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Urban Growth and Clustering Surakarta Peri-Urban Area

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Abstract

The high rate of urbanization in the world has an impact on the urban growth that extend to urban fringe areas or commonly called suburbanization. Surakarta City is one of the PKN in Central Java Province which serves the surrounding area. During its development, Surakarta City was transformed into a main city that served its suburbs. Limited land in cities causes urban activity to spread to peri-urban areas. As a result, there have been many changes in agricultural land into built-up areas that threaten the food resilience. Research on urban growth is not only calculating changes in area over a certain period of time, but needs to pay attention to the cluster area. This study aims to monitoring urban growth and clustering of the Surakarta peri-urban area. This study used remote sensing methods to detect land use change and cluster analysis to classify peri-urban areas based on suburbanization characteristics. This research used a random forest supervised classification method to determine the type of land cover and a non-hierarchical method in clustering its peri-urban areas. The results showed that for 18 years, there was an increase in the area of built land covering an area of 4248 hectares. It is predicted that the peri-urban area of Surakarta will continue to grow. In 2036, 9024 hectares will be built in the peri-urban area of Surakarta. In the cluster analysis test, 3 clusters were produced including clusters with low, medium, and high suburbanization characteristics.

Keywords: cluster area; remote sensing; urban growth

1. Introduction

The high rate of urbanization is considered as a sustainable development issue in several countries. More than 55% of the world's population lives in urban areas lately. In 2050, the population is predicted arising into 68% (United Nation, 2018). The insufficient land availability in the city causes urban activities spread to the periphery areas. The suburban area located outside the city administrative boundary where there is a shift in the characteristics of the village and the city. The growth of these suburbs has turned into a peri-urban area which has a role to support the main city (Sugestiadi and Basuki, 2019). The peri-urban areas undergo transformation in agricultural land cover significantly. Those transformations generally shape settlements, commercial area, and industry. Besides, those elicit the shifting spatial shifts in physical appearance and the socio-economic conditions in peri-urban area (Pham et al., 2015)

Suburbanization is a process of urban transformation in the suburbs which is characterized by rapid and fragmented growth. The enhancement economic activity results a decrease in the population in the main city through migration to suburbs area. This population migration is designated by an increase in population in peri-urban areas while at the same time the population in the main city decreases (Rahayu and Mardiansjah, 2018). One of the causes of suburbanization is the high demand for housing in the main city and unaffordable land prices. This situation compelled residents in the city to migrate to access housing

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needs in the periphery areas so that the number of residents in the peri-urban areas has increased rapidly (Buchori et al., 2020).

The phenomenon of suburbanization occurs through several processes. Suburbanization in developing countries happens naturally. In addition, the suburbanization process also occurs due to the influence of development policies. The phenomenon of suburbanization in Indonesia is characterized by the appearance of formal and non-formal housing, which is commonly called "kampung" in peri-urban areas (Wu, F., & Keil, R., 2020). The presence of land use change into residential areas, both formal and non-formal dominated by middle income families who come from the main city. The appearance of settlements in peri-urban areas cannot be separated from the development of peri-urban areas with various activity such as industry and commercial which encourage the conversion agricultural area to built-up land (Baye, F., Wegayehu, F., & Mulugeta, S., 2020; Pribadi, D. O., & Pauleit, S., 2016).

Surakarta city has the main activities of commercial and service that serving the surrounding area. In the spatial plans of Central Java Province, Surakarta City has a role as main activity area and its surrounding areas. Surakarta Metropolitan Area is designated as a strategic area from the point of view of economic growth and its surrounding areas incorporated in the Subosukowonosraten area (Regional Spatial Plan Central Java Province 2009-2029). Land use changes that occur in the suburbs of Surakarta City tend to change in commercial uses, housing, and mix used following road network patterns, diverse densities and heterogeneous building patterns (Putri et al., 2017; Purnamasari, L. S., Yudana, G., & Rini, E. F., 2017; Obermayr, C., 2017). During 2008 to 2018, peri-urban area of Surakarta City has seen an increase the number of households by 59453 households while Surakarta City in the period 2008 to 2018 showed a pattern of decreasing population from 146860 households in 2008 to 106951 households in 2018 (Statistics of Surakarta Municipality 2008-2018). The emergence of new housing area in peri-urban area can be dangerous to agricultural land. This is will certainly threaten food resilience due to the massive conversion of agricultural land to built-up area (Wahyudi, A., Liu, Y., & Corcoran, J., 2019)

The availability of spatial information is basic data for analyzing land use change. However, land use maps are often very limited, making it difficult to detect land use change (Sudhira & Ramachandra, 2004). Currently, remote sensing methods are often used to detect land use change and predict urban growth pattern, for example the cellular automata (CA) model which is able to predict urban growth pattern based on data on specific characteristics and trends in land use change (Li, X., & Yeh, A. G. O., 2002; Al-shalabi et al., 2013). In the process of land use change analysis based on remote sensing, the classification process is one of the most important processes in classifying land use. The use of machine learning able to produce a classification that is more accurate than statistical methods and can describe it spatially (Maxwell, A. E., Warner, T. A., & Fang, F., 2018; Jamali, A., 2019)

A study conducted by Buchori et al., (2020) shows that during 2005 to 2017 the suburban area of Surakarta City there was increase in the area of built-up land, the majority of which came from agricultural land cover. In addition, this study shows a positive correlation between urban growth and an increase in the level of social welfare. However, this study does not attempt to predict future urban growth in peri-urban Surakarta City. Meanwhile, Sejati et al., (2019) tried to analyze trends in urban development and their relationship with increasing land surface temperature. This research also tries to predict future land cover patterns but has not classified which areas require planning. This study aims to determine urban growth trend and clustering of the peri-urban areas of Surakarta City. The regional clustering aims to prioritize of development in peri-urban area Surakarta City which affected by extreme land use changes so that the function of the area is maintained according to its role.

2. Research Method

2.1. Data

The data used in this study enclose satellite image data for 2000, 2013, 2018, data on the number of houses, data on the number of households and population data. The data is then processed using image classification techniques to consider trends in peri-urban growth and statistical data is processed using cluster analysis to obtain regional clusters. The following is the satellite image information used in this study.

Table 1. Landsat Composite Band for Land Cover Detection

No	Year	Type	Data Acquired	Band Combination	Detection
1	2000	Landsat 5 TM	2000/7/6	R=5, G=4, B=3	Urban
2	2013	Landsat 8 OLI	2013/6/23	R=7, G=6, B=4	Urban
3	2018	Landsat 8 OLI	2018/7/13	R=7, G=6, B=4	Urban

In addition to using satellite imagery data, this study uses statistical data obtained from a literature survey. for example, data on the number of houses and data on the number of households. These data were obtained through surveys to related agencies. These statistical data are used as input for cluster analysis based on suburbanization characteristics. The data was analyzed statistically so that groups of peri-urban areas with the level of suburbanization were formed.

2.2. Methods

Satellite image data is analyzed through supervised classification so as to obtain a land cover pattern. Satellite imagery for 2000 draws upon Landsat 5 TM imagery with a band combination of 5,4,3 while satellite

imagery in 2013 and Landsat 8 OLI imagery with a band combination of 7,6,4 in 2018. The results of the image classification process. The following step is determining the area cluster. Regional clusters are villages that are members of the peri-urban areas in Surakarta. The villages will be clustered accustoming the level of suburbanization in the area. This research can be described in the following flow chart.

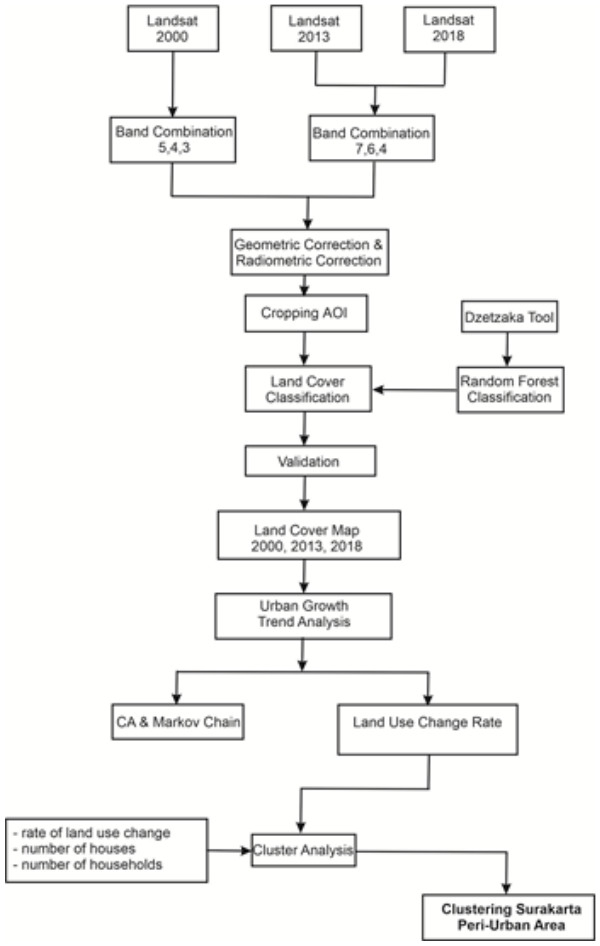

Figure 1 Research Flow Chart

3. Result and Discussion

3.1. The Growth Trend in Surakarta Peri-Urban Area

The growth of peri-urban areas in Surakarta gave an impact on transformation in spatial pattern. The transformations in spatial patterns generally occurred in rural areas which turn into built-up lands with various uses, such as housing, commercial uses and industry. In 2000, the urbanization issue began to occur in Surakarta City and its surroundings. The results of the image classification in 2000, the built-up land of peri-urban area in Surakarta is 1754 hectares, while the agricultural area is 24,555 hectares. The growth of the built-up area in peri-urban area was not precisely patterned yet.

The built-up area located in Kartasura subdistrict, Solo-Yogyakarta and Solo-Boyolali main routes pass. This area is quite strategic. Moreover, this area was traversed by the main road network and facilitated by a trade center and an education center. The growth of built-up land was also found around the main road network of Solo-Karanganyar with trade in services as peculiar feature. The growth of built-up area was still unlikely pointed in northern and southern area. The area is still dominated by agriculture. Rural characteristics got overpowered in 2000.

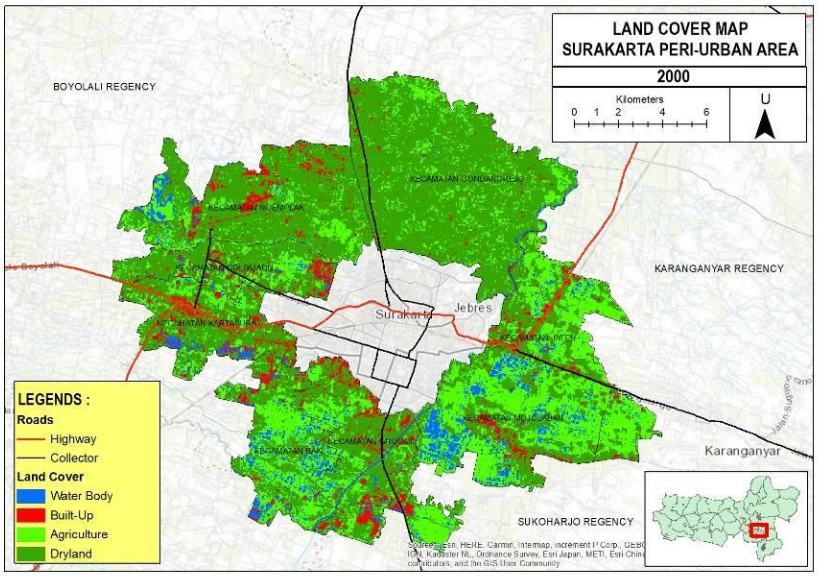

Figure 2 Land Cover Surakarta Peri-Urban Area in 2000 (Processes from Landsat5 2000)

In 2013, the growth of developed area began to come up in many peri-urban areas. The western peri urban area such as Kartasura and Colomadu subdistricts have significant expansion of built-up area followed by southern and eastern. The growth pattern of peri-urban areas in 2013 was denoted by the expansion of the built-up land starting to form a ribbon development pattern. It emphasized the element of accessibility as a salient factor for regional growth. The peri-urban areas, such as Kartasura, Colomadu, Jaten, and Grogol sub-districts are traversed by a main road network with high accessibility so that the expansion is more concentrated around the road network. Pertaining to the result of Landsat 8 OLI imagery for the land cover of peri-urban areas in Surakarta in 2013 consisted of 3231 hectares of built-up land, 485 hectares of water bodies, 4194 hectares of wetland agriculture and 15364 hectares of dry land agriculture. built-up land has significant expansion. built-up land expands to 1477 hectares from 2000 to 2013. In 2013, the built-up areas concerned on the southern part of Surakarta, such as Grogol and Baki districts. Those districts have grown rapidly due to the development of Solo Baru which impacts on increasing consumption of built-up land.

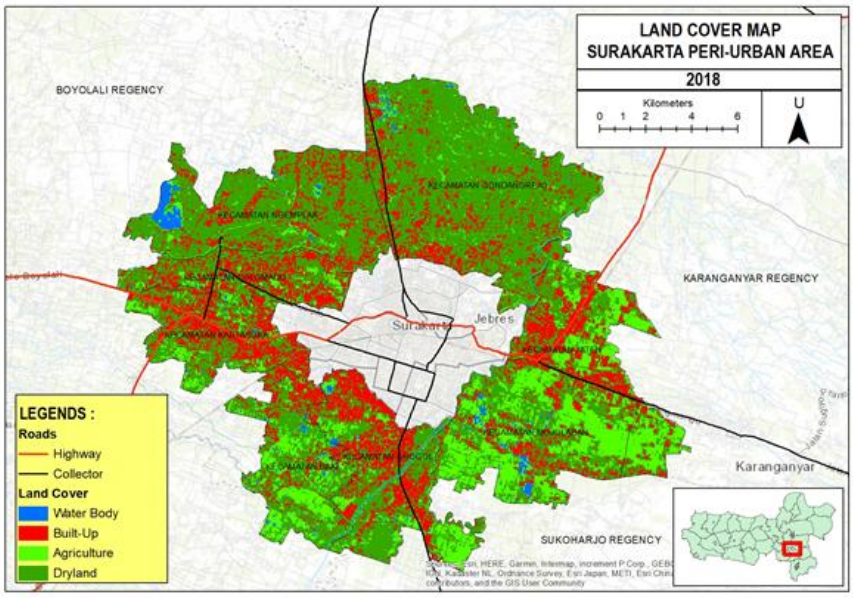

Figure 3 Land Cover Surakarta Peri-Urban Area in 2013 (Processed from Landsat8 OLI 2013)

The peri-urban growth in Surakarta has expanded to the suburbs in 2018. Previously, in 2013 the growth of peri-urban areas was concentrated over the main road network. The growth of peri-urban areas started to spread to rural areas in 2018. The sub-districts such as Gondangrejo and Ngemplak, which are traversed by the construction of a national toll road connecting Surakarta City and Ngawi Regency, were considered as eminent factor of the high land conversion in this region. In addition, the increasing need for housing elicited great impact on the high expansion of built-up area. In the 2013-2018, it would proportionally

adjust to the rapid population growth in peri-urban areas in Surakarta. The growth of peri-urban areas in the 2013-2018 range was greater than the 2000-2013. It was undoubtedly exposed from the transformation of built-up land expansion in 2013-2018 which was greater than that in 2000-2013.

The land expansion established in 2013-2018 was 2769 hectares compared to 2000-2013 which was only 1754 hectares. There was significant gap in a span of five years. While wetland agriculture underwent an expansion insignificantly. Predominantly, wetland agriculture was positioned on southern part of Surakarta, mainly following the previous developments or the expansion concentrated around the main road network. The northern part of the region has also undergone a change from being developed into a residential area due to limited land in downtown. Apart from the built-up cover land, dry land agriculture has also expanded insignificantly. Dry land agriculture was a type of agricultural land cover with non-technical irrigation. This type of land cover was generally located in plateau area or on unproductive agriculture. This type of land cover had a tendency conversing into built-up area. In Surakarta, dry land agriculture in peri-urban areas have increased by 600 hectares in 5 years, but the type of wetland agriculture has decreased dramatically in the number of 2844 hectares. The following is a trend of land conversion in peri-urban areas in Surakarta in 2000-2018.

Table 2. The Change Land Cover During 2000-2018 (Processed from Landsat5 2000, Landsat8 2013 and Landsat8 2018)

Land Cover	Area (hectares)		
	2000	2013	2018
Built-Up	1754	3231	6002
Water Body	720	639	296
Agriculture	8055	7038	3369
Dryland	15516	15137	13356
Total	**26045**	**26045**	**26045**

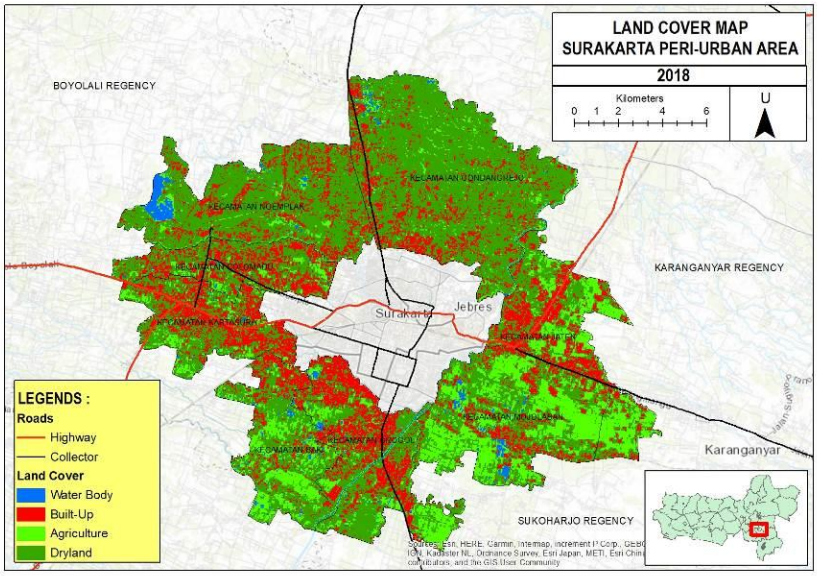

Figure 4 Land Cover Surakarta Peri-Urban Area in 2018 (Processed from Landsat8 OLI 2018)

3.2. Projection of the Surakarta Peri-Urban Area in 2036

Projection process of land cover conversion requires a markov analysis process to determine the tendency of land conversion occurring in peri-urban areas. The pattern of land conversion has the possibility of changing to another land cover based on 2 images with different time periods. This study draws upon Landsat 5 TM 2000 and Landsat 8 OLI 2018 images as input for the Markov analysis. The results of this analysis are in the form of numbers from the range 0-0.9 which when added together have a value of 1.

The results of the Markov analysis perform the chance of changing the function of wetland and dryland agriculture. Wetland agriculture has a 69% chance of turning into built-up land while dry land agriculture has a 57% chance. Built-up land cover tends to be stagnant or unlikely transform into another land cover and water bodies tend to remain. The results of this Markov analysis are applied to predict land cover that will shape in the future. The following are the results of Markov's analysis.

Table 3. Markov Chain Analysis

Land Cover	Built-Up	Water Body	Agriculture	Dryland
Built-Up	0,6839	0,0147	0,1201	0,1812
Water Body	0,0532	0,4884	0,2033	0,2551
Agriculture	0,6945	0,0314	0,0793	0,1948
Dryland	0,5718	0,0075	0,069	0,3517

The land cover projection is a model developed through the cellular automata approach. This approach describes a land cover as a cell transformation due to the activities around it. The results of the Markov analysis are used as input to analyze the projected land cover that occurs 18 years or in 2036. In 2036, the projected land cover in peri-urban areas changed based on 2000 to 2018.

The projection in 2036 will expand significant, especially in the area of built-up land. The role of Surakarta as activity core for adjacent areas bring about the expansion of built-up land around the peri-urban areas. Urban growth in the area forms concentric and radial growth types. The projected land cover in 2036 shows concentric growth in locations that are still dominated by agriculture in 2018. Meanwhile, radial growth gets stronger with regional growth, especially in the transportation sector. The projected map of land cover in 2036 can be seen in the following figure.

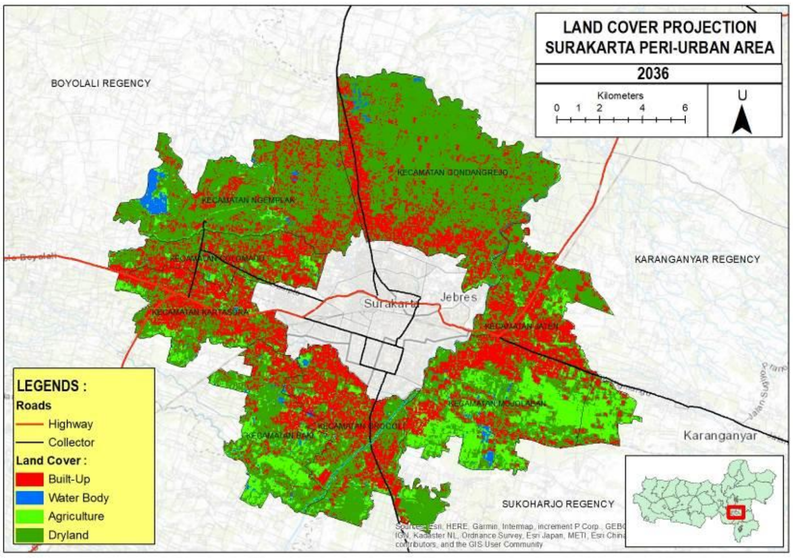

Figure 5 Projected Land Cover 2036

The projection land cover at peri-urban areas in Surakarta come through rapid change. Built-up land is projected to increase to 3022 hectares from 2018-2036. This is quite reasonable because the areas directly adjacent to the city are densely settled so that the developing area fills the empty spaces that can be built. In 2036, the built-up land has an area of 9024 hectares or 34.64% of the total area. This figure has increased by 11% from 2018. It blatantly confirms that the growth of peri-urban areas are determined by many factors and that will present different pace of growth every year.

3.3. Classification of Peri-Urban Area in Surakarta Based on Suburbanization Characteristics

The cluster object in this study is the village as the smallest administrative area. The total number of villages in peri-urban areas at Surakarta is 99 villages which will then be clustered according to their suburbanization characteristics. The villages will be clustered based on the the number of households, the number of houses, and the number of built-up area expansion. All data were carried out by values uniformity through the Z-Score because they possess different range values. All data are normally distributed so that the object clustering process can be continued at the next stage. It is proved by the Kolmogorov-Smirnov test which yields value> 0.05. The results of the KS test can be seen in the following table.

Table 4. KS Test

One-Sample Kolmogorov-Smirnov Test

		Zscore(households)	Zscore(built-up area)	Zscore(houses)
N		99	99	99
Normal Parameters[a,b]	Mean	,0000000	,0000000	,0000000
	Std. Deviation	1,00000000	1,00000000	1,00000000
Most Extreme Differences	Absolute	,162	,170	,138
	Positive	,162	,170	,138
	Negative	-,108	-,112	-,115
Kolmogorov-Smirnov Z		1,615	1,690	1,373
Asymp. Sig. (2-tailed)		,011	,007	,046

a. Test distribution is Normal.

b. Calculated from data.

The iteration process will form three clusters with high, medium and low suburbanization characteristics. Cluster I is a group of villages with a low level of suburbanization. This cluster has a minus Z-Score value on the variable. Cluster II is possessed by a high level of suburbanization which is indicated by a Z-Score value> 1. Cluster III belongs to cluster with a moderate level of suburbanization designated by a Z-Score value that has a range of 0-1. The following table is the result of forming the final cluster.

Table 5. Final Cluster

Final Cluster Centers

	Cluster		
	1	2	3
Zscore(Households)	-,42179	3,46253	,67069
Zscore(built-up area)	-,38618	2,02640	,80471
Zscore(houses)	-,46268	3,27228	,82339

After forming clusters have accomplished, an anova test is carried out to examine the effect of each variable in cluster formation. All variables have a significant effect in forming clusters. The variable number of houses is the most influential variable in cluster formation. All variables have a significance value <0.05, so it can be said that all variables have a significant influence in forming clusters. Anova test results can be blatantly seen in the following table

Table 6. Anova Test

ANOVA

	Cluster		Error			
	Mean Square	df	Mean Square	df	F	Sig.
Zscore(households)	35,692	2	,277	96	128,733	,000
Zscore(built-up area)	21,277	2	,578	96	36,841	,000
Zscore(house)	37,151	2	,247	96	150,496	,000

The F tests should be used only for descriptive purposes because the clusters have been chosen to maximize the differences among cases in different clusters. The observed significance levels are not corrected for this and thus cannot be interpreted as tests of the hypothesis that the cluster means are equal.

The result of the cluster consists of 3 groups consisting of 71 villages with low levels of suburbanization, 4 villages with high levels of suburbanization and 24 villages with moderate levels of suburbanization. The following is a table of cluster groups formed.

Table 7. Peri-Urban Cluster Based Suburbanization Characteristic

Cluster	Cluster Members
I	Jatikuwung, Rejosari, Jeruksawit, Kragan, Wonosari, Dayu, Krendowahono, Jati, Dagen, Jetis, Brujul, Tegalmade, Laban, Wirun, Bekonang, Cangkol, Klumprit, Kragilan, Sapen, Triyagan, Joho, Demakan, Dukuh, Plumbon, Gadingan, Pondok, Parangjoro, Pandeyan, Kadokan, Grogol, Gedangan, Kwarasan, Manang, Ngrombo, Mancasan, Gedongan, Jetis, Bentakan, Kudu, Kadilangu, Bakipandeyan, Menuran, Duwet, Siwal, Waru, Purbayan, Ngemplak, Kertonatan, Wirogunan, Ngabyean, Singopuran, Gonilan, Ngasem, Bolon, Paulan, Gajahan, Blulukan, Gawanan, Gedongan, Tohudan, Klodran, Ngargorejo, Sobokerto, Ngesrep, Donohudan, Pandeyan, Kismoyoso, Dibal, Sindon, Manggung, Giriroto
II	Ngringo, Cemani, Makamhaji, Kartasura
III	Wonorejo, Plesungan, Selokaton, Bulurejo, Karangturi, Tuban, Suruhkalang, Jaten, Sroyo, Palur, Telukan, Madegondo, Langenharjo, Sanggrahan, Banaran, Gentan, Gumpang, Pabelan, Ngadirejo, Pucangan, Malangjiwan, Baturan, Gagaksipat, Sawahan

Based on the cluster analysis, there is a fact that the phenomenon of suburbanization in peri-urban Surakarta City is fast and tends to be concentrated around the main road network. The phenomenon of urban growth should be a serious concern for all stakeholders. In the future, Surakarta City is predicted to become a metropolitan city, so the urban planning of Surakarta Metropolitan area must be carried out comprehensively. Spatial planning documents are not only used as a reference in development but also as an instrument of control so that development becomes integrated.

Members of clusters II and III are examples of growth that change spatial physical features. In a period of 18 years, the area underwent numerous land use changes. This region is growing with the emergence of shopping centers, retail stores and housing. When the availability of land in this cluster area starts to be low, it is estimated that the phenomenon of suburbanization will naturally lead to the cluster I area. The following is a cluster map of the peri-urban area of Surakarta City based on the characteristics of suburbanization.

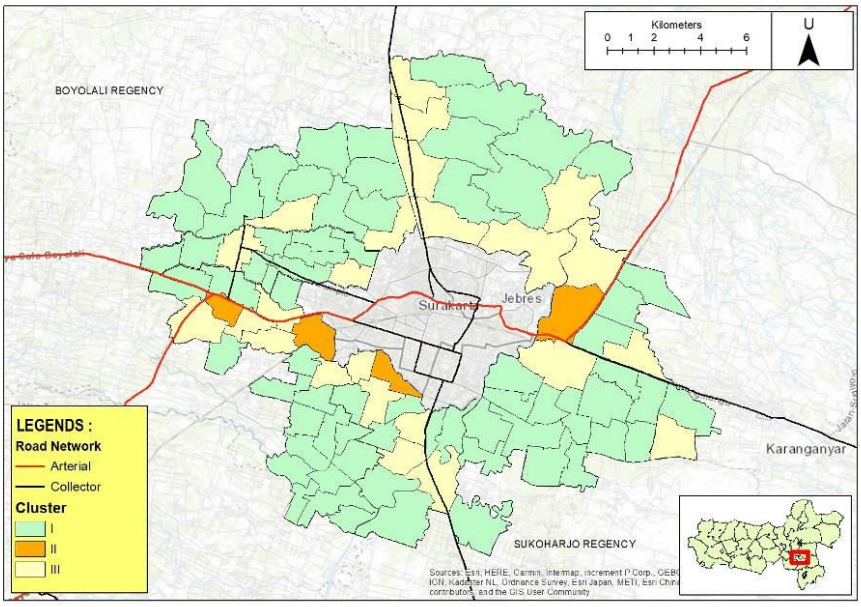

Figure 6 Cluster Map of Peri-Urban Area

3.4. Impact of Suburbanization in Surakarta Peri-Urban Area

Suburbanization has various impacts in surakarta peri-urban area. This research will explain the impact of suburbanization in Surakarta Peri-Urban Area in the socio-economic sector and spatial aspects. The first impact of suburbanization is an increase in community welfare. A study conducted by Buchori et al., (2020), shows that there is a positive correlation between the development of built-up land and the increase in community welfare, which is marked by a decrease in the number of pre-prosperous families. The development of industries and trade centers in peri-urban area creates a domino effect in the surrounding area which is marked by the appearance of small shops and housing.

Overall, the number of pre-prosperous in each peri-urban area has decreased at the same time the area has expansion in built-up land. Gondangrejo area, which is located in the north of Surakarta City, has the highest number of pre-prosperous families compared to other peri-urban area. This is related to the initial phase of the dynamics of urban growth of Surakarta City, which developed to the south and west first rather

than to the north. Mojolaban is an area where the number of pre-prosperous families has decreased the highest, namely 2714 families in just five years. Mojolaban is developing which is marked by the emergence of new housing estates. This forced the early residents who inhabited in Mojolaban area to migrate to other places. Most of the migrants who live in Mojolaban are prosperous family, so the number of pre-prosperous family in this area is significantly reduced. The following is a table of the relationship between increasing the area built to welfare transition in Surakarta Peri-Urban Area.

Table 8 Impact Suburbanization on Social Welfare

No	Subdistrict	Pre-Prosperous Family		Built-Up Area (ha)	
		2013	2018	2013	2018
1	Gondangrejo	6393	5503	1188	1598
2	Jaten	2456	2064	645	946
3	Mojolaban	5649	2935	597	780
4	Grogol	3587	3238	902	1191
5	Baki	1201	1098	520	634
6	Kartasura	3037	2636	609	929
7	Colomadu	972	900	724	759
8	Ngemplak	2247	2148	782	796

The impact of suburbanization does not always on increasing the level of welfare. Often it has an impact on the problem of decreasing the level of welfare due to the loss of the main livelihood of farmers, informal workers who do not have sufficient skills and environmental problems (Peng & Bai, 2016; Aguilar, 2008; Dewi & Rudiarto, 2013). Therefore, the phenomenon of suburbanization on peri-urban area becomes important in regional planning.

The second impact of suburbanization is changes in socio-economic conditions. urban growth in suburban area not only affects spatial changes but also changes in socio-economic conditions (Kurnianingsih & Rudiarto, 2014; Mardiansjah et al., 2018). Changes in socio-economic conditions in relation to the population and all economic activities in the region. The condition of the area before suburbanization was dominated by rural areas which had a low population density and inhabitant had livelihoods as farmers and breeders. Then the suburbanization which changes the previous conditions to become urban characteristics (Connoly et al., 2021).

An indication of changes in social conditions after suburbanization is an increase in population density. Population growth in Surakarta Peri-Urban Area is faster than the population growth rate in the Surakarta metropolitan area (Mardiansjah, Sugiri & Sari, 2019; Mardiansjah et al., 2018). This shows that the growth pattern in Surakarta Peri-Urban Area occur so fast. According to Slach et al., (2019), the increase in population density in peri-urban areas cannot be separated from urban shrinkage. The trigger of this phenomenon is due to the economic condition of the people in urban areas which continues to decline, forcing them to leave the city center area. In 2008, most peri-urban area had a population density of less than 20 people / hectare and between 21-40 people / hectare. Only areas such as Cemani and Kartasura Villages have population densities> 100 people / hectare. Based on the results of the analysis of land use change trends between 2013-2018, there was a significant growth in peri-urban area, which resulted in an increase in population density. Areas with high density such as in Cemani, Kartasura, Makamhaji and Gumpang in 2018 increased with Grogol, Madegondo, Singopuran, Ngadirejo, Purbayan, Tohudan, Gentan, Kwarasan and Gentan areas.

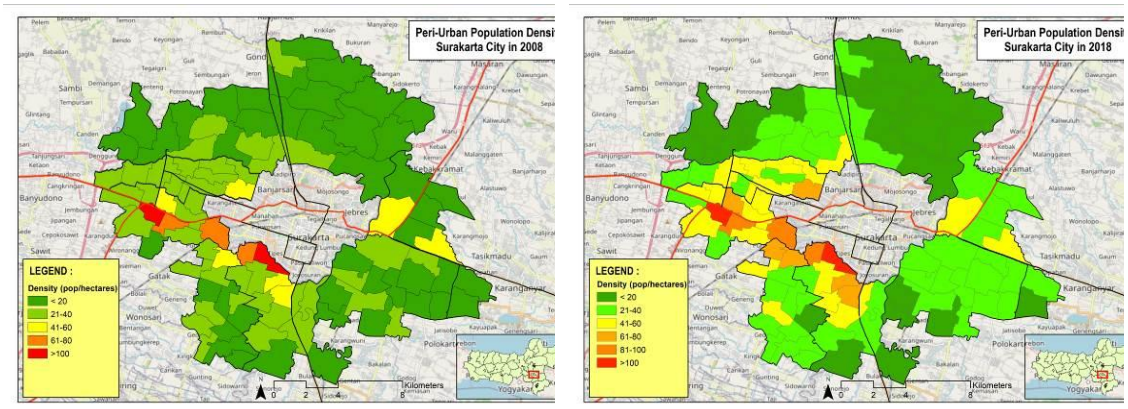

Figure 7 Comparasion Population Density 2008-2018

Changes that occur also include changes in the livelihoods of rural communities. Rural communities who work on farming slowly shift their livelihoods as impact of reduction agricultural land (Kawashima & Hoang, 2015). Some of the others work in the informal sector. As the population increases, in general there is also a transition in the types of jobs in suburban communities. In peri-urban area, the impact of suburbanization on livelihood transition occurs in the agricultural and non-agricultural sectors.

In 2008 the agricultural sector was still the main activity in peri-urban area. The number of people who work in the agricultural sector reaches 82% of the total population which is included in the productive age, while those who work in the non-agricultural sector are only 18%. Jobs included in the non-agricultural sector include entrepreneurs, employees, services, industrial workers and civil servants. In 2018, suburbanization around Surakarta City changed the use of agricultural land to industrial and commercial areas, resulting in a decrease in the number of workers in the agricultural sector. The number of people working in the agricultural sector in 2018 was 338 334 people or 59% of the total population of productive age.

In general, agricultural activities in peri-urban area are still dominant, but based on the decrease in the number of workers in the agricultural sector, it is an indication that the suburbanization at peri-urban area has changed not only spatial appearance but also socio-economic conditions. Agriculture has been the main source of income in peri-urban area for many years. If this condition continues, it can be ascertained that agricultural productivity as a basic human need is also threatened.

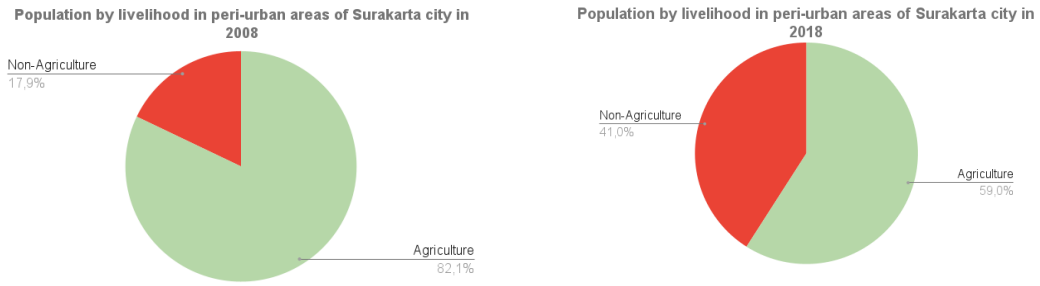

Figure 8 Livelihoods Transition in Surakarta Peri-Urban Area

The last impact is increasing need of backlog level. As a result of urban growth, the peri-urban area, the need for housing has also increased. However, unaffordable prices housing in the city center, the provision of housing is mostly found in suburban areas (Kim et al., 2013). The phenomenon of the emergence of formal and informal housing is also found in many peri-urban areas. Research conducted by Dewi & Ratnasari (2016), shows that housing developments are often found in suburban areas at affordable prices. In addition, the construction of houses in suburban areas targets the middle-income and low-income people. However, the high demand for housing cannot always be fulfilled by the ability to own houses. So, the result is increasing number of backlogs in suburban areas (Onatu & Mbinza, 2019).

Rural areas, especially those in peri-urban areas, have a low-level backlog before suburbanization. The average area has a backlog of <200 units in 2013. Only areas in the southern have a high number of backlogs because urban growth Surakarta City is moving south at the beginning. In 2018, the number of backlogs increased to several northern peri-urban areas. Ngemplak and Gondangrejo are the destinations for migrants to access housing facilities. In 2013, almost all northern peri-urban area had a low backlog or even more occupancy than the number of households. However, in 2018, there was a slight shift in the increase in the number of backlogs in northern peri-urban. An increase in the number of backlogs in suburban areas as a result of the suburbanization of Surakarta. Things that are an early indication of an increase in the backlog in the northern peri-urban areas include the emergence of many new housing estates, many lots of land to be bought and sold, and houses with more than 1 household. The following is a comparison of the number of backlogs in 2013 and 2018.

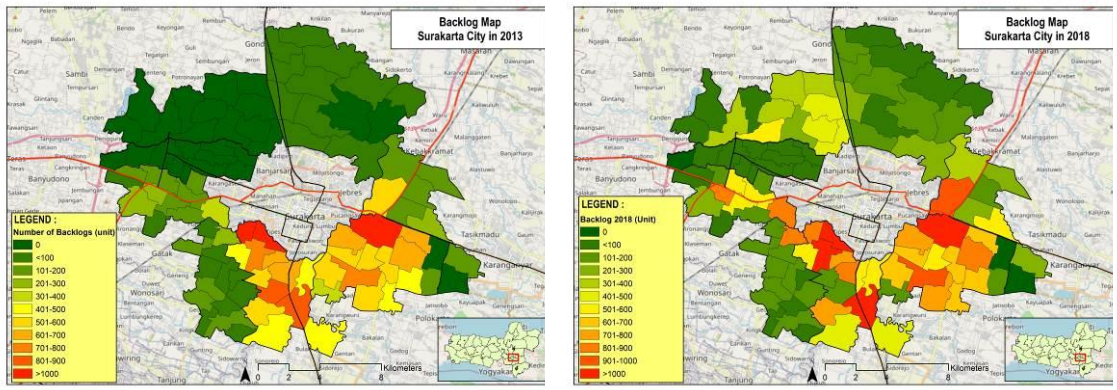

Figure 9 Comparasion Backlog Level 2013-2018

4. Conclusion

The peri-urban area of Surakarta City has been growing continuously for 18 years. The growth trend from 2000 to 2018 was characterize by expansion of the built-up land in peri-urban area. The expansion of built-up land in peri-urban areas cannot be separated from the phenomenon of suburbanization in peri-urban areas. Peri-urban area Surakarta City has expanded especially around the main road network. For almost two decades, built-up area has expanded by 4248 hectares for 18 years from 2000 to 2018. For 18 years, urban growth in peri-urban area has been leads to the western and southern of Surakarta City. the peri-urban area in western is the main route connecting Yogyakarta Special Region as well as connecting Surakarta City and Semarang City the capital of central java province. This area also has a main activity such as markets and education institution so that the land in this area growing very rapidly. Meanwhile, in the south is the peri-urban area which is expanded due to the development of a trade activity center.

Suburbanization in Surakarta Peri-Urban Area has both positive and negative impacts. The positive impact of suburbanization is an increase in the level of social welfare, both directly and indirectly. Land development built as a shopping and industrial center has an impact on the economic turnover around the area so that the welfare of the surrounding also raised. However, the negative impacts of suburbanization include changes in the livelihoods of farmers and an increase in the backlog level in peri-urban area. The shift in the livelihoods of farmers in peri-urban area will have an impact on local level food supply because of peri-urban Surakarta City is one of the producers of food crops. Meanwhile, the high demand for housing has not been able to target the lower class, so the backlog level continues to increase.

In addition to observing urban growth trends, this study also clustering peri-urban area based on spatial characteristics and suburbanization characteristics. This study shows that the areas directly adjacent to Surakarta City have stronger urban characteristics than areas further away, but the distance factor is not the only factor that triggers suburbanization. For example, Kartasura and Grogol are examples of peri-urban area that have developed due to regional development. This is not directly adjacent to the city of Surakarta but has a fast regional development rate. The phenomenon of suburbanization needs to be concern by local governments. Based on projections in 2036, peri-urban area Surakarta City will continue to expand that result in urban agglomeration. This phenomenon needs to be concern by preparing a more comprehensive spatial plan for the metropolitan area of Surakarta.

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