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Assesing the Sustainability Status and Sustainable Settlement Development in Periurban of Jabodetabek Metropolitan Area

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Abstract: In developing countries, fast-growing populations, urbanization, and rising economic sectors cause a vast demand for settlement areas. Consequently, in order to meet those demands, development in periurban of metropolitan area is inevitable. In periurban of Jabodetabek Metropolitan Area, some rapid developments tend to happen in Bekasi Regency, where the research location is South Cikarang District, it provides the space for settlement development. Later, the dynamic change of land use also occurs, following the rapid expansion of industrial area that it's growth process leads to unsustainability. Sustainable settlement development in Jabodetabek Metropolitan area is influenced by dynamic conditions on its periurban area. Methods used were spatial analysis, Multi Dimentional Scaling (MDS), descriptive analysis. The research result showed that sustainable status fairly sustainable and in the context of sustainable settlement development, consistency is needed in the implementation of related regulations, suppressing the rate of population immigration and increasing the area's capacity.



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Keywords: Settlement, Sustainable Settlement Development, Sustainability Status, Periurban Area, Multi Dimensional Scaling (MDS).

评估雅加达都市区郊区的可持续性现状和可持续定居点发展

摘要：在发展中国家，快速增长的人口、城市化进程和新兴经济部门对居住区的需求巨大。因此，为了满足这些需求，大都市郊区的开发势在必行。在雅博德塔别克都市区郊区，一些快速发展的地区往往位于勿加泗县（本研究的地点是其南芝卡朗县），这为居住区的发展提供了空间。随后，随着工业区的快速扩张，土地利用也发生了动态变化，其增长过程导致了不可持续性。雅博德塔别克都市区可持续居住区发展受到其郊区动态条件的影响。所采用的方法包括空间分析、多维尺度分析 (MDS) 和描述性分析。研究结果表明，该地区的可持续现状较为稳定，在可持续居住区发展的背景下，需要持续实施相关法规，抑制人口迁移率，并提高该地区的承载力。

关键词：定居点、可持续定居点发展、可持续性状况、城郊地区、多维尺度 (MDS)

1. Introduction

In developing countries, fast-growing populations, urbanization, and rising economic sectors cause a vast demand for settlement areas. Consequently, in order to deliver those demands, development in periurban of metropolitan area is inevitable. According to Firman, growth in the peri-urban metropolitan area is physically marked by the rapid growth of new settlement areas [1]. The tendency of periurban growth in the metropolitan system in Indonesia will continue in the future due to the high population growth, the emergence of new settlement areas as a container to accommodate the development of housing, industry and commercial activities in the metropolitan area, especially in the Jabodetabek metropolitan area [2]. Later, resulting in the government's unpreparedness and limitations in controlling spatial planning, providing infrastructure, transportation services, and providing social facilities that cannot be implemented properly [3]. In fact, until now, periurban area in a metropolitan system are still attractive areas to live in, because land prices are relatively cheap compared to land prices in the city and the location is still within a reasonable distance for a round trip [4]. This results in environmental degradation, infrastructure crisis, congestion, disaster risk and unpreparedness of government officials so that the development process leads to unsustainability [4], [5]. In this condition, it is important to realize sustainable settlement development in the peri-urban by examining the sustainability status according to environmental, social, economic and institutional dimensions.

In periurban of Jabodetabek Metropolitan Area, some rapid developments tend to happen in Bekasi Regency, where the research location is South Cikarang District.

South Cikarang District is a district with the largest number of industrial areas in Bekasi Regency, including the Jababeka Industrial Area, Lippo Cikarang Industrial Area, East Jakarta Industrial Park and Bekasi International Industrial Estate with an area of 2,395 hectares [6]. In this area there are also 1,200 business units engaged in the industrial and warehousing sectors and 59 housing areas [7]. According Bekasi Regency Spatial Planning 2011-2031, South Cikarang is part of the first Development Area (WP 1) in Bekasi Regency which is directed to become a center of industrial activity with the main function of industrial development, settlements, and supporting industrial activities [8]. Then, development in South Cikarang District occurred rapidly due to demands to support industrial development and supporting industrial activities, especially housing and services, to meet the housing needs of its people which caused land conversion, so that existing land use became inefficient and environmental degradation. The development of settlement areas and the rapid increase in industrial activity in South Cikarang District leads to uncontrolled and random development known as the phenomenon of urban sprawl [4], [9]. This situation has the potential to cause a conflict of interest between humans and the environment which will be a threat to the sustainability of settlement areas in the dimensions of sustainability, namely economic, social, environmental and institutional [10]. To overcome these issues, this study aims to assess the sustainability status and sustainable settlement development in the peri-urban Metropolitan Jabodetabek.

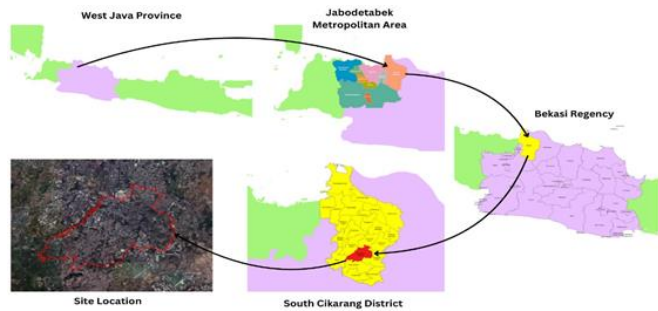
2. Methods

The research location is the periurban area of the

Jabodetabek Metropolitan Area which tends to rapid development in Bekasi Regency, namely South Cikarang District where includes 7 villages, namely Ciantra Village, Cibatu Village, Pasirsari Village, Serang Village, Sukasejati Village, Sukadami Village and Sukaresmi Village (figure 1.). The materials used include a. raster data, namely aerial photo map data from the recording years 2013, 2019, 2023 b. vector data, land use maps from 2013, 2019, 2023; road network maps; spatial pattern maps; land value zone maps; land ownership maps; Protected Rice Field (LSD) maps; The tools used are Rappfish; ArcGIS and camera. Data were obtained from primary and secondary sources. Primary data was obtained directly from the study location, while secondary data was used to obtain further insight into the study location.

- The analysis methods used in this study are :
- a. Spatial analysis (GIS) to detect dynamic changes in land use and using calculation of

Index Sprawl value	% growth of built up areas [11]
=	% growth of population



- b. Multi Dimensional Scaling (MDS) to obtain the sustainability status of economic, social, environmental and institutional dimensions using attributes and descriptive analysis to analyze the conditions of sustainable settlement development at the research location [12]. Sustainability analysis conducted through three stages: 1) Attributes determination for sustainable settlement management criteria, which includes dimensions of environmental, economic, social and institutional; 2) The valuation of each attribute in an ordinal scale based on sustainability criteria for each dimension; 3) The scoring is based on the result of questioneres in accordance with the stipulated requirement. The scores ranged from 1 – 4, which is interpreted from strongly disagree (poor) to strongly agree (good). Results of the scoring was analyzed using Rap-Urbanfringe program to determine the position of the sustainability status in each of these dimensions (see Table 1).

Table 1. Sustainability Index and Status

Index value	Category of Sustainability
00.00 - 25.00	Not sustainable
25.01 – 50.00	Less sustainable
50.01 – 75.00	Fairly sustainable
75.01 – 100.00	Good sustainable

Leverage analysis is used to determine the sensitive attributes which are very influential in improving the status of sustainable development of urban fringe settlement. The determination sensitive attributes is based on the priority of analysis leverage result that taking into account of the changes the root mean square (RMS) ordination on the X axis. The greater the change in RMS value, the greater the role of these attributes in increasing the sustainability status of urban fringe settlement.

3. Result and Discussion

The growth of settlement area (built up area) were approached with land cover change analyzes in study area year 2013, 2019, and 2023. The results of analysis are presented in Figure 2. and Table 2.





Figure 2. Land Use Map Year 2013, 2019 and 2023

Table 2. Land Use of South Cikarang District Year 2013, 2019 and 2023

Land Use	2013 (Ha)	%	2019 (Ha)	%	2023 (Ha)	%
Built up area	2983,83	56	3150,65	59	3567,75	67
Settlement	1695,42	32	1333,15	25	2215,69	42
Industry	1288,11	24	1817,5	34	1352,06	26
Non Built up	2314,13	44	2147,01	41	1729,74	33
Agriculture	916,74	17	881,58	17	531,74	10
Open space	1308,57	25	1176,61	22	1079,58	20
Water body	88,82	2	88,82	2	118,42	2
	5297,49	100	5297,49	100	5297,49	100

The growth of built-up land use has accelerated significantly and this is supported by the urban sprawl index value of 1.72%. The condition shows that during the observation period the growth of built-up land and population growth is high where the growth of built-up land is dominated by settlements and followed by population growth. This is due to the rapid increase in new housing, followed by a decrease in the number of family head members as well as changes and diversification of urban activities such as the development of trade, services and industry.

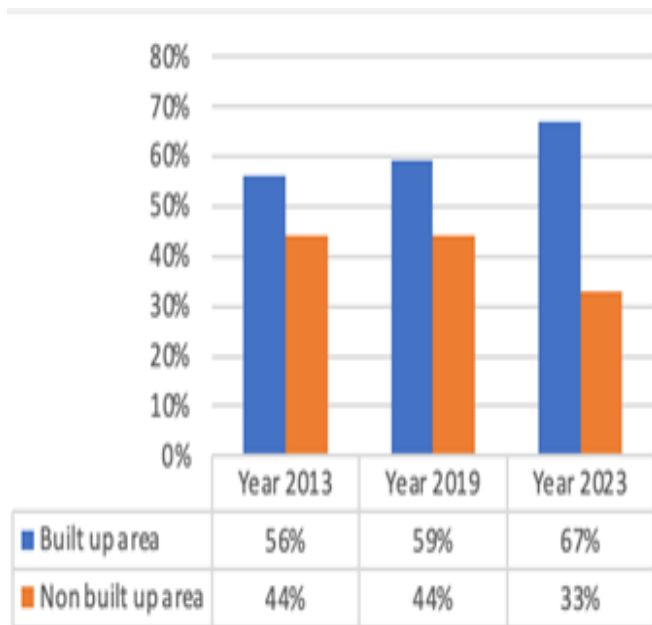


Figure 3. Percentage Built area and Non Built up Area South Cikarang Year 2013, 2019 and 2023

The current use of built-up land, in this case residential land use, is based on conformity with the

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direction of the Bekasi District Spatial Plan Year 2011-2031, there are inconsistencies where residential land use takes up land allocated for industry and riparian zones. (see table 3). Rapid and inconsistent built-up land growth conditions, if allowed to continue, will interfere with the sustainability of the study area, currently symptoms of unsustainability have occurred such as: random built-up land growth (urban sprawl), congestion, slums, high building density, flooding and air pollution.

Table 3. Land use inconsistencies

Land use (2023)	Spasial plan	Area (ha)	%
Settlement	Industry	318,3	97
Settlement	Riparian zone	10,6	3
	Total	328,9	100

Based on the results of the analysis of sustainability status including environmental, social, economic and institutional dimensions, the sustainability status for the study area was obtained (see Table 4).

Table 4. Sustainability Status

No.	Sustainable Dimension	Index Value	Category of Sustainability
1.	Ecology	46.65	Less Sustainable
2.	Economy	68.57	Fairly Sustainable
3.	Social	48.54	Less Sustainable
4.	Institution	70.86	Fairly Sustainable
5.	Multy Dimension	58,65	Fairly Sustainable

Multidimensional analysis of the sustainability status of the research area for regional development shows a sustainability index value of 58.68, meaning that the sustainability of regional development in the research area is quite sustainable. This moderately sustainable status is due to the low sustainability index value of the four dimensions assessed where the dimensions with less sustainability index values are the ecological dimension of 46.65 and the social dimension of 48.54, while the economic dimension sustainability index value of 68.57 and the institutional dimension sustainability index value of 70.86 have sufficient sustainability categories. This condition shows a tendency towards unsustainability. Kite diagram of four dimension (Ecology, Social, Economi and Institution) see Figure 3.

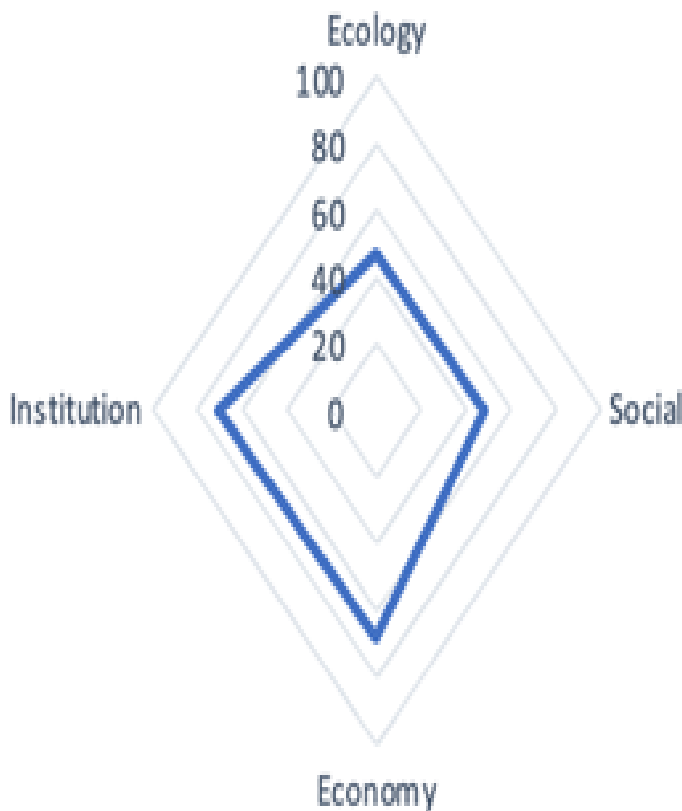


Figure 3. Diagram Sustainability Status

Analysis of the attributes derived from the four dimensions resulted in 11 attributes that acted as levers in each dimension partially (see Figure 4).

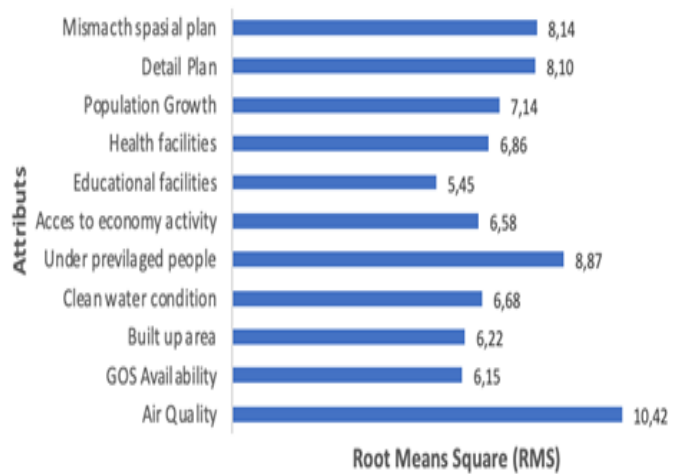


Figure 4. RMS Value of Leverage Attributes

In order to improve the sustainability status of the study area, the eleven attributes need to be intervened. Of the eleven sensitive attributes, there are three attributes that need to be controlled development intensity, three attributes need to be increased activity intensity, one attribute that should be made and four attributes that need to be planned development. Attributes that need to be planned development well

Attributes that need to be controlled are the rate of population growth or population density, the development of built-up land that is not in accordance with the plan. Based on the analysis of the dynamics of changes in built-up land use experiencing rapid growth acceleration with high density and consuming a large amount of land, this growth condition tends to be uncontrolled because currently the area of built-up land that is not in accordance with the direction of the existing plan shows a large percentage.

Attributes that need to be improved because they currently exist but the development of services is still limited are health facilities, education facilities, and clean water services. There is a tendency to decrease services due to limited services and government and rapid population growth and the expansion of the settlement area that must be served so that there is an imbalance. In order for the sustainability status of the research area to increase, this attribute must be increased in the intensity of its activities.

Attributes that need to be controlled in the implementation of their activities and also planned for development properly and consistently are accessibility to economic activities, air pollution, availability of green open space and pre-prosperous population. The attributes of accessibility to economic activities, availability of green open space are attributes that add to the attractiveness of residential areas in the study area so that their development must be prepared carefully because if allowed to be organised without good direction it causes the area to be undirected which causes the attribute of air pollution and also the pre-prosperous population to increase. An attribute that should be

prepared and created immediately as it is currently unavailable and indispensable for area control in the study area is the availability of detailed plans.

5. Conclusion

The growth of built-up land cover in the study area during the period 2013, 2019 and 2023 shows an acceleration and a considerable amount of change with a sprawl index value of 1.77. This indicates that there has been an urbanisation process in the Jabodetabek metropolitan peri-urban area. The distribution of land use is currently uncontrolled, indicating a deviation between the current location of settlements and the designation of settlements based on the direction of the Bekasi Regency Spatial Plan 2011-2031. The increase in land use in the study area is not only influenced by population growth but also by the development of facilities that support residents in activities such as trade and services.

Through the analysis of the current status of sustainability in the study area, it is found that the multi-dimensional sustainable status shows moderately sustainable with the ecological dimension and social dimension showing less sustainable status while the economic dimension and institutional dimension show moderately sustainable status.

In order to improve the status of sustainability in the study area as a periurban metropolitan area of Jabodetabek, there are 11 attributes that are leverage attributes and need to be intervened. Intervention on these attributes can be done through 1. reduction and control of the intensity of its development includes attributes: Increasing the intensity of activities considering that currently these activities already exist but are still limited and if not increased will adversely affect the sustainability of the area including : Health facilities, Education facilities, availability of clean water; 3. Control and implementation must be carefully and consistently planned for development including: accessibility to economic activities, availability of green open space, air pollution and the level of pre-sufficient families; 4. Attributes that must be made to support interventions that have been and will be carried out are the preparation of detailed plans.

References

- [1] T. Firman, "Demographic and spatial patterns of Indonesia's recent urbanisation," *Popul. Space Place*, vol. 10, no. 6, pp. 421–434, 2004.
- [2] T. Firman and I. A. I. Dharmapatni, "The challenges to sustainable development in Jakarta metropolitan region," *Habitat Int.*, vol. 18, no. 3, pp. 79–94, 1994.
- [3] J. T. Hidajat, S. R. P. Sitorus, E. Rustiadi, and M. Machfud, "Dinamika Pertumbuhan dan Status Keberlanjutan Kawasan Permukiman di Pinggiran Kota Wilayah Metropolitan Jakarta," *Globe*, vol. 15, no. 1, Juni, pp. 93–100, 2013.
- [4] Y. Budiyaning and V. Pratiwi, "Peri-urban typology of Bandung metropolitan area," *Procedia-Social Behav. Sci.*, vol. 227, pp. 833–837, 2016.
- [5] J. T. Hidajat, S. R. P. Sitorus, and E. Rustiadi, "Urban sprawl effects on settlement areas in urban fringe of Jakarta Metropolitan Area," *J. Env. Earth Sci*, vol. 3, no. 12, pp. 172–180, 2013.
- [6] D. Hudalah, H. Winarso, and J. Woltjer, "Peri-urbanisation in East Asia: A new challenge for planning?," *Int. Dev. Plan. Rev.*, vol. 29, no. 4, pp. 503–519, 2007.
- [7] Rizky, "Evaluasi Penggunaan Lahan Terhadap Rencana Tata Ruang Wilayah Kabupaten Bekasi 2011-2031," 2022, *Tesis Sekolah Arsitektur Perencanaan Dan Pengembangan Kebijakan Universitas Brawijaya*.
- [8] Pemerintah Daerah Kabupaten Bekasi, "Peraturan Daerah Kabupaten Bekasi Nomor 12 Tahun 2011 Tentang Rencana Tata Ruang Wilayah Kabupaten Bekasi Tahun 2011 - 2031," 2011, *Bekasi: Sekretariat Daerah*.
- [9] D. Pardamean, J. T. Hidayat, and A. Wicaksono, "ANALISIS HUBUNGAN URBAN SPRAWL DAN DAYA DUKUNG DAYA TAMPUNG LINGKUNGAN HIDUP-SEKTOR AIR DI KOTA DEPOK," *J. Syntax Lit.*, vol. 9, no. 7, 2024.
- [10] H. S. Yunus, "Dinamika wilayah peri-urban: determinan masa depan kota," (*No Title*), 2008.
- [11] S. R. Staley, *Urban Sprawl" and the Michigan Landscape: A Market-Oriented Approach*. USA: Mackinac Center for Public Policy, 1999.
- [12] P. Kavanagh and T. J. Pitcher, "Implementing Microsoft Excel software for Rapfish: a technique for the rapid appraisal of fisheries status," 2004.

参考文献:

- [1] T. Firman, "印度尼西亚近期城市化的人口和空间模式", 《人口空间》, 第10卷, 第6期, 第421-434页, 2004年。
- [2] T. Firman和I. A. I. Dharmapatni, "雅加达大都会区可持续发展面临的挑战", 《人居国际》, 第18卷, 第3期, 第79-94页, 1994年。
- [3] J. T. Hidajat、S. R. P. Sitorus、E. Rustiadi和M. Machfud, "雅加达大都会区郊区定居点的增长动态

- 和可持续性”，《环球》，第15卷，第6期，第421-434页，2004年。2013年6月1日，第93-100页。
- [4] Y. Budiyanitini 和 V. Pratiwi, “万隆大都市区的半城市化类型学”，《社会行为科学》，第227卷，第833-837页，2016年。
- [5] J. T. Hidajat、S. R. P. Sitorus 和 E. Rustiadi, “城市蔓延对雅加达大都市区城市边缘区定居点的影响”，《环境地球科学杂志》，第3卷，第12期，第172-180页，2013年。
- [6] D. Hudalah、H. Winarso 和 J. Woltjer, “东亚的半城市化：规划的新挑战？”，《国际发展计划评论》，第13卷，第12期，第172-180页，2013年。 29，第4期，第503-519页，2007年。
- [7] Rizky, “根据2011-2031年勿加泗摄政区空间规划对土地利用进行评估”，2022年，Brawijaya大学建筑、规划与政策发展学院论文。
- [8] 勿加泗县政府, “勿加泗县2011年第12号区域条例关于2011-2031年勿加泗县空间规划”，2011年，勿加泗：区域秘书处。
- [9] D. Pardamean、J. T. Hidayat 和 A. Wicaksono, “德波市城市扩张与环境承载力-水资源部门关系分析”，《语法学杂志》，第9卷，第1期。7，2024。
- [10] H. S. Yunus, “城郊地区动态：城市未来的决定因素”，（无标题），2008年。

[11] S. R. Staley, “城市蔓延”与密歇根景观：一种市场导向的方法。美国：麦基诺公共政策中心，1999年。

[12] P. Kavanagh 和 T. J. Pitcher, “为 Rapfish 实施 Microsoft Excel 软件：一种快速评估渔业状况的技术”，2004年。

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