Urban region formation of small cities and the growth of urban settlements in peripheries: the case of Tegal and Pekalongan urban regions in Central Java, Indonesia

Fadjar Hari Mardiansjah¹, Agung Sugiri¹, Samsul Ma’rif¹

¹Universitas Diponegoro (Undip), Jl. Prof. Sudarto, SH, Tembalang, Semarang, Central Java, Indonesia

Corresponding author: fadjarmardiansjah@lecturer.undip.ac.id

Abstract. The expansion of urban areas has become a spatial feature in the urbanization process of cities in Indonesia. As the most densely populated island in the world, Java has experienced such formation in both large and smaller cities. In most cases of expanded urban formations of small cities in Java, the formation has also created growing towns or urban settlements in the peripheries. Using the cases of the expanded urbanization process occurring in Tegal City and Pekalongan City, two smaller cities of Java whose urban areas have expanded into the territory of surrounding regency (regencies or non-urban districts), this paper aims to elaborate on an understanding of the extent of which the growth of urban settlements in peripheries in the expansion process of small cities. The research, which uses the territory of subdistricts to delineate the towns, tries to find how the spatial process affects the formation of urban regions as well as the towns in the peripheries. The analysis on villages’ transformation in peripheries was implemented by showing the spatial evolution of population density in the regions. Next, the development of towns in peripheries was analyzed to show the influence of such an urbanization process on the formation of towns in the peripheries of small or medium cities in Java. Time series and comparison analysis are employed to develop an understanding of how urbanization affects spatial formation in peripheries. The results show that the urbanization process of small cities needs to be managed in an integrated manner so that the urbanization and peri-urbanization processes can be directed to produce better formation of the urban region.

Keywords: urbanization, urban settlements, urban region formation

1. Introduction

Especially in Java, the urbanization process has brought many cities, including the larger and smaller cities, to grow in an expansion process beyond their administrative boundaries into surrounding areas, which mostly are the territory of the surrounding regency or non-urban districts [1]. Firman [2] said that urbanization and urban growth in Java could be classified as recent phenomena, as its urbanization level was still 35.7% in 1990, which increased to 48.7% in 2000. Java started to have more than half of the population be the urban population at the beginning of the 2000s, as in 2010 it had 58.5% in its urbanization level [3]. However, Zhang & Deng [4] argue that urbanization in Indonesia, which is dominantly contributed by the process in Java, reached extraordinary urbanization in the 1980s. Furthermore, although Zhang & Deng [4] argue that urbanization in Indonesia has entered into the adjustment era in the 1990s, Mardiansjah et al. [3] argue that urbanization in Indonesia, including in
Java, has entered into a more complicated era after the 1980s since the absolute increase of urban population was getting larger in every decade, although the annual growth rate has been slowing down. Using the terms of mega-(urban)-region, defined by Florida et al. [5], which can be defined as a polycentric integrated set of cities and their surrounding suburban hinterland where labor and capital can be reallocated efficiently to perform economic functions in massing talent together and increase production capability, innovation, and markets, to be related to the global economy, urbanization process in Java could be classified distinct, although it is new. The urbanization process has not only created megacity (city with more than 10 million population), as Jakarta has become a megacity with more than 10 million population [6], but it is also considered to develop the mega-urban region as today the Jabodetabek Urban Region has reached nearly 30 million population, developed by Jakarta with several surrounding cities, i.e., the city of Bekasi, Depok, Bogor, Tangerang and South Tangerang (Tangerang Selatan) and vast sub-urban areas in the territory of the three regencies (non-urban districts) surrounding Jakarta, i.e., Regency Bekasi, Bogor and Tangerang; and also develop many other urban regions, large and smaller, as the results of the extended character in the process. Fahmi et al. [7] show urban expansion and the development of the urban region in the Cirebon Area in West Java Province as much smaller urban region development, while Mardiansjah et al. [8] show the development of Tegal, Pekalongan, and Magelang area in Central Java Province. In short, the urban expansion process in Java does not only occur in big cities like Jakarta, Surabaya, Bandung, and Semarang [3] [9] [10] [11] [12] and [13], but also in smaller cities like Malang, Surakarta and Yogyakarta [14] [15] [16], and even in much smaller cities, as also happened in the city of Cirebon [7]) as well as the city of Tegal and Pekalongan [8]). In many cases of urban expansion, similar phenomena in which the growth in the peripheries is more intensive than that in the core have become the main characters in the process. Firman [2] argues that urban growth outside the cities’ boundaries is reflecting the real growth of the cities.

Urbanization which is still continuing for some next decades has become an important process in development process of many developing countries since the middle of the last century [6] [17] [18] [19]. Urbanization is a multidimension process that relates to the growth of the urban population as well as cities and towns in a region. It is an urban process consisting of social and economic processes in the increasing urban population and activities as well as their concentrations in a region [20] [21], which is followed by a spatial process in the formation, development, and also expansion of existing urban areas [22]. Increasing urban population, area expansion, and increasing number of urban concentrations in the region become parts of the results of the urbanization process. Therefore, urbanization is still and will become a major challenge in the development process of many countries, especially for those in which the urbanization level is still low or moderate.

Many cases show that the expansion of urban areas is also caused by the limited ability of urban core areas to accommodate the needs of the growth of urban population activities in the cities, which then are accommodated by the suburban areas that are able to provide space for growth and development of large urban activities at a more affordable price [23]. These expansion phenomena made Jones [24] argue that the use of city administrative boundaries is becoming increasingly irrelevant in analyzing the dynamics of urban growth. Therefore, the understanding of the dynamics of urban growth must be carried out in ways that combine the dynamics in the city and the dynamics that occur in its peripheries outside the administrative boundaries of the city [24].

Jones [24] also illustrates that the general pattern is growth in peripheries, especially the areas adjacent to the city, with more rapid growth in the peripheries than that in the core. It will change the function of rural areas in the peripheries to become urban areas by providing places for urban activities, developing the areas as urban development areas, and expanding urban areas into larger ones. So, the spatial expansion process has also become a strengthening the roles of peripheries in larger urban areas. The strengthening roles come from the increasing number and density of population in the areas, which is followed by an intensification of activities that take advantage of the available land at a good price and good accessibility, and the available population as potential labor for industrial and other urban activities as well as the potential market for business activities. The development of industrial activities,
business, and commercial trade, as well as service activities and other urban activities in the peripheries takes advantage of these two important factors.

The urbanization process which is the motor of growth and regional economic development [25][26] [27], also becomes the motor of growth and spatial development of urban areas [28] [29]). One of the implications of this development is the transformation in urban structure, in which it becomes more complex than the previous structures, i.e., from a monocentric traditional urban structure with one center into a polycentric structure with a core and many other centers / multiple centers in the urban area [29]. Kloosterman & Musterd [30] said that polycentricity is the existence of multiple centers in one area that can either refer to intra-urban patterns of clustering urban population and activities or to the inter-urban pattern of cities (and/or towns) that are not randomly spread but are concentrated in relatively close proximity in a number of densely populated clusters that also include smaller cities or towns and villages. The transformation from a monocentric into a polycentric one in the expansion of urban areas not only increases the population density in certain areas on the outskirts but also increases the development of activities in those areas, especially the areas that have good transportation networks and accessibility. Agyemang et al.[28] argue that many cities, both in developed and developing countries, have undergone this process of transformation.

The development of polycentric urban regions, especially in western Europe, has increased the attention of scholars and researchers to analyze its implications for development, especially in terms of achieving two dimensions, i.e., a more balance spatial pattern of development and a higher level of spatial or territorial competitiveness [31][30][29], [32] [33] [34] and [35]). Parr [29] argues that polycentric urban regions offer some possible economic advantages that mainly come from inter-industry linkages in the areas, in both convergent industrial linkages and/or sequential industrial linkages. The importance network model of the spatial organization of cities has also increasing when the cities have different functions, in terms of urban facilities that spread over different cities, but they complement each other [33].

However, urbanization, peri-urbanization, and polycentricity not only provide opportunities as it will also increase challenges that should be managed. He & Zhang [36] argue that the urbanization process is a crucial factor in the change of inequality, especially between agricultural and non-agricultural activities, which in spatial terms could be seen as rural to urban areas. In addition, He & Zhang [36] also said that the relation between the urbanization process and inequality is developed by the distribution effects of urbanization. Siqueira-Gay et al. [37] argue that inequality is related to the distribution of opportunities among people and places, and since the territory is the spatial area in which the people live, then territory becomes an important the ground where the distribution of the opportunities should be allocated, then the spatial point of view also becomes an important aspect in the discourse of inequality. Furthermore, Senoret et al. [38] argue that fragmentation characteristics of the cities bring influence the existence of inequality within cities, and Yin et al. [39] said that spatial inequality is also contributed by unequal spatial accessibility, while Siqueira-Gay et al. [38] said that accessibility provides potential opportunities for interaction that spatially links the integration of environmental issues and social issues. In this context, the urbanization process and densification of urban places, as well as the development of the polycentric urban region and another urban development process could compound urban segregation and fragmentation that lead to inequality in terms of different access to urban opportunities, such as access to urban services, proximity to workplaces and urban mobility, which could contribute into barriers to sustainable urban development and/or sustainable urbanization.

This study aims to comprehend the formation of smaller urban regions in which the development involves the urbanization process of small cities and the growth of towns in their peripheries. Depth understanding of spatial processes in the formation of the urban regions including urban settlements in the peripheries in the urbanization process is an important understanding for the formulation of strategies and policies in the management process, so the urbanization process can be directed positively, beneficially, and more in line with the concepts of sustainable urbanization [23].
2. Study areas, data, and methods

2.1. Study areas
This research uses two developing urban regions formed by cities in Central Java Province, i.e., Tegal City and Pekalongan City, which according to the result of the National Population Census, could be classified as medium cities as they have a populations of 239,599 and 281,434 respectively. These two urban regions, separated by a regency, i.e., Regency Pemalang, are located in the west-northern coastal areas of Central Java Province. They are located in the corridor of Pantura National Road, the most important road in Java and also in the country (see Figure 1).

![Map and orientation of Tegal and Pekalongan Urban Regions.](image)

2.1.1. Tegal Urban Region. Combining with the in-situ urbanization process in its peripheries, the urbanization process in Tegal City has developed Tegal Urban Region, formed by Tegal City as the core area and urban concentrations or settlements in its two surrounding regencies: i.e., Regency Tegal and Regency Brebes. The territory of Tegal City is divided into four subdistricts, while those of Regency Tegal, and Regency Brebes are divided into 18 and 17 subdistricts respectively. However, the administrative area of the subdistrict varies significantly. As a subdistrict in an urban district, the area of those Tegal City is very small compared to those in the regency, as two of them are about 6.5 km² and the other two are about 10 to 12 km². Meanwhile, the area of those in Regency Tegal is larger, with the minimum is about 13.5 km² for Subdistrict Slawi which play the role as the capital of the regency, and the maximum is about 88.6 km² for Subdistrict Bumijawa, one of the least urbanized subdistrict in the regency. Moreover, the administrative area of subdistrict in Regency Brebes are more varies or larger than those in Regency Tegal. The smallest subdistrict is Subdistrict Kersana with an area of 25.23 km², and the largest is Subdistrict Bantarkawung with an area of about 2005 km². Subdistrict Brebes, the capital of the regency has an area of 82.3 km².
2.1.2. Pekalongan Urban Region. has a similar process to that is occurred in Tegal Urban Region. The urbanization process in Pekalongan has also developed Pekalongan Urban Region, which is formed by Pekalongan City and urban concentrations or settlements in its two surrounding regencies: i.e. Regency Pekalongan and Regency Batang. The territory of Pekalongan City is also divided into four subdistricts, while those of Regency Pekalongan and Regency Batang are divided into 19 and 15 subdistricts respectively. Similar to the situation in the Tegal Urban Region, the administrative area of subdistricts in Pekalongan City is much smaller than those in the regency. The area of subdistrict in the city is about 9.5 to 15 km², while the range of area of subdistrict in Regency Pekalongan is about 9.5 to 93 km², and those in Regency Batang are about 23.5 to 83.5 km².

2.2. Data and methods
There are two groups of data used in this research, i.e., data for examining the development of urban concentrations or settlements in the peripheries, and data for analyzing the level of services of settlements in the peripheries. The first group consists of data on villages’ classification and their population, produced by the Statistics of Indonesia in 1990, 2000, 2010, and 2019, in which the first three are related to the national population censuses. Meanwhile, for data in 2019, the year that is used to represent the recent situation, the research utilized the 2010 villages’ classification utilized and the 2019 population data compiled from the monograph of the regency.

Urbanization process in the peripheries in this study is analyzed by the development of urban villages, classified by BPS (Badan Pusat Statistik or Statistic Indonesia), who classifies all villages into non-urban villages and urban villages (or urbanized villages). Their growing population density is also used in the investigation, using the threshold of 1500 inhabitants/km², as population density for areas that could be classified as urban centers in the concept of Degree of Urbanization [40]. The analysis also investigates the growth and development of towns or urban settlements in the peripheries by analyzing the process in four points of years, i.e., 1990, 2000, 2010, and 2019. However, the maps and some data will only be presented for 1990 and 2019. The investigation of urban concentrations’ development is implemented by identifying agglomerations of adjacent urban villages in the peripheries, in the four points of time, and by analyzing their characteristics based on two variables, i.e., population and density of the concentrations, variables suggested by the concept of degree of urbanization in analyzing and differing urban concentrations to other areas [40] [41]).

3. Results and discussions

3.1. Peri-urbanization, and the growth of urban settlements in the peripheries of urban regions
Leaf [42] defines peri-urbanization as the development of intermixing together of urban and rural activities in peripheries around cities, which is understood as a specific characteristic of urbanization and urban transition in some particular Asian countries. It is considered as an outward expansion of cities into peripheries that creates a peri-urban area, a mix urban development that retains rural characteristics and activities in the area [43]. The expansion of transportation and communication technologies brought the possibility for some particular places in the peripheries to rapidly absorb population and urban activities, then change places into urban places that could be consequentially later become parts of the larger urban territories [42].

Peri-urbanization that occurred in the two urban regions is indicated by the development of urbanized villages in the territory of the surrounding regency. The peri-urbanization process has increased density and transformed many villages from non-urban into urbanized ones, and then formed growing urban settlements by the agglomeration of the growing adjacent urbanized villages. Table 1 shows the increasing number of urbanized villages in the two urban regions, while the growing distribution of villages by their population density are indicated by Figure 2 and 3.
Table 1. The development of urbanized villages in the two urban regions

| Regions               | 1990 | 2000 | 2010 | 2019 |
|-----------------------|------|------|------|------|
| Tegal Urban Region    | 117  | 136  | 246  | 247  |
| - Regency Tegal       | 85   | 95   | 142  | 143  |
| - Regency Brebes      | 32   | 41   | 104  | 104  |
| Pekalongan Urban Region| 85  | 107  | 182  | 183  |
| - Regency Pekalongan  | 59   | 71   | 110  | 110  |
| - Regency Batang      | 26   | 36   | 72   | 73   |

| Regions               | 1990 | 2000 | 2010 | 2019 |
|-----------------------|------|------|------|------|
| Tegal Urban Region    | 20.6 | 23.3 | 42.1 | 42.3 |
| - Regency Tegal       | 29.6 | 33.1 | 49.5 | 49.8 |
| - Regency Brebes      | 11.4 | 13.8 | 35.0 | 35.0 |
| Pekalongan Urban Region| 16.0| 20.1| 34.1 | 34.3 |
| - Regency Pekalongan  | 20.7 | 24.9 | 38.6 | 38.6 |
| - Regency Batang      | 10.5 | 14.6 | 29.0 | 29.4 |

Peri-urbanization that occurred in Tegal Urban Region has been more intensive than that of in Pekalongan. Tegal Urban Region has a larger number of urbanized villages, as well as the proportion of urbanized villages to the total, in all of the time than those in the Pekalongan Urban Region. Nearly half of the villages in Regency Tegal was urbanized in 2019, and so for more than 40% of the villages in the Tegal Urban Region (see Table 1). However, it is indicated that as the less urbanized region, Pekalongan Urban Region has slightly faster urbanization rate than that of the Tegal Urban Region. In fact, the less urbanized region in each area: i.e., Regency Brebes in Tegal Urban Region and Regency Batang in Pekalongan Urban Region, are the regions that have faster process of urbanization than others. These processes also indicate a converging process in Tegal Urban Region, in which the gap between the two periphery areas becomes smaller, which has not occurred yet in Pekalongan Urban Region.

In the spatial context, Figure 2 and 3 show that Tegal Urban Region also has an extensive area of villages with more than 1500 inhabitants/km², the threshold of population density for areas that could be classified as urban centers according to the concept of Degree of Urbanization [40]. The area of villages with 1500 to 3000 inhabitants/km² in the Tegal Urban Region was extensively growing between 1990 to 2019, and has made the northern part of this urban region dominated by villages with more than 1500 inhabitants/km². Moreover, the brown, dark-brown, and red areas, which have much higher density, have also developed in a more extensive manner than the area of the city of Tegal, the core area that is located at the north junction of the road network as well as rail network in the urban region, which are covered by a combination of dark-brown and red areas in 2019. These areas could be considered as the expansion of the core area that extend along the corridor of the available regional road, especially the road that connect Tegal City to Slawi Town, the capital of the Regency Tegal. The expansion process has also occurred in Pekalongan Urban Region, however, the expansion process in this region produces different formation than that of in Tegal Urban Region, as is still concentrated around the city of Pekalongan that become the core for the urban region.
As suggested by Leaf [42], the different formation of spatial development among these two urban regions is considered to be influenced by the availability of transportation network in the regions, especially the road network. Especially in the second picture, it is shown that the areas or villages with higher population density are extended along the regional roads’ corridor and formed an inverted L shape in the inner area of Tegal Urban Region. It indicated that the core area of the urban region has been extended in the corridor of the two regional road available in the inner area. Then, the extension of the core areas also influenced the expansion process of the rest urban areas, which fills the inner areas.
and expands it to the surrounding areas, especially to the areas that have road network connecting them to the extension of the core areas. Some urban concentrations are also formed and developed scattered in the outer areas, which still have stronger rural characters. These processes resulted in a vast expansion in the spatial formation created in Tegal Urban Region.

Meanwhile, similar process with differences in the availability of the road network occurs in Pekalongan Urban Region, but in a different spatial formation. The inexistence of regional road networks except the Pantura route makes the development and expansion of the urban core area in this urban region expanded from the past area only to its surroundings which makes the core area wider in a still concentric pattern. The rest urban areas also expand into the surrounding areas, benefitting local road networks, which have made urban areas become larger than only the core areas. In fact, there is part of the core areas that experienced a decreasing in population density. These processes resulted in a concentric formation in the urban region. In addition, some scattered urban concentrations or settlements are also formed and developed in particular locations in the outer areas, which mainly are areas that have intersection of road network.

3.2. The growth of urban settlements in the peripheries of urban regions

While creating their spatial formation of urban areas, urbanization and peri-urbanization in the two urban regions have also develop urban concentrations or urban settlements in the peripheries. The analysis of the urban settlements’ growth is implemented by identifying the agglomerations of urbanized villages and applying an assumption to facilitate the identification and analysis, the urban concentrations or settlements are formed by agglomeration of adjacent urbanized villages, in which those that are agglomerated in the same subdistrict formed the same towns, and so adjacent villages in different subdistrict are assumed to form different towns although they are next to one and each other.

The analysis shows that peri-urbanization in Tegal and Pekalongan Urban Regions have created a large number of urban concentrations or settlements with a variety of size in their peripheries. Table 2 shows that they created 47 and 36 urban concentrations respectively in 2019, which have developed from 29 and 26 urban concentrations in 1990. Another difference is in the largest type of urban settlements in the two urban region, in which Tegal Urban region has larger types of urban settlements than those of Pekalongan. Therefore, the differences are also reflecting the different pace of urbanization process in the two urban regions, in which Tagal Urban Region has more rapid process than that of Pekalongan, although Pekalongan City has a slightly larger size than that of Tegal City in 1990 (see Table 3).

In the differences, however, three are at least five similarities in the development of urban settlements/concentrations in the peripheries among the two urban regions. The first similarity is in the enlarging size of urban settlements in the peripheries. Moreover, the enlargement could lead to the creation of towns with a comparable size to the size of Tegal City, the core area of the urban region. Table 2 and 3 show that the size of the urban settlements has been enlarging in the two urban regions, in the observation period. Tegal Urban Region that had the largest size of between 50,000 to 100,000 dwellers, with six urban settlements in 1990, has had two towns with more than 100,000 populations in 2019. The two towns are Brebes of Regency Brebes and Adiwerna of Regency Tegal, which are located within a radius of ten kilometers from the city center of Tegal City. Brebes Town is the largest with 135,793 population in 2019 while Adiwerna is with 118,228 dwellers.

However, the factual condition shows that Adiwerna Town is developed continuously with an inseparable physical development with Talang and Dukuhturi Towns, as an extension of Tegal City’s urban areas to the south, following the existing regional road to Slawi and then to Purwokerto, a town with a similar size to that of Tegal City, which play as the growth center as well as service center in the south-western part of the province. Table 3 shows that Talang and Dukuhturi are the towns with 98,166 and 91,404 dwellers respectively, so the agglomeration of the three towns create a town with more than 300,000 urban dwellers in 2019, a size that comparable to medium size cities, which is in fact larger than the size of Tegal City as the core of the urban region. It can be considered that Dukuhturi-Talang-
Adiwerna Town is an extension town of Tegal City to the south, as Dukuhturi is bordering to Tegal City, and Talang is bordering to Dukuhturi, while Adiwerna is bordering to Talang.

Table 2. The development of urban settlements in the two urban regions

| Type of urban settlements                  | Tegal UR | Pekalongan UR |
|-------------------------------------------|----------|---------------|
| In the year of 1990                        |          |               |
| Larger-size towns (> 100,000 population)   | -        | -             |
| Medium-size towns (50,000 - 100,000 population) | 6        | 2             |
| Small-size towns (30,000 - 50,000 population)   | 1        | 2             |
| Smaller-size towns (10,000 - 30,000 population) | 9        | 6             |
| Smallest/micro-size towns (<10,000 population) | 13       | 18            |
| Total                                      | 29       | 26            |
| In the year of 2000                        |          |               |
| Larger-size towns (> 100,000 population)   | -        | -             |
| Medium-size towns (50,000 - 100,000 population) | 6        | 2             |
| Small-size towns (30,000 - 50,000 population)   | 3        | 2             |
| Smaller-size towns (10,000 - 30,000 population) | 9        | 7             |
| Smallest/micro-size towns (<10,000 population) | 13       | 16            |
| Total                                      | 31       | 27            |
| In the year of 2010                        |          |               |
| Larger-size towns (> 100,000 population)   | 2        | 1             |
| Medium-size towns (50,000 - 100,000 population) | 9        | 2             |
| Small-size towns (30,000 - 50,000 population)   | 9        | 4             |
| Smaller-size towns (10,000 - 30,000 population) | 13       | 13            |
| Smallest/micro-size towns (<10,000 population) | 15       | 16            |
| Total                                      | 48       | 36            |
| In the year of 2019                        |          |               |
| Larger-size towns (> 100,000 population)   | 2        | 1             |
| Medium-size towns (50,000 - 100,000 population) | 9        | 3             |
| Small-size towns (30,000 - 50,000 population)   | 10       | 3             |
| Smaller-size towns (10,000 - 30,000 population) | 11       | 12            |
| Smallest/micro-size towns (<10,000 population) | 15       | 17            |
| Total                                      | 47       | 36            |

It is also interesting to know that this agglomerated town is not only has a larger size than Tegal City, but it also has a comparable population density to Tegal City, as Dukuhturi part and Talang part have a comparable population density with that of Tegal City (see Table 3). Considering the population density level, it could be said that Dukuhturi and Talang are the core area of the agglomerated town, while Adiwerna is the peripheries as the population density of this part of town, which is only 631 inhabitants per square kilometer, is much lower than those of the other two parts that are more than 3000 inhabitants per square kilometer.
Table 3. The growth of the core area and selected urban settlements in the two urban regions, which have population more than 50,000 dwellers

| Type of Urban Settlements | Tegal Urban Region | Pekalongan Urban Region |
|--------------------------|--------------------|-------------------------|
|                          | Condition in 2019  | Previous in 1990        | Condition in 2019  | Previous in 1990        |
| Metropolitan Core        | Tegal City (238,758; 6.017) | Tegal City (215,424; 5.429) | Pekalongan City (204,366; 4.516) | Pekalongan City (242,865; 5.367) |
| Urban concentrations / settlements in the peripheries | Brebes\(^a\) (16; 135,793; 4.024) | Brebes\(^a\) (11; 83,017; 3.533) | Batang\(^a\) (19; 123,073; 4.042) | Batang\(^a\) (6; 29,957; 2.651) |
| Settlements with a population that more than 100,000 (Larger-size towns) | Tegal City (238,758; 6.017) | Tegal City (215,424; 5.429) | Pekalongan City (204,366; 4.516) | Pekalongan City (242,865; 5.367) |
| Pangkah\(^a\) (20; 99,654; 3.970) | Pangkah\(^a\) (15; 63,560; 3.240) | Kedungwuni\(^c\) (15; 88,580; 4.650) | Kedungwuni\(^c\) (8; 38,585; 3.003) | Kedungwuni\(^c\) (8; 38,585; 3.003) |
| Talang\(^a\) (18; 98,166; 6.015) | Talang\(^a\) (15; 62,157; 5.133) | Tirto\(^a\) (13; 65,428; 4.451) | Pajomblangan (2; 4.072; 2.275) | Tirto\(^a\) (3; 9.120; 5.527) |
| Dukuhuturi\(^a\) (16; 91,404; 6.387) | Dukuhuturi\(^a\) (13; 70,535; 6.253) | Kedungwuni\(^c\) (15; 88,580; 4.650) | Kedungwuni\(^c\) (8; 38,585; 3.003) | Kedungwuni\(^c\) (8; 38,585; 3.003) |
| Klumpok\(^c\) (9; 83,346; 3.098) | Klumpok\(^c\) (2; 22,354; 3.444) | Slawi\(^c\) (10; 57,313; 4.135) | Pajomblangan (2; 4.072; 2.275) | Tirto\(^a\) (3; 9.120; 5.527) |
| Slawi\(^c\) (10; 83,346; 3.098) | Slawi\(^c\) (10; 57,313; 4.135) | Bumiayu (4; 38,054; 2.838) | Bumiayu (4; 38,054; 2.838) | Bumiayu (4; 38,054; 2.838) |
| Bumiayu (11; 76,951; 2.694) | Bumiayu (11; 76,951; 2.694) | Kalidan gkap (1; 4.385; 2.829) | Kalidan gkap (1; 4.385; 2.829) | Kalidan gkap (1; 4.385; 2.829) |
| Kluwut (7; 75,828; 1.682) | Kluwut (1; 15,214; 1.933) | Mejasen\(^a\) (10; 66,980; 3.603) | Mejasen\(^a\) (2; 15,271; 4.094) | Mejasen\(^a\) (2; 15,271; 4.094) |
| Mejasen\(^a\) (10; 66,980; 3.603) | Mejasen\(^a\) (2; 15,271; 4.094) | Keman tran (2; 7,206; 5.222) | Keman tran (2; 7,206; 5.222) | Keman tran (2; 7,206; 5.222) |
| Dukuhengan\(^a\) (8; 58,485; 2.901) | Dukuhengan\(^a\) (2; 18,253; 2.986) | Dukuhengan\(^a\) (8; 58,485; 2.901) | Dukuhengan\(^a\) (2; 18,253; 2.986) | Dukuhengan\(^a\) (8; 58,485; 2.901) |
| Dukuhwaru\(^a\) (7; 51,529; 2.729) | Dukuhwaru\(^a\) (7; 51,529; 2.729) | Dukuhwaru\(^a\) (7; 51,529; 2.729) | Dukuhwaru\(^a\) (7; 51,529; 2.729) | Dukuhwaru\(^a\) (7; 51,529; 2.729) |

Notes: The three numbers in parentheses represent (the number of urbanized villages agglomerated; population number; and population density) of the town. The years in the 1990 column indicates the starting formation of the town, that is identified by the period of the villages, which formed the town, started classified as urban villages. Letter C in superscrtipt after the name of the town indicates that the towns are located relatively close to the core, which is less than 20 km.
Table 4. The growth selected urban settlements in the two urban regions, which have population less than 50,000 dwellers

| Type of Urban Concentration | Tegal Urban Region | Pekalongan Urban Region |
|-----------------------------|--------------------|------------------------|
| **Condition in 2019**       | **Previous in 1990** | **Condition in 2019**  | **Previous in 1990** |
| *Concentrations with more a population of 30,000 to 50,000 (Medium-size towns)* | | | |
| Tanjung (7; 47.120; 2.492) | Tanjung (2; 9.873; 2.023) | Buaran (10; 47.466; 4.975) | |
| Jatibarang (9; 43.950; 3.089) | **2000**: 9.343; 2.023 | Bojong (15; 40.780; 2.508) | |
| Margasari (4; 42.683; 1.722) | Margasari (1; 11.139; 2.584) | Wono kerto (7; 35.802; 4.871) | |
| Lebaksu (7; 41.895; 2.462) | Lebaksu (3; 20.472; 2.180) | | |
| Paguyangan (5; 39.928; 2.320) | Paguyangan (1; 3.391; 1.401) | | |
| Suradadi (4; 37.827; 1.801) | Suradadi (4; 32.887; 1.566) | | |
| Ranggas pandawa (2; 35.942; 1.976) | Ranggas pandawa (2; 31.703; 1.745) | | |
| Balapulang (4; 35.694; 1.955) | Balapulang (2; 17.655; 1.927) | | |
| Cikandang (7; 35.381; 2.555) | Cikandang (3; 14.025; 2.226) | | |
| Tanub (7; 30.562; 3.366) | Min daia (1; 2.991; 2.601) | | |
| *Concentrations with more a population of 10,000 to 30,000 (Small-size towns)* | | | |
| Banjaratma (3; 28.547; 3.862) | Banjaratma (1; 8.413; 3.059) | Sagi (7; 29.259; 2.144) | |
| Tonjong (3; 23.359; 1.500) | **2010**: Tonjong (3; 19.394; 1.246) | Sagi (1; 6.789; 3.464) | |
| Lanangan (1; 23.375; 2.061) | **2010**: Lanangan (1; 21.325; 1.246) | Kalijambel (1; 3.126; 1.718) | |
| Jatikoreh (2; 20.561; 1.907) | **2010**: Jatikoreh (2; 16.732; 1.881) | Wonopringgo (9; 29.004; 2.969) | |
| Sawojajar (2; 17.196; 1.156) | **2010**: Sawojajar (2; 14.787; 1.644) | Gringsing (6; 8.361; 1.369) | |
| Limbangan (2; 16.244; 1.151) | **2010**: Limbangan (2; 14.787; 1.048) | Warungasem (10; 27.706; 2.762) | |
| Losari (3; 13.670; 2.237) | Losari (2; 9.498; 1.985) | Tulis (9; 23.624; 1.129) | |
| Bumijawa (1; 12.854; 1.243) | Bumijawa (1; 8.872; 858) | Tulas (4; 5.704; 2.824) | |
| Rembul (2; 12.117; 1.605) | **2010**: Rembul (2; 11.940; 1.581) | Pelen (1; 8.346; 2.815) | |
| Jatirawa (2; 11.094; 3.786) | **2010**: Jatinawa (2; 9.978; 3.405) | Krengseng (1; 8.071; 1.725) | |
| Prupuk (1; 10.461; 2.589) | Prupuk (1; 11.460; 2.837) | Warungasem (6; 12.656; 2.943) | |
| | | | |
| | | | |
Similar spatial feature also occurs in Brebes Town as the extension of Tegal City to the west following the existing Pantura National Road. Subdistrict Brebes is a subdistrict that bordering to Tegal City. However, the core of Brebes Town is about five to ten kilometers from the core area of Tegal City. The urban areas of Tegal City have also developed extended and uninterrupted from the city to Brebes Town and also then to Klampok Town in Subdistrict Wanasari of Regency Brebes. Therefore, the factual condition shows that Brebes Town is agglomerated with Wanasari Town and create an agglomerated town with 219,139 urban dwellers in 2019, which is comparable to the size of Tegal City in 1990. In this agglomerated town formation, Brebes part is considered as the core and Klampok-Wanasari Town could be considered as the periphery as the density of Brebes as well as its size are larger than those of Klampok.

The second similarity is the urban settlements’ constellation that shows that most of the largest towns in every urban region are located in a relatively close distance to the core. As could be seen in Table 3, the two largest towns in Tegal Urban Region, which are Brebes and Adiwerna are the towns that are located within a radius of 10 kilometers from Tegal City. Furthermore, nine from twelve towns with more than 50,000 inhabitants in Tegal Urban Region are the towns that are located within a radius of 20 kilometers from the city. Only three towns, which are Bumiayu, Klwuut and Dukuhtengah, that are located more than 20 kilometers, with Klwuut is about 30 km from the city while Bumiayu and Dukuhtengah are about 50 to 60 km from the city. Similar to the constellation in Tegal Urban Region, the four towns with more than 50,000 population, or the four largest towns in Pekalongan Urban Region are located relatively close to Pekalongan City, as their distance to the core area in its urban region are less than 20 kilometers. Moreover, as also seen in Table 4, the dominance of close-distance towns becomes smaller with the smaller size of the towns. These phenomena indicate the important of the proximity to the core that brings influences to places in the periphery to grow. This factor brings addition to the transportation network factor, i.e., the availability of transportation network in the regions, suggested by Michael Leaf [42] that has been discussed before.

The third similarity is in the growing process of towns in peripheries. The growing process involves expansion process of urban areas into their surroundings, as well as merging process of the existing urban areas and also the formation of new urban areas in the growth and development process of towns in the peripheries as are indicated in Tables 3 and 4. The expansion process, for example, is shown by the growing process of Brebes Town in Tegal Urban Region, which has grown from 11 urbanized villages in 1990 to 16 urbanized villages in 2019. Almost all of the towns developed experienced this growing process in their development. Slawi Town of Tegal Urban Region has not experienced this process because of a distinctive reason, i.e., all part of Slawi, which consists only ten villages, has been appointed as the capital of the regency since the formation of the regency. The merging process, for example, is shown by the experience of Bumiayu Town in Tegal Urban Region, which today formed by 11 urbanized villages, developed from the previous Bumiayu Town that has four urban villages and Kalilangkap Town that has only one urbanized town in 1990. In this process, the towns that has merged were separated previously until the in-between village(s) classified as urbanized villages. There are many towns that experienced the merging process, involving in all of the type of towns according their size. Some towns have merged from the town that were formed in different time with the other town to merge. Tirto Town in Pekalongan Urban Region is an example for this kind of merging process. Tirto Town, which was formed by 13 urbanized villages in 2019, has merged from the previous Tirto Town with three urbanized villages in 1990 and Wuled Town that was formed in 2000 with only one urbanized village. There are also some few towns that has formed by more than two previous town. Gringsing Town (6 urban villages in 2019) of Pekalongan Urban Town, which has merged from the previous Gringsing (2 urban villages), Plesen Town (one urban villages) and Krengseng Town (one urban villages) in 1990.

The fourth similarity is the tendencies that smaller urban settlements or concentrations to grow faster than the larger ones. Tables 3 and 4 show many towns, especially those that were still become towns with less than 30,000 population in 1990 have grown to become towns with two, three or even four time bigger in the population size in 2019. Batang Town in Pekalongan Urban Region shows this tendency.
The experiences of some other towns like Tirto, Wiradesa, Wonokerto, Sragi, Gringsing and some other towns in Pkalongan Urban Region has also shown this tendency. In Tegal Urban Region, the tendency is also shown by the experiences of many towns like Klampok, Kluwut, Mejsem, Dukuhtengah, Tanjung, Margasari, Paguyangan, and many more. The rapid growth of these smaller towns occurs in two growing paths, i.e., growing by enlarging their urban areas by the surrounding villages that become urbanized villages in the following periods so they have a larger number of urbanized villages agglomerated in the town in the following periods, or they have merged into other growing town that is located close to them.

Furthermore, the increasing number of the urban settlements formed and developed in peripheries become the fifth similarity, while the greater number of the towns occurs in the smaller size of the towns become the sixth similarity among the phenomena of urban region formation in the two small-medium cities in Central Java. Tables 2 shows that the number of towns or urban settlements in peripheries of the two urban regions has increased in the observation periods, i.e., from 1990 to 2019. Moreover, the table also shows that the number of towns or urban settlements in peripheries tend to be larger with the smaller size of urban settlements, in which the smaller size urban settlements tend to grow to become a larger size urban settlements in the following decades. These phenomena indicate the importance of giving attention as well as managing the smaller size of towns in the urbanization or peri-urbanization process, because the formation of small towns will stimulate the growth of the larger urban areas, as most of them will grow and develop to be larger towns in the following periods.

4. Conclusion

Extended urbanization process that occurs on small cities like Tegal and Pekalongan Cities has expanded the urban areas beyond their administrative limits to form much larger urban region than the urban areas of the cities themselves. The agglomeration economies of these small cities have brought the forces, influence powers, which have transformed many places in the peripheries into places with a relatively high-density population. The transformation brings the environments in the peripheries to form some particular places into towns or urban settlements and concentrations that have population number as well as density which are equivalent to those of the small cities that later become the core area in the larger urban region. From the peripheries’ point of view, the process is resulted by the combination of the core cities’ power together with the internal power of the places that later grow the places to become towns or urban settlements and concentrations in the peripheries. Leaf [42] suggests the availability of transportation network in the regions becomes an important spatial factor that creates such transformation in the peripheries. In addition, this study shows that the proximity of places to the core area or the main urban center has also become another important spatial factor in the spatial transformation peripheries.

Based on a long-term analysis and observation, this study also shows that the combination forces, supported by the two spatial factors has created larger urban settlements and concentrations in peripheries that still have a great tendency to grow in near future. The analysis as well as field observation show that the rural-to-urban transformation process is only transforming particular places into urban areas and remains some other particular places still become places with rural characteristic and some places into with lower degree of urbanization areas that are defined as semi-dense area or urban cluster in the Degree of Urbanization [40], indicated by lower density of population in the area (about 300 to 1500 inhabitants per square kilometers), if they are compared to the places that categorized as urban areas that have higher density (more than 1500 inhabitants per square kilometers). So, the spatial formation of the peripheries creates many towns, involving large and small or urban settlements and concentrations, surrounded by semi-urban as well as rural areas, which made the peripheries become peri-urban areas. The question on will the growth of urban settlements and concentration transform the region from monocentric regions in the past into polycentric urban regions in the future, will be an interesting subject to analyze. However, the phenomena of the growth of urban settlements and concentrations into larger urban areas than the core today and, in the future, should be also an interesting subject to observe. The main reason is because most of urban areas in peripheries are developed from
rural settlements in the past, which are transformed in a long time to become urban areas as they experiencing a population growth as well as increasing in population density in their area, and change the areas into more urban than rural. As they have grown from rural settlements, it could be expected that many of the towns have disadvantages in the provision of urban infrastructure and facilities that makes the residents are extensively underserved of basic services like water provision, sanitation as well as educational services. Therefore, the growth and development of large towns in peripheries, as urban settlements and concentrations should also be used as indicators for the growing needs of urban infrastructure and facilities, for both the population reside in the towns as well as rural communities living in the surroundings. In addition, the growth of smaller towns in the peripheries of urban region should also be managed well and anticipated, since the smaller towns or urban settlements and concentrations could become larger towns with their rapid growth in the following periods. By no means suggesting larger towns could be neglected in the growth management issue, the formation and the growth of smaller towns have to be controlled, so then their growth and development could be limited in particular areas without stimulating other areas to grow and be transformed into urban areas. These efforts should be implemented in order to perform direction for the growth of the entire urban region.

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5. Acknowledgment

We thank the Faculty of Engineering, Universitas Diponegoro, for the funding of this research through the Grants on Strategic Research of RKAT Funds in the Budget Year of 2021 (Contract No. 3178/S/pwk/8/UN7.5.3.2/PP/2021)