekalongan Regency ranged from 500 to 4,000 people/sq km, indicating that only four of the 18 subdistricts had population densities above 4,000 people per square km. These four subdistricts lie close to Pekalongan City. The population density of Batang Regency also has similar conditions, ranging from 550 to almost 4,000 people/sq km, and only one of the 15 subdistricts had a population density of almost 4,000 people/sq km that lies in the eastern periphery of Pekalongan City. Based on that information, also shown in Figure 2, the urbanization of Pekalongan City has expanded toward city boundaries resulting in urban housing development in the subdistricts around the city.

The phenomena of urban sprawl in the study area is in line with that stated by some researchers. Sinha (2018) claimed that the leading causes of the urban sprawl phenomenon in developing countries were regional inequality, rapid urbanization, and the emergence of new urban spots. The new urban

spots provide innovative housing construction along with proper urban facilities. Urban residents have known to select housing locations by considering affordable land prices and good transportation accessibility located on the fringe areas (Gopal & Nair, 2014; Habibi & Asadi, 2011; Sinha, 2018; Turok & McGranahan, 2013). Similarly, private housing developers prefer to select housing development are in urban fringes because land prices are cheaper and relatively close to the city (Adyatma & Hadi, 2022; Pahlevi, Dinanti, Subagiyo, Qomariyah, & Varo, 2023; Yasin, Yusoff, Abdullah, Noor, & Noor, 2021).

Regarding the study objectives, the condition of urban facilities in the villages will be explored. The provision of these facilities was analyzed with the following parameters, including (1) the accessibility to main and collector roads, (2) the availability of water network services, (3) the availability of electrical network services, and (4) the accessibility to health and educational facilities. The facilities' conditions are categorized into Good with a score of 4, Fair 3, Poor 2, and Very Poor 1, depending on the number of facilities provided and the parameter that meets the required standards. Table 3 shows the number of villages in each regency according to the urban facilities conditions .

Table 3. Number of Villages According to the Urban Facilities Conditions

No	City/Regency	Number of Villages according to conditions of urban facilities				Total
		Good	Fair	Poor	Very Poor	
1	Pekalongan City	14	8	5	0	27
	- Urban Village	14	8	4	0	26
	- Rural Village	0	0	1	0	1
2	Pekalongan District	17	42	113	113	285
	- Urban Village	17	28	58	8	111
	- Rural Village	0	14	55	105	174
3	Batang District	8	53	72	115	248
	- Urban Village	8	33	19	12	72
	- Rural Village	0	20	53	103	176
	Total	39	103	190	228	560

Table 3 and Figure 3 showed that Kelurahan was not all classified as an urban village with good facilities. Five Kelurahan in Pekalongan City has poor urban facilities and 22 Kelurahan with Fair–Good condition. The facilities condition of Pekalongan

Regency needs more concern; only 45 of the 111 Urban Village (40%) had Fair–Good condition. Meanwhile, in Batang Regency, 41 Urban Villages had Fair-Good and 20 Rural Villages had Fair conditions.

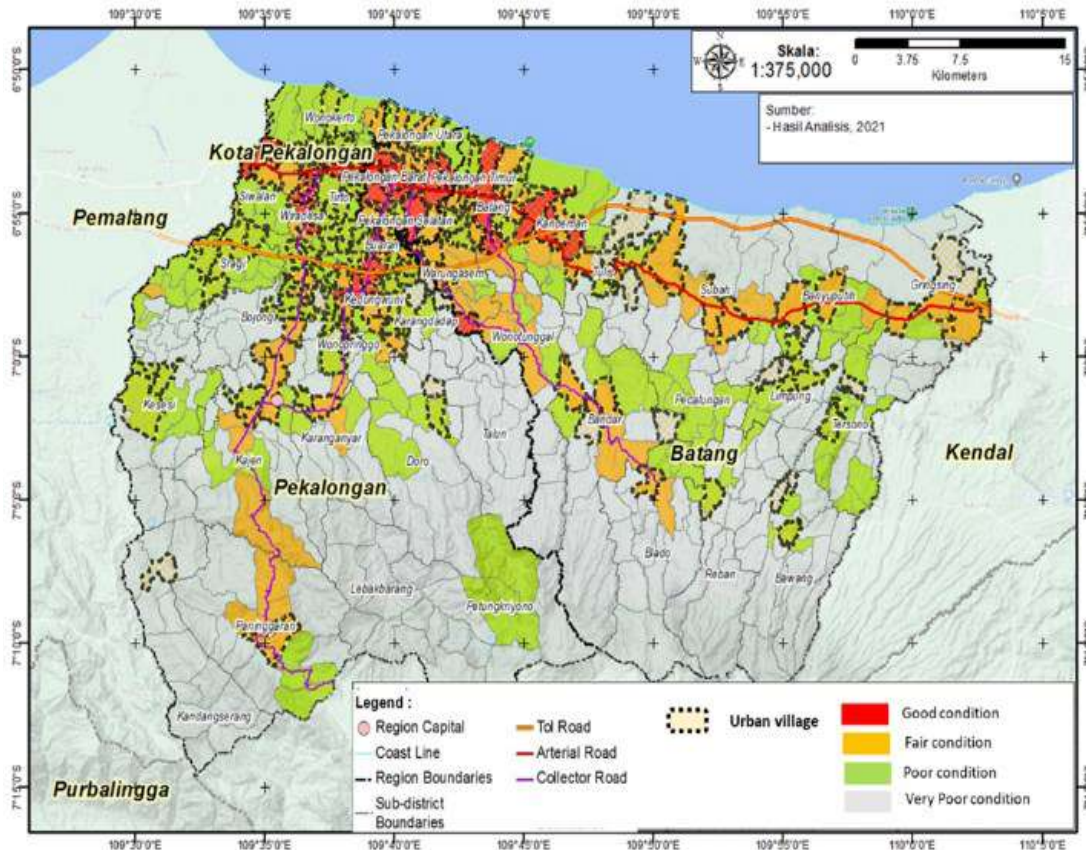


Figure 3. Condition of Urban Facilities in Pekalongan City and its Surrounding

Figure 3 also shows that good and fair-quality urban facilities tend to be located along the main transportation corridors, contrary to the theory, which states that urban sprawl is carried out in a disorganized and uncontrolled way and can be deprived of infrastructure services (Sudhira and Ramachandra, 2007 in Karakayaci (2016)). A lack of drinking water service affects urban facilities with fair conditions. Waste and wastewater management parameters have yet to be included in assessing urban facilities' conditions. This study does not use SNI 031733-2004 on Procedures for Planning Housing Environments in Urban Areas.

The urban sprawl phenomenon in Pekalongan City and its surroundings, as shown in Table 3 and Figure 3, indicated that urban development in Pekalongan Regency and Batang Regency has yet to be connected with Pekalongan City as the central. This condition also stated that each region is managed separately. Therefore, managing urban areas that expand towards city boundaries requires an integrated development policy rather than just responding to market demand.

4. CONCLUSION

Urban sprawl is one of the main problems of cities in suburban areas. Urban sprawl, as an impact of urbanization, made urban development uncontrolled, leading to a massive expansion at the fringe area. It had raised urban agglomeration and new small towns. It also pressures the fringe area and causes significant problems when the development is uncontrolled and unmanaged (Habibi & Asadi, 2011; Turok & McGranahan, 2013). Based on this study, the urban sprawl phenomenon has emerged in Pekalongan City, and its expanded development exceeded and spread to Pekalongan Regency and Batang Regency. Urban sprawl in Pekalongan City and its surroundings followed a concentric and linear model. The concentric model expands in Pekalongan City with the capital district as the center. The linear model expands west and east of Pekalongan City, following the primary road network at northern Pekalongan and Batang Regency. It has transformed some of Desa and Kelurahan in Pekalongan and Batang Regency into urban areas. One hundred eleven villages of

Pekalongan Regency and 63 villages of Batang Districts were transformed from rural to urban. However, they needed to be supported by adequate facilities such as clean water networks, electricity, health, and educational services, and even the facilities have good and fair-quality conditions. Based on the analysis, urban development must be managed in an integrated development policy among the city and regencies to control the expansion as well as to provide integrated urban facilities.

5. ACKNOWLEDGMENTS

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DETERMINATION OF URBAN SPRAWL PHENOMENON IN PEKALONGAN CITY AND ITS SURROUNDING

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Endrawati Fatimah^{1*}, Aris Choirul Anwar²

¹Urban and Regional Planning Department, Faculty of Landscape Architecture and Environmental Technology, Universitas Trisakti, Indonesia

²Urban and Regional Development Institute, Indonesia

Abstract. Urbanization defines as a spatial and socio-economic transformation process from rural to urban areas. While urban sprawl is the process of propagation of the appearance of urban physical characteristics from the inner city toward the urban fringe area. Pekalongan City has grown from a small town to a medium-sized city with a population of 300,000 people. This study aims to identify the phenomenon of urban sprawl in Pekalongan City and its surroundings (Pekalongan and Batang Regency) and identify the urban environment quality based on the condition of the public services availability in these urban areas. The data used in this study were the 2019 Village Potential (PODES) from the Central Agency on Statistics (BPS) and a digital base map from the Geospatial Information Agency (BIG). The urban-rural classification scoring from the BPS was used to identify urban areas as the method in this study. The results showed that 111 out of 285 villages in Pekalongan Regency and 63 out of 248 villages in Batang Regency could already be classified as urban areas and formed an urban agglomeration with Pekalongan City. This study also showed that the environmental quality in urban areas with urban sprawl phenomenon has met the standards and criteria for urban public services compared to other areas.

Keywords: Pekalongan; Urban Development; Urban Sprawl

[Judul: Fenomena Urban Sprawl di Kota Pekalongan dan Sekitarnya] Urbanisasi dapat dimaknai sebagai proses transformasi dari pedesaan menjadi perkotaan. Sedangkan urban sprawl dikenal sebagai proses perambatan yang menunjukkan ciri-ciri fisik Kawasan perkotaan dari Kawasan pinggiran akibat perkembangan pusat kota. Kota Pekalongan telah berkembang dari kota kecil menjadi kota menengah dengan penduduk mencapai 300.000 jiwa. Penelitian ini bertujuan untuk mengidentifikasi fenomena urban sprawl di Kota Pekalongan dan sekitarnya (Kabupaten Pekalongan dan Kabupaten Batang) serta mengidentifikasi kualitas lingkungan perkotaan berdasarkan kondisi ketersediaan pelayanan publik di kawasan perkotaan tersebut. Data yang digunakan adalah Potensi Desa (PODES) 2019 dari Badan Pusat Statistik (BPS) dan peta dasar digital dari Badan Informasi Geospasial (BIG). Metode yang digunakan untuk mengidentifikasi kawasan perkotaan adalah skoring klasifikasi perkotaan pedesaan dari BPS. Hasil penelitian menunjukkan bahwa sebanyak 111 dari 285 desa di Kabupaten Pekalongan dan 63 dari 248 desa di Kabupaten Batang sudah dapat diklasifikasikan sebagai kawasan perkotaan serta membentuk aglomerasi perkotaan dengan Kota Pekalongan. Kajian ini juga menunjukkan bahwa kualitas lingkungan di kawasan perkotaan yang mengalami urban sprawl sudah memenuhi standar dan kriteria pelayanan publik perkotaan dibandingkan dengan kawasan lainnya.

Kata Kunci: Perkembangan Perkotaan; Pekalongan; Urban Sprawl.

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1. INTRODUCTION

Urbanization is a rapid transformation process from rural to urban settlements, whose existence is globally observed, especially in Indonesia. Based on several previous studies, the global urban

population has increased five times between 1950–2018, from 751 million to 4.2 billion. The urban population in Indonesia increased rapidly from 30 to 100 million between 1971 and 2015. By 2018, the urbanization rate had reached 54.7% of the total population (Indonesia National Statistics Agency,

2022). This urbanization rate indicated that the urban population in Indonesia is larger than the rural.

The growth of the urban population had consequences for urban compaction and expansion. Urban compaction is the densification and mixed land use to intensify the metropolitan areas (Gopal & Nair, 2014). Burgess (2000), called the urban compaction a driven increase of developed areas and population densities to intensify urban economic, social, and cultural activities resulting in an impact to change the city size, the spatial formations, and the housing system. This impact was beneficial to achieve environmental, social, and global sustainability derived from the concentration of urban functions (Burgess, 2000; Gopal & Nair, 2014). Based on those criteria, urban compaction characteristics were high population density, mixed land uses, and urban function intensification.

As a concept, urban compaction has increased socioeconomic liveability. However, good public transport, access to the inner-city, solid waste management, affordable housing, and public services need to be supported (Bibri, Krogstie, & Kärrholm, 2020; Gopal & Nair, 2014). Based on this concept, improving the quality of civilization needs to be evaluated through urbanization. Furthermore, infrastructure levels and public services capacity also should be analyzed further. These conditions were subsequently evaluated comprehensively based on economic, social, and environmental sustainability (Chen, Zhang, Liu, & Zhang, 2014).

Urbanization and rapid urban growth in Java, studied by Firman (2017), essentially showed that the development was uncontrolled, leading to a massive expansion at the fringe area. It had raised urban agglomeration and new small towns. It also caused remarkable improvement in the existing metropolitan development and surroundings (Firman, 2017; Wirawan & Tambunan, 2018).

Urbanization has been long discussed from academic and policy perspectives and prioritized internationally because of its severe impacts on the global environment, such as land consumption and degradation, air pollution, clean water scarcity,

poverty, social segregation, and disaster vulnerability (Chen et al., 2014; Cocheci & Petrisor, 2023; Kötter, 2004). Urbanization also caused problems in the inner city, such as inadequate public facilities to meet basic needs, including housing, clean water, educational and health infrastructures, and open spaces. Attempting to provide residents with housing and improve living conditions was part of the development pressure for high urbanization (Jones & Mulyana, 2015).

In addition to those studies, rapid urbanization also has resulted in the urban sprawl phenomenon pressuring uncontrolled land expansion (Habibi & Asadi, 2011; Kötter, 2004; Polidoro, de Lollo, & Barros, 2012; Sinha, 2018; Turok & McGranahan, 2013). Urban sprawl phenomenon has direct effects on (1) the land conversion of non-urban areas, (2) increasing traffic volume, and (3) marginalization of the indigenous communities. Regardless of the urban sprawl effect, the inner city condition has worsened due to unable meeting the basic needs that the resident has been growing and spreading. This condition could cause more chaotic and complex environmental problems (Habibi & Asadi, 2011; Kötter, 2004; Polidoro et al., 2012; Turok & McGranahan, 2013).

This study aims to identify urban areas development in Pekalongan City and its surrounding (Pekalongan and Batang Regency) on the Northern Coast of Java Island, Indonesia, and to analyze the public services conditions in the urban area. Pekalongan City and its surroundings were selected due to the rapid urban development pressure on the Northern Coast, which has been the main route of economic activity in Java since the Dutch colonial period.

2. DATA AND METHODS

The data used in this study were the 2019 Village Potential (PODES) from the Central Agency on

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*Email: endrawati@trisakti.ac.id

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Statistics (BPS) and a digital base map from the Geospatial Information Agency (BIG).

The unit analysis was Kelurahan (urban village) or Desa (village), the smallest administrative area in a

city and regency. Urban areas were classified using urban and rural village criteria set by the BPS. This classification used the scoring method by the BPS focused on three criteria, as shown in Table 1.

Table 1. Criteria, Classification, and Scores of Urban–Rural Village

Criteria	Sub Criteria	Classification	Score
Population Density per sq. km	-	< 500	1
		500 - 1,249	2
		1,250 – 2,499	3
		2,450 – 3,999	4
		4,000 – 5,999	5
		6,000 – 7,499	6
		7,500 – 8,499	7
		>8,500	8
Percentage of Household working in the Agricultural sector	-	>70	1
		50.00 - 69.99	2
		30.00 – 49.99	3
		20.00 – 29.99	4
		15.00 – 19.99	5
		10.00 – 14.99	6
		5.00 – 9.99	7
		<5.00	8
Accessibility to Urban Facility	1. Kindergarten	• Available on location or within ≤ 2.5 km	1
	2. Secondary School	• Available within >2.5 km	0
	3. High School		
	4. Traditional or Permanent Market	• Available on location or within ≤ 2 km	1
	5. Shops	• Available within >2 km	0
	6. Hospital	• Available on location or within ≤ 5 km	1
		• Available within >5 km	0
	7. Hotel/Billiard pool Hall/Discotique/Massage Parlors/Salon	• Available	1
		• Not Available	0
8. Percentage of household access to telephone	• ≥8.00	1	
	• <8.00	0	
9. Percentage of household access to electricity	• ≥90.00	1	
	• <90.00	0	

Source: Indonesia National Central Statistics Agency (2020)

This study calculates scores for each village in the study area, then classify it into the urban village or rural village categories. Based on the BPS criteria, a village can achieve a maximum score of 25 and a minimum score of 2. The cut point used to determine urban village is 9. Villages with a score of 9 or more are classified as urban villages, while villages with a score of less than 9 are classified as rural villages (Firmansyah & Wahyuni, 2022; Indonesia National Central Statistics Agency, 2020). The spread of the urban sprawl phenomenon was described by mapping each village's scoring and classification. Then, the superimpose method

compared the urban sprawl phenomenon map with the village's administrative status. The results showed new village criteria, namely (1) Urban Kelurahan, (2) Rural Kelurahan, (3) Urban Desa, and (4) Rural Desa. Based on the results, the conditions of the public facilities were identified for each village using the regulation standards.

11 3. RESULT AND DISCUSSION

Pekalongan City is located on the Northern Coast of Java and has 27 Kelurahan in an area of 45.25 sq. km. Pekalongan Regency is located southwest of

Pekalongan City, with 23 Kelurahan and 272 Desa in an 836.1 sq. km. Meanwhile, Batang Regency is located east of Pekalongan City with 13 Kelurahan

and 239 Desa in an area of 788.6 sq. km. Figure 1 shows the study area based on the administrative status.

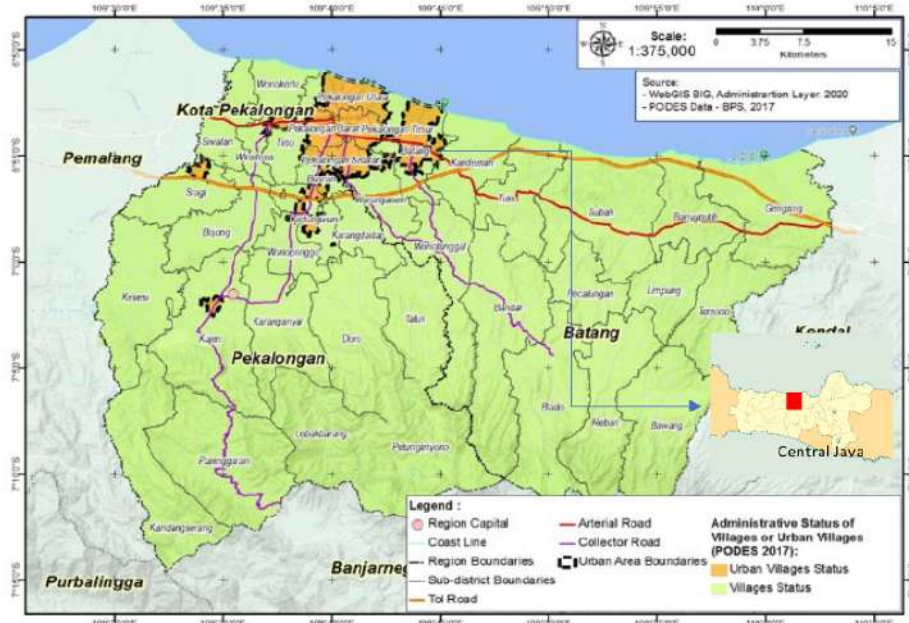


Figure 1. Study Area Based on the Subdistrict Administrative Status
 Source: Indonesia National Central Statistics Agency (2020) and Analysis, 2021

Analysis using BPS criteria and superimpose method has different results in the urban-rural classification regarding the distribution of urban villages, as indicated in Figure 2. Based on Figure 2, the urban sprawl phenomenon is spread in all directions and extends beyond the inner city, primarily following highway, arterial, and collector roads. The urban agglomeration in Pekalongan City and its surroundings was also significantly expanded.

Compare to Figure 1, Figure 2 shows the transformation of some villages (Desa) in Pemalang, Batang, and Pekalongan regencies from rural villages to urban villages. These phenomena indicate that urban sprawl have occurred in Pekalongan city. Figure 2 also shows that urban areas in Pekalongan City and its surroundings have expanded in a concentric and linear model, as shown in Figure 3. The concentric model expands in Pekalongan City with the capital district as the center. The linear model expands west and east of

Pekalongan City, following the primary road network at northern Pekalongan and Batang Regencies. As it is known that this study area is one of the strategic areas passed by the corridor belt that connects two metropolitan areas on an international and national scale, namely the National Strategic Area of Jabodetabekpunjur and Kedungsepur. This corridor belt is currently connected to the highway and will also be connected to the Jakarta-Surabaya Semi-High Speed Rail Mega Project. This linear model aligns with the axial theory initiated by Babcock in 1932, which states that transportation networks have a vital role in influencing cities' spatial development (Yunus, 2010). Areas along transportation routes have high mobility, so physical development will be faster than areas between transportation routes (Nasukha & Herwangi, 2019; Yunus, 2010).

Table 2 shows the comparative analysis of the Desa and Kelurahan classification regarding the administrative status and rural-urban criteria.

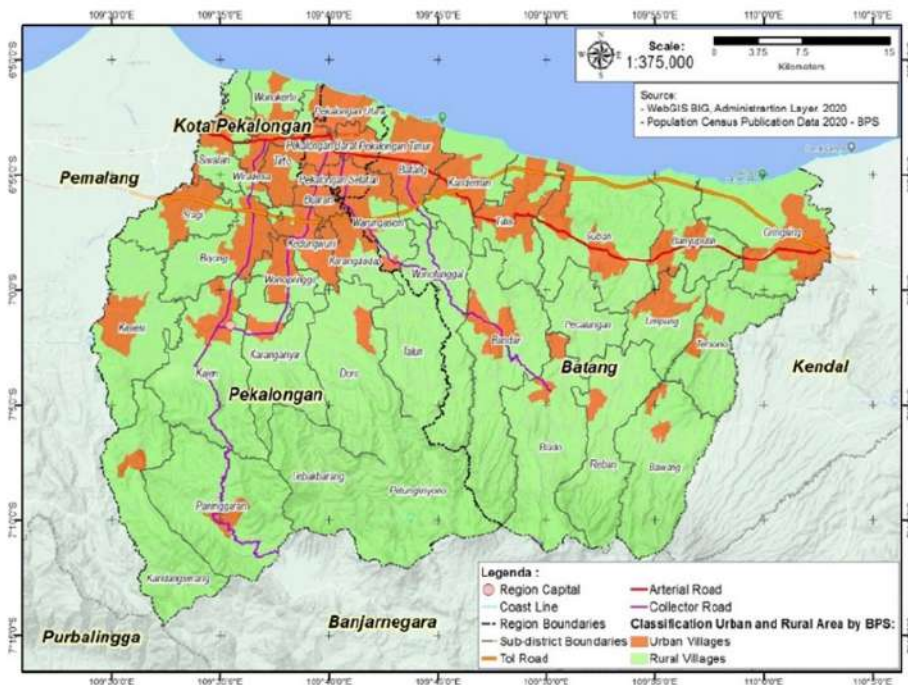


Figure 2. Urban and Rural Villages based on the Classification Criteria
 Source: Indonesia National Central Statistics Agency (2020) and Analysis, 2021

Table 2. Comparison of Urban-Rural Areas between Administrative Status and BPS Classification Criteria

City/ Regency	Administrative Status				Urban -Rural Classification using The Central Statistics Agency's (BPS) Criteria			
	Number of Desa	Number of Kelurahan	Rural Area (hectares)	Urban Area (hectares)	Number of Rural Village	Number of Urban Village	Rural Area (ha)	Urban Area (ha)
Pekalongan City	-	27		4.588	1	26	354	4.234
Pekalongan Regency	272	13	87.937	1.451	174	111	73.150	16.238
Batang Regency	239	9	83.824	1.790	176	72	68.983	16.630
Total	511	49	171.761	7.829	351	209	142.488	37.102

Table 2 shows the result of urban-rural villages classification in Pekalongan City and each regency. It can be seen that some of Desa has transformed into urban areas, and the Kelurahan remains in rural characteristics. One of the 27 Kelurahan in Pekalongan City classifies as a rural village occupying 354 Ha, or about 7.7% of the area, as shown in Figure 3. The rural village of Pekalongan City lies in the northern area and is inhabited by residents working as fishermen or fishpond owners (Central Statistics Agency of Pekalongan City, 2021;

Mardiansyah & Rahayu, 2020). Meanwhile, almost 100 Desa in Pekalongan Regency and 63 Desa in Batang Regency transformed into urban settlements. The urban sprawl observed in those regencies occupied about 30,000 ha, wider than Pekalongan City.

Based on the BPS, the population growth rate of Pekalongan City is low; it was less than 1% from 2000 to 2020. The population and population densities in 2000 and 2020 were 261,745/307,150

people/Ha and 5,784/6,787 people/Ha (BPS Kota Pekalongan, 2021). In comparison, the population growth rate of Pekalongan and Batang Regencies was 1,53% and 1.24%, respectively (Central Statistics Agency of Batang Regency, 2021; Central Statistics Agency of Pekalongan Regency, 2021).

The population density of Pekalongan Regency ranged from 500 to 4,000 people/sq km, indicating that only four of the 18 subdistricts had population densities above 4,000 people per square km. These four subdistricts lie close to Pekalongan City. The population density of Batang Regency also has similar conditions, ranging from 550 to almost 4,000 people/sq km, and only one of the 15 subdistricts had a population density of almost 4,000 people/sq km that lies in the eastern periphery of Pekalongan City. Based on that information, also shown in Figure 2, the urbanization of Pekalongan City has expanded toward city boundaries resulting in urban housing development in the subdistricts around the city.

The phenomena of urban sprawl in the study area is in line with that stated by some researchers. Sinha (2018) claimed that the leading causes of the urban sprawl phenomenon in developing countries were regional inequality, rapid urbanization, and the emergence of new urban spots. The new urban

spots provide innovative housing construction along with proper urban facilities. Urban residents have known to select housing locations by considering affordable land prices and good transportation accessibility located on the fringe areas (Gopal & Nair, 2014; Habibi & Asadi, 2011; Sinha, 2018; Turok & McGranahan, 2013). Similarly, private housing developers prefer to select housing development are in urban fringes because land prices are cheaper and relatively close to the city (Adyatma & Hadi, 2022; Pahlevi, Dinanti, Subagiyo, Qomariyah, & Varo, 2023; Yasin, Yusoff, Abdullah, Noor, & Noor, 2021).

Regarding the study objectives, the condition of urban facilities in the villages will be explored. The provision of these facilities was analyzed with the following parameters, including (1) the accessibility to main and collector roads, (2) the availability of water network services, (3) the availability of electrical network services, and (4) the accessibility to health and educational facilities. The facilities' conditions are categorized into Good with a score of 4, Fair 3, Poor 2, and Very Poor 1, depending on the number of facilities provided and the parameter that meets the required standards. Table 3 shows the number of villages in each regency according to the urban facilities conditions.

Table 3. Number of Villages According to the Urban Facilities Conditions

No	City/Regency	Number of Villages according to conditions of urban facilities				Total
		Good	Fair	Poor	Very Poor	
1	Pekalongan City	14	8	5	0	27
-	Urban Village	14	8	4	0	26
-	Rural Village	0	0	1	0	1
2	Pekalongan District	17	42	113	113	285
-	Urban Village	17	28	58	8	111
-	Rural Village	0	14	55	105	174
3	Batang District	8	53	72	115	248
-	Urban Village	8	33	19	12	72
-	Rural Village	0	20	53	103	176
	Total	39	103	190	228	560

Table 3 and Figure 3 showed that Kelurahan was not all classified as an urban village with good facilities. Five Kelurahan in Pekalongan City has poor urban facilities and 22 Kelurahan with Fair-Good condition. The facilities condition of Pekalongan

Regency needs more concern; only 45 of the 111 Urban Village (40%) had Fair-Good condition. Meanwhile, in Batang Regency, 41 Urban Villages had Fair-Good and 20 Rural Villages had Fair conditions.

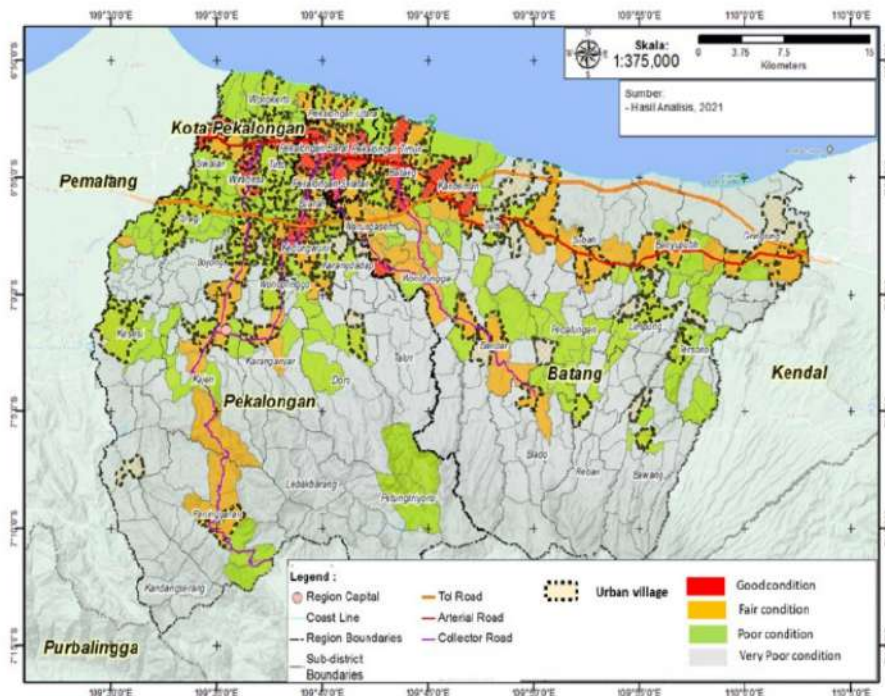


Figure 3. Condition of Urban Facilities in Pekalongan City and its Surrounding

Figure 3 also shows that good and fair-quality urban facilities tend to be located along the main transportation corridors, contra¹² to the theory, which states that urban sprawl is carried out in a disorganized and uncontrolled way and can be deprived of infrastructure services (Sudhira and Ramachandra, 2007 in Karakayaci (2016)). A lack of drinking water service affects urban facilities with fair conditions. Waste and wastewater management parameters have yet to be included in assessing urban facilities' conditions. This study does not use SNI 031733-2004 on Procedures for Planning Housing Environments in Urban Areas.

The urban sprawl phenomenon in Pekalongan City and its surroundings, as shown in Table 3 and Figure 3, indicated that urban development in Pekalongan Regency and Batang Regency has yet to be connected with Pekalongan City as the central. This condition also stated that each region is managed separately. Therefore, managing urban areas that expand towards city boundaries requires an integrated development policy rather than just responding to market demand.

4. CONCLUSION

15

Urban sprawl is one of the main problems of cities in suburban areas. Urban sprawl, as an impact of urbanization, made urban development uncontrolled, leading to a massive expansion at the fringe area. It had raised urban agglomeration and new small towns. It also pressures the fringe area and causes significant problems when the development is uncontrolled and unmanaged (Habibi & Asadi, 2011; Turok & McGranahan, 2013). Based on this study, the urban sprawl phenomenon has emerged in Pekalongan City, and its expanded development exceeded and spread to Pekalongan Regency and Batang Regency. Urban sprawl in Pekalongan City and its surroundings followed a concentric and linear model. The concentric model expands in Pekalongan City with the capital district as the center. The linear model expands west and east of Pekalongan City, following the primary road network at northern Pekalongan and Batang Regency. It has transformed some of Desa and Kelurahan in Pekalongan and Batang Regency into urban areas. One hundred eleven villages of

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5. ACKNOWLEDGMENTS

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