JPSTD
Journal of Placemaking and Streetscape Design
JPSTD 2(2): 155–169
ISSN 3025-5449

Institute for Advanced Science, Social and Sustainable Future
MORALITY BEFORE KNOWLEDGE

Spatial planning based on urban waste-generating: A streetscape design perspective

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Received Date: September 15, 2024 Revised Date: January 29, 2025 Accepted Date: January 30, 2025

ABSTRACT

Background: The concept of sustainable spatial planning can solve the limited land area of DKI Jakarta Province. The increasing amount of waste generation in DKI Jakarta Province and the increasing population will cause the Bantargebang TPST's capacity to be insufficient soon. This research aims to analyze the amount of waste generation in DKI Jakarta Province. **Method:** The quantitative research approach uses mixed methods, including literature review and descriptive and spatial statistics. The data is secondary data from the Environmental and Cleanliness Information System of the DKI Jakarta Province Environmental Service (SILIKA). **Finding:** The results show the distribution of waste generation, presented in the form of a GIS (Geographic Information System) map. The results of this research show that the increase in the population of DKI Jakarta Province impacts waste generation; waste generation in 2019 increased by 54% in 2021. Recapitulation of waste generation in DKI Jakarta Province in 2021 Measurement Period I, the highest in East Jakarta, 2247.39 tonnes, and the lowest in Central Jakarta, 787 tons of waste. **Novelty/Originality of this Article:** This study introduces a GIS-based spatial analysis of waste generation in DKI Jakarta, highlighting the direct impact of population growth on waste production and the urgent need for sustainable spatial planning to address land scarcity and waste management challenges.

KEYWORDS: DKI Jakarta Province; land use; waste generation; waste management.

1. Introduction

The problem of urbanization in recent years has resulted in a severe impact on society's social economy and the surrounding environment. Urbanization has contributed to environmental pollution, such as air pollution, water pollution, and an increase in solid waste, in this case, rubbish (Hidayah et al., 2021). The waste problem in developing countries such as Indonesia is a problem that still needs to be resolved, as is the case experienced by various developing countries and other developed countries. Based on Law Number 18 of 2008 concerning Waste Management, it is explained that waste is the remainder of human daily activities and natural processes in solid form, the source of waste comes from waste generation, waste is an object or item that no longer has a use, and is no longer valuable for use by humans so it is thrown away (Zuchriyastono & Purnomo, 2020), waste generation such as the types and characteristics of waste, due to the increasing number of people on earth due to the diverse culture, lifestyle and consumption patterns of society every year, is made clear by the National Waste Management Information System (SIPSN) which shows that Indonesia's waste generation in 2022 will be 20,266,439 tonnes/ year, those that have been successfully managed are 13,561,288 tons/year and those that

Cite This Article:
Rusni, N. K. (2025). Spatial planning based on urban waste-generating: A streetscape design perspective. *Journal of Placemaking and Streetscape Design, 2*(2), 155-169. https://doi.org/10.61511/jpstd.v2i2.2025.1133

have not been managed to date are 6,705,151 tons/year. The widespread distribution of waste on land also has fatal consequences for the marine sector; various anthropogenic activities can contribute to waste, and the increasing population has an impact on the generation of waste around residential locations, including residential, industrial, office, educational, market activities, etc (Toruan et al., 2021).

The concept of sustainable spatial planning is crucial to be implemented in DKI Jakarta Province. With the rapid development of urban areas, the population continues to increase while residential land becomes increasingly scarce. According to data from the Central Statistics Agency in 2022, the population of DKI Jakarta Province reached 10,562,088 in 2020 and increased to 10,609,681 in 2021. This population growth significantly impacts waste generation. Regarding waste management issues, it has been concluded that the increasing rate of waste production is not proportional to the efforts and processes undertaken to address it. As the capital city of Indonesia, DKI Jakarta has implemented various waste management strategies, not only focusing on landfill operations but also adopting newer approaches, such as managing waste directly at its source. The National Waste Management Information System (SIPSN) reported that the daily waste generation in DKI Jakarta Province amounted to 7,158.63 tons per day in 2022. To date, raising public awareness and involvement remains necessary, such as through direct socialization about the importance of waste management starting from households to encourage active community participation. Moreover, the government must pay closer attention to implementing effective waste management efforts (Zuchriyastono & Purnomo, 2020).

In Law Number 18 of 2008 concerning Waste Management, it is explained that waste management activities consist of two activities, namely waste reduction and waste handling; waste reduction such as (3R) reduce, reuse, and recycle, waste handling such as selection, transportation, collection, processing and final processing of waste. The problem that is still common today is that waste management by the community needs to be following the Waste Management Law. It is known that some people still rely on the collection-transport-dispose system. 33.08% of waste still needs to be managed in DKI Jakarta Province in 2022 (SIPSN, 2023). Suppose some people in DKI Jakarta Province still rely on the collection-transport-disposal system. In that case, it can be predicted that in a short time, the capacity of Bantargebang TPA will no longer be sufficient and available to accommodate the waste of DKI Jakarta Province (Akhmad et al., 2022). The high amount of waste is known to be caused by increasing population, urbanization, and increasing economic development, but this is not accompanied by the availability or existence of an effective waste management system (Halimah & Machdum, 2023).

Urban waste refers to objects or items that no longer have any use and are no longer valuable to humans; hence, they are discarded (Zuchriyastono & Purnomo, 2020). It is further stated that waste is an unused product resulting from human activities daily, and if not managed optimally, it will increase waste accumulation (Mamahit et al., 2021). According to Nindya et al. (2022), waste is classified into organic and inorganic. The most common waste comes from residential areas, comprising 75% organic and 25% inorganic waste. The community can utilize organic waste for composting and eco-friendly fertilizer production, as well as for making biogas and briquettes.

In contrast, inorganic waste remains difficult to reuse, with minimal proper management processes, and it is challenging to degrade. Some inorganic waste cannot be degraded by nature at all. Plastic waste is The most common type of inorganic waste in the community. Indonesia was once the second-largest contributor of plastic waste to the ocean after China (Puspitasri et al., 2022).

The high amount of urban waste generated in DKI Jakarta Province every year is not balanced with optimal waste management, so a study of waste generation and waste composition is needed, which can be utilized in implementing a waste management system and finding out the pattern of waste distribution it will be presented in the form of a GIS map (Geographic Information System), based on this description, the problem underlying this research is that there is still a lack of information regarding the distribution of waste as seen from the size of waste generation in DKI Jakarta Province and the spatial pattern of

distribution of waste generation in DKI Jakarta Province. This research aims to analyze spatial waste generation patterns in DKI Jakarta Province.

One of the factors contributing to waste management problems in developing countries is the need for more public awareness about the environment, as well as the perceived suboptimal involvement of the government and other institutions. Therefore, the main foundation that needs attention within society is education. Education can provide knowledge to the community, shaping behavior, actions, concern, and responsibility toward the environment, particularly regarding waste issues. Education is a crucial component in achieving sustainable development. Increasing waste management awareness within the academic community can positively influence those around them (Hidayah et al., 2021). Solid waste is a crucial issue within metropolitan administrative areas, involving ecological concerns and population growth. The increase in urban populations results in higher waste production. Waste issues today are no longer just about cleanliness and climate; they have evolved into a complex social problem that may require consistent sacrifices (Dahri et al., 2022).

Currently, the government's approach to waste management focuses on an "end-of-pipe" solution, emphasizing waste collection, transportation, and disposal at landfills (TPA) (Anugerah & Yahya, 2022). Waste management with active community involvement plays a significant role in reducing the volume of waste, serving as an appropriate measure to anticipate the rise of urban waste. Community members and individuals can engage in positive behaviors such as waste containment, collection, sorting, and recycling to reduce the increase in waste volume. Several factors affect waste processing and hinder the system, including population distribution and density patterns, geographical and environmental conditions, socioeconomic factors, physical environment, behavior and attitudes, and cultural norms in urban and rural areas. Problems arise at downstream, process, and upstream levels. Downstream, littering remains relatively high. During the process stage, challenges often include limited resources for collaboration among officials and communities. Upstream, the application of waste processing systems and final processing stages is often suboptimal. In Indonesia, 56% of waste is managed by the government, while the rest is burned (35%), buried (7.5%), composted (1.6%), and handled using other methods (15.9%) (Prihandoko & Setiabudi, 2022).

1.1 Urban ecology

In the book Ecology of Urban Environments by Parris (2016), ecology is defined as the study of the distribution, abundance, and behavior of organisms in relation to their interactions with one another and their environment. Over time, population growth has increased, leading to diverse needs within a region, which can result in both positive and negative impacts of development. One of the adverse effects of development is evident in the increasing environmental degradation caused by pollution, which stems from human activities. Housing has become a primary human need, growing rapidly and uncontrollably. The demand for housing is rising not only in urban areas but also extending to remote villages (Kibas et al., 2023).

Within an urban system, interactions between different subsystems occur, including changes in population that influence human behavior in cities, economic and social life, and environmental changes that impact urban natural resources. The rapid development of DKI Jakarta has led to land scarcity for construction, alongside the rising demand for residential land. Consequently, land prices in both urban and rural areas have increased, while the reality remains that land availability is no longer sufficient. This situation has driven the necessity for urban development to adopt the Green City concept, which emphasizes ecological considerations in city planning and development to achieve sustainable well-being. The Green City concept is expected to address regional development challenges by integrating various ecological aspects, such as land use and green buildings, waste management, sanitation, environmental regulations, water availability, and transportation (Kibas et al., 2023).

Spatial utilization is a development program that involves and optimizes space within a designated timeframe as outlined in regional spatial planning. The objective of spatial utilization is to support sustainable development by utilizing land wisely, in accordance with its designated purpose, while considering conservation and cultivation functions (Mberu et al., 2022). Landscape ecology represents the harmony between social components, such as population, and natural environmental elements, such as physical landscapes. A crucial role of urban populations is to foster awareness and active participation in improving environmental quality through waste management and reforestation efforts.

1.2 Population and species level responses to urbanization

The biophysical processes of urbanization can have widespread effects on populations and species by altering the quantity, quality, timing, and spatial distribution of resources essential for the survival of microbes, fungi, plants, and animals, such as shelter, nesting sites, food, water, sunlight, and nutrients within a specific area. Additionally, human activities contribute significantly to biological introductions and biological invasions, with some species spreading into urban environments either intentionally or unintentionally. These processes influence the abundance of non-human species in urban settings, altering interactions within and between species, including predation, cannibalism, parasitism, symbiosis, and mutualism, as well as more complex ecological interactions. Population growth and decline are determined by four fundamental processes: birth, death, immigration, and emigration. Human disturbances, changes in resource availability, and shifts in intra- and interspecific interactions can impact the survival rates of juvenile and adult individuals, offspring production, and the number of individuals migrating into or out of urban populations.

Urbanization generally occurs due to the appeal of cities, which offer opportunities, employment, and the hope of a better future. Physically, urban development impacts land use by shifting areas from their original function—such as green spaces—into residential and industrial zones to accommodate increasing spatial demands. Other physical effects include the distribution of urban facilities, transportation networks, movement patterns toward city centers, environmental issues, and the emergence of slum settlements. Socially, urbanization can contribute to rising unemployment, poverty, and crime rates. The transformation of urban areas is evident in the rapid increase in population mobility over time. Urbanization refers to the migration of people from rural to urban areas, leading to changes in population distribution within a region (Anggraeni, 2022). As the capital city and the largest metropolitan area in Indonesia, DKI Jakarta experiences continuous population growth each year. This makes it a primary destination for urban migration, driven by factors such as extensive development, increased demand for labor, and a strong economic sector. Urbanization is not solely related to demographic changes but also influences community activities and societal dynamics. The economic advancement of urban areas attracts rural populations to migrate to cities. Many individuals feel compelled to leave their hometowns due to low economic conditions and limited job opportunities. However, the presence of more promising urban areas that offer a better standard of living and sufficient employment opportunities serves as a major driver of urbanization (Anggraeni, 2022).

Population growth or decline can alter interactions within and between species, creating feedback loops in which different species' populations continue to increase or decrease, sometimes leading to local extinction. Urbanization impacts ecological communities through four key processes: community-level selection, ecological shifts, ecological dispersal, and diversification. Additionally, urbanization significantly affects terrestrial, freshwater, and marine ecosystems beyond the geographical boundaries of cities. Therefore, a logical approach to understanding how populations (and the species within them) respond to urbanization is by examining its effects on vital rates, which ultimately drive population growth or decline (Parris, 2016). The environment is inherently linked to cultural elements, as these two aspects of life interact closely. Environmental and

cultural issues frequently emerge within society, including in urban and metropolitan areas. Environmental problems in urban regions are prevalent and include waste management issues, flooding, declining air quality, and pollution (Umam, 2021).

2. Methods

This quantitative research approach uses a mixed literature review method and descriptive and spatial statistics. The data used is secondary data from the Environmental and Cleanliness Information System of the DKI Jakarta Province Environmental Service (SILIKA) for 2023. The DKI Jakarta Province area is geographically located between 6ºS-7 ºS and 106 ºE-108 ºE. It borders the western part of Tanggerang City, the eastern part of Bekasi City, and the southern part of Depok City.

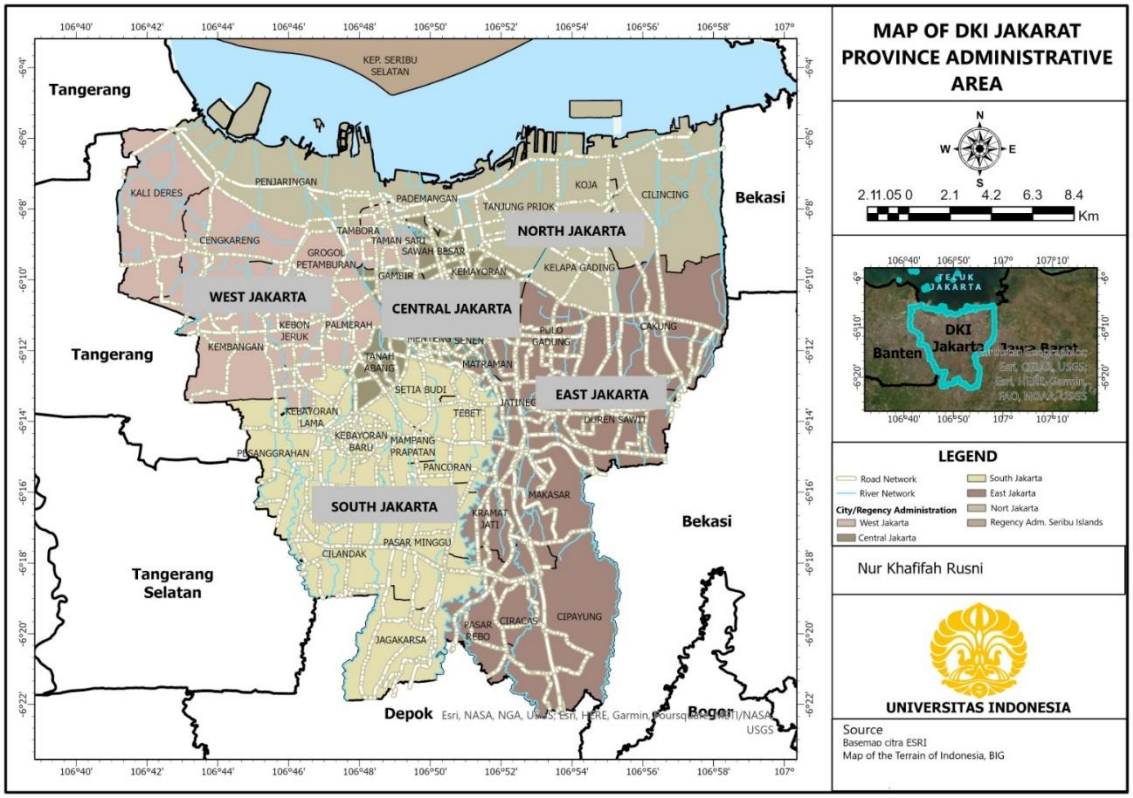

Fig. 1. Administration map of DKI Jakarta Province

The land and sea area of DKI Jakarta Province is 664.01 km^2, consisting of 6 administrative city areas and administrative districts into 44 sub-districts, 267 sub-districts, 2,757 RWs, and 30,610 RTs. The following cities and sub-districts are in DKI Jakarta Province: (a) Central Jakarta consists of 8 sub-districts—Sawah Besar, Kemayoran, Gambir, Johar Baru, Senen, and Cempaka Putih; (b) North Jakarta includes 5 sub-districts—Penjaringan, Pademangan, Koja, Kelapa Gading, and Clincing; (c) West Jakarta comprises 8 sub-districts—Kali Deres, Cengkareng, Taman Sari, Tambora, Grogol Petamburan, Kembangan, Kebon Jeruk, and Palmerah; (d) South Jakarta consists of 10 sub-districts—Setiabudi, Tebet, Pancoran, Pasar Minggu, Jagakarsa, Mampang Prapatan, Cilandak, Passanggrahan, Kebayoran Lama, and Kebayoran Baru; (e) East Jakarta includes 10 sub-districts—Cakung, Pulo Gadung, Matraman, Jatinegara, Duren Sawit, Makasar, Ciracas, Cipayung, Pasar Kebo, and Kramat Jati; (f) Thousand Islands consists of 2 sub-districts—South Thousand Islands and North Thousand Islands.

3. Results and Discussion

3.1 Analysis of land use development in DKI Jakarta Province

The Special Capital Region of Jakarta, as the nation's capital, has continuously undergone changes over the last 20 years, particularly in terms of land use. The increasing population is one of the crucial factors contributing to changes in land use. According to data from the Central Statistics Agency in 2022, it was reported that the population of Jakarta Province in 2021 reached 11 million people, specifically 10,609,681 people, with an annual population growth rate of 0.57%. The population density is 15,978 people per square kilometer. The population increase corresponds with the rising demand for residential land and employment opportunities. The ever-decreasing availability of land has triggered frequent misuse of land functions (Hasibuan et al., 2020). The current condition of Jakarta is marked by a shortage of green open spaces, as well as water absorption areas such as lakes, reservoirs, and others. Discussions around environmental and social issues have become increasingly prominent in urban society, such as the clean water crisis, air pollution or declining air quality, annual flooding, health problems leading to educational issues, and even inter-community conflicts. One of the efforts by the Jakarta Provincial Government to address improper land conversion is the expansion of public green spaces. Based on data from the Ministry of Environment and Forestry in 2022, the green space area in Jakarta Province is 0.378 km^2, which, when compared to the total area, only accounts for 5.6%, falling below the minimum green space requirement according to Law No. 26 of 2007, which mandates 20% for public green space and 10% for private green space.

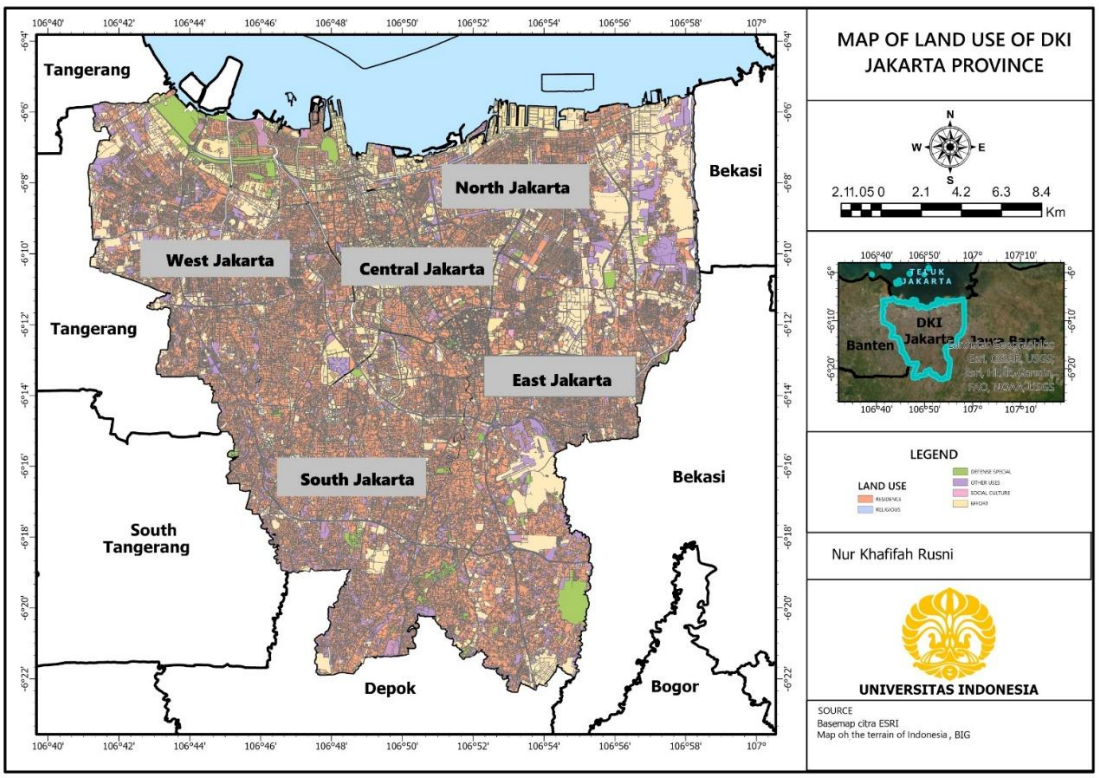

Fig 2. Land use map of DKI Jakarta Province in 2023

Land use refers to human intervention, either permanently or periodically, in a particular area, with the aim of fulfilling material, spiritual, or a combination of needs (Savitri, 2022). Rapid urban development can lead to changes in land use patterns in a region, such as the rapid growth of the Special Capital Region of Jakarta, which has resulted in an increased demand for land, despite the limited availability. Vacant land has become a

target for urban expansion, with land that initially served as vacant or agricultural land now being converted into areas of development (Kartikakirana, 2021). The land use in Jakarta Province in 2023 can be seen in Figure 2.

Based on Fig 2, the spatial land use in Jakarta Province in 2023 is dominated by residential and business activities. Only a tiny portion of land is explicitly used for agriculture, located in Cipayung District, East Jakarta, and Penjaringan District, West Jakarta. Central Jakarta and South Jakarta are mainly dominated by residential land use, marked by numerous government offices, apartments, and commercial centers. According to data from the Central Statistics Agency in 2022, Central Jakarta has the highest population density in the province, with 20,360 people/km^2. North Jakarta is dominated by land use for business purposes, evidenced by the large number of factories and urban industries.

3.2 Analysis of waste generation in Jakarta Province

The annual waste generation from 2019 to 2021 in Table 1 shows that the annual waste in Jakarta Province has increased each year. In 2019, the recorded waste generation was 2,008,546.37 tons, and it increased by almost 54% in 2021, reaching 3,083,437 tons. The waste generation data can be seen in Table 1.

Table 1. Annual waste generation data of Jakarta Province.

Year	Annual Waste Generation (Tons)
2019	2,008,546.37
2020	3,054,812.22
2021	3,083,437.85

(SIPSN, 2023).

The waste generation data, based on the Environmental and Cleanliness Information System (SILIKA) of the Jakarta Environmental Agency in 2023, is derived from the first-period waste measurement of each district in Jakarta Province for the year 2021. However, due to data limitations, the data presented only includes waste generation from the five provinces of Jakarta. Waste generation data from the Thousand Islands has not yet been obtained. The waste generation data for each district can be seen in Table 2.

Table 2. Waste generation data for period I in Jakarta Province, 2021

City	Subdistrict	Waste Generation (Tons)
Center Jakarta	Sawah Besar	88.63
	Kemayoran	179.87
	Gambir	67.15
	Johar Baru	100.59
	Senen	89.54
	Cempaka Putih	70.68
	Menteng	63.97
	Tanah Abang	126.57
	Penjaringan	224.54
North Jakarta	Pademangan	117.54
	Koja	242.52
	Kelapa Gading	100.02
	Cilincing	307.33
	Kali Deres	314.71
West Jakarta	Cengkareng	401.88
	Taman Sari	88.81
	Tambora	186.46
	Grogol Petamburan	165.41
	Kembangan	212.5
	Kebon Jeruk	251.53
	Palmerah	161.09
South Jakarta	Setiabudi	81.22

East Jakarta	Tebet	166.23
	Pancoran	121.86
	Pasar Minggu	230.83
	Jagakarsa	252.77
	Mampang Prapatan	108.85
	Cilandak	156.9
	Pasanggrahan	183.3
	Kebayoran Lama	229.69
	Kebayoran Baru	108.4
	Cakung	399.59
	Pulo Gadung	214.53
	Matraman	132.26
	Jatinegara	226.41
	Duren Sawit	310.4
	Makasar	155.7
	Ciracas	220.9
	Cipayung	203.64
	Pasar Kebo	163.48
	Kramat Jati	220.48

The recapitulation data on waste generation from the first measurement period for each city in DKI Jakarta Province in 2021, the availability of Temporary Disposal Sites (TPS) in each area of DKI Jakarta Province, and the total population can be seen in Table 3.

Table 3. Waste generation data for each city in DKI Jakarta Province in 2021

Regency/City	Recapitulation of Waste Generation (tons)	Total TPS (points)	Population (People)
City Adm. Central Jakarta	787	119	1,006,460
City Adm. North Jakarta	999.95	204	1,784,753
City Adm. West Jakarta	1,782.39	259	2,440,073
City Adm. South Jakarta	1,640.05	158	2,233,855
City Adm. East Jakarta	2,247.39	348	3,056,300

(Total TPS data from the Environmental and Cleanliness Information System of the Environmental Service (SILIKA) DKI Jakarta Province 2023, Population Data (Badan Pusat Statistik, 2022)

Based on Table 2, which presents the waste generation data for the first period in DKI Jakarta Province in 2021, a Spatial Map of Waste Generation in DKI Jakarta Province for 2021 has been created for each district, as shown in Figure 3. Based on Fig. 3, which illustrates the Waste Generation Map of DKI Jakarta Province for the First Measurement Period in 2021, the highest waste generation level was recorded in Cengkareng District, West Jakarta, with 401.88 tons of waste. This was followed by Cakung District, East Jakarta, with 399.59 tons, and Kalideres District, West Jakarta, with 314.71 tons. Meanwhile, the lowest waste generation was recorded in Menteng District, Central Jakarta, with 63.97 tons.

In terms of citywide waste generation, East Jakarta had the highest total waste production at 2,247.39 tons. According to Table 2, this high level of waste generation corresponds with the availability of 348 Temporary Disposal Sites (TPS) and the highest population, totaling 3,056,300 residents. Conversely, Central Jakarta recorded the lowest waste generation at 787 tons, with 119 TPS and the lowest population of 1,006,460 residents. This aligns with the findings of Sriagustini & Nurazijah (2022), who stated that waste generation levels increase in proportion to population density. Without community and government awareness in waste management from the source—including waste reduction, recycling, and reuse—waste accumulation will continue to rise.

Over time, the increasing waste generation in DKI Jakarta has become a critical environmental issue. Urban development has led to environmental degradation, particularly through land use conversion into residential areas, which have expanded rapidly. As a result, DKI Jakarta is now predominantly characterized by residential and commercial land use. The environmental impact of urbanization is evident, with worsening

pollution and increasing waste generation due to human activities. Therefore, sustainable development through spatial planning must be implemented in DKI Jakarta to mitigate environmental degradation risks.

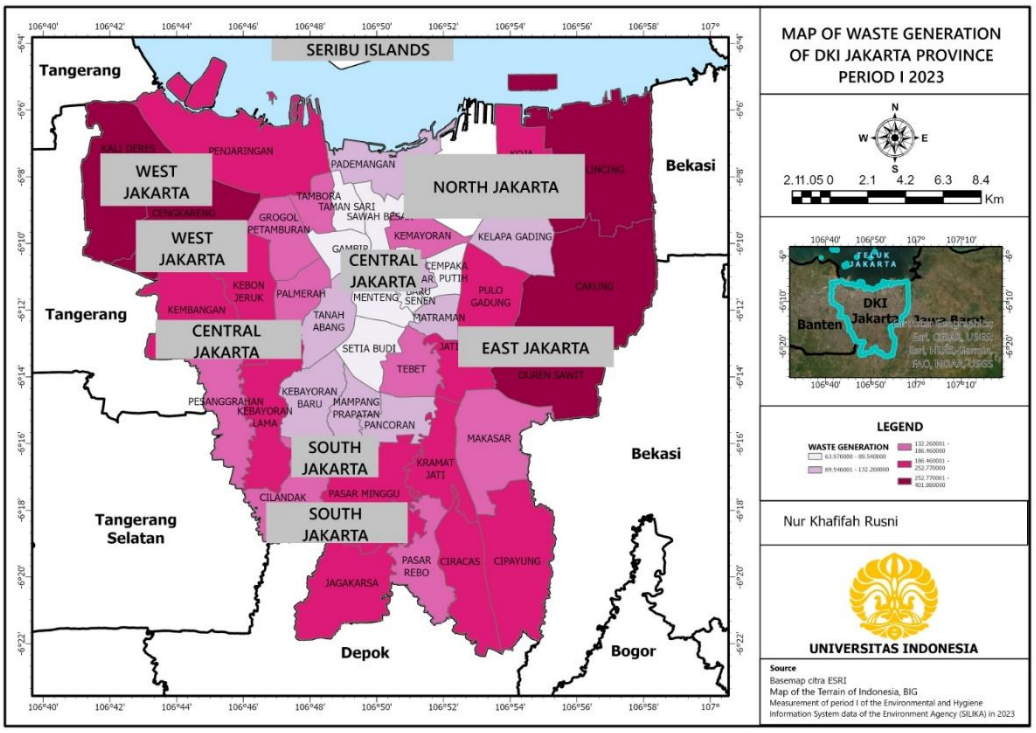

Fig. 3. Waste generation in DKI Jakarta Province Period I 2021

3.3 Discusion

Environmental science is crucial for sustainable development, as it is expected to reduce the risk of environmental damage caused by ongoing development. According to Miller & Spoolman (2015), sustainability is the ability of cultural systems, natural systems, and human economies to endure and adapt to changing environmental conditions without being limited by time. The components of the environment include the natural environment, the built environment, and the social environment, which are interconnected, interact, and depend on one another (interdependence) to function. Therefore, the sustainability of the social environment is greatly influenced by the sustainability of the natural and built environments.

Based on Law Number 32 of 2009 concerning Environmental Protection and Management, sustainable development is defined as a conscious and planned effort that integrates aspects of the environment, society, and economy into development strategies to ensure the integrity of the environment, as well as the safety, capability, welfare, and quality of life of both present and future generations. Humans can live more sustainably if their sensitivity to the environment is heightened, if they learn from nature, live more simply on Earth, and become active environmental citizens. An orientation towards sustainability can be developed by implementing three key ideas as the foundation of environmental literacy: natural capital is essential to support life on Earth and the economy; humans must be careful not to exceed the Earth's estimated capacity or ecological tipping point, as human ecological footprints are vast and rapidly expanding. Therefore, to achieve sustainable development, we must consider the limits of natural capacity, both now and in the future, when fulfilling current and future needs and desires. Society can realize sustainable development with environmentally conscious standards by fostering awareness and concern among people, without forgetting the surrounding environment and other living beings, with the aim of enhancing the well-being and quality of life for the present and future.

The Bantargebang Integrated Waste Disposal Site (TPST), located in Bantargebang, Bekasi City, West Java, has been in operation since 1989 and serves as the final disposal site (TPA) for waste from Jakarta Province and Bekasi. TPST Bantargebang is the largest TPST in Indonesia, covering 110.3 hectares (Ellyza et al., 2021). Initially, the waste management system used the sanitary landfill method, which involves stacking waste in a concave area, compacting it, and then covering it with soil. However, the uncontrolled daily waste volume has led to an enormous accumulation of waste at TPST Bantargebang, turning it into a "mountain of garbage." As a result, the current system has shifted to open dumping. The average waste volume is around 7,000-8,000 tons daily, with 60% being domestic waste from households, handled by 1,200 garbage trucks. Currently, the site's capacity is nearing its maximum limit, and it is estimated that TPST Bantargebang will no longer be operational in a few years. Additionally, some zones are still not adequately managed, relying on the open dumping system, contributing to environmental damage due to methane gas and leachate (Sukwika & Noviana, 2020).

Waste management has become highly complex and dynamic. It is considered complex because it requires the involvement of multiple stakeholders, including the government, industries, communities, traders, and various NGOs. It is dynamic because the volume of waste will continuously change and increase over time. Therefore, addressing waste issues is difficult if only approached from a technical perspective, such as containment, collection, and transportation to landfills (TPA). It must also be tackled holistically by raising primary awareness and involving the community, which is a major contributor to the increase in waste (Anugerah & Yahya, 2022).

Various efforts have been made by the government to address the waste problem at TPST Bantargebang, including the improvement and effective management of the TPA since the enactment of Law Number 18 of 2008 on Waste Management. A critical issue to date is the decreasing and limited capacity of TPST Bantargebang, with a maximum capacity of 49 million tons and only 10 million tons remaining. The open dumping system exacerbates the situation, as the garbage mountain has exceeded a height of 35 meters, with odor pollution reaching a radius of up to 10 km (Sukwika & Noviana, 2020). If this issue persists and the amount of waste continues to increase each year, TPST Bantargebang will soon reach its capacity limits. Therefore, in addition to raising awareness among the public as daily waste producers, the government is preparing a new or replacement landfill site. This new site, as planned by the Jakarta Provincial Sanitation Agency, will be located in (specific location) and will be designed to minimize environmental impact and maximize efficiency. Unfortunately, if TPST Bantargebang becomes full, it will be closed and abandoned without any other function, and this cycle will continue with other TPAs when they reach full capacity. This repeated search for new landfills negatively impacts land productivity and reduces green open spaces. According to Government Regulation Number 21 of 2021 of the Republic of Indonesia, every city must have at least 20% of its total area as public green open space (RTH). However, Jakarta Province only has 9.8% RTH (Ellyza et al., 2021).

To address the social and environmental issues related to TPST Bantargebang's waste, the Jakarta Provincial Government is striving to transform waste management concepts into economically valuable practices. Jakarta Province has committed to ending open dumping and sanitary landfill systems, which involve burying waste with red soil and covering it with geomembrane. Instead, a more innovative approach using the landfill mining system will be implemented. Landfill mining involves the extraction of valuable materials and resources from waste burial zones, such as metals, plastics, and organic matter, which can be recycled or repurposed. This system is expected to increase the capacity of the waste burial zones and recover materials that can be reused, with the ultimate goal of making new land available for use (Sukwika & Noviana, 2020).

Policy analysis is the process or activity of synthesizing information, including research results, to produce public policy recommendations. Public policy refers to government decisions in the form of actions that influence the actions of individuals or society (Anugerah & Yahya, 2022). several public policy analyses for waste cleanup actions, namely

rationale for planning waste cleanup actions, the need for involvement in waste cleanup policy, output and outcome, basic strategies

Rationale for planning waste cleanup actions. Since 2019, the Indonesian government has faced various challenges related to the waste management system in its efforts to achieve universal sanitation targets. These challenges include low levels of waste service access, low awareness, and clean and healthy behavior (PHBS) among the public. Additionally, the commitment of local governments in waste management is still less effective, and there is a lack of sanitation management institutions and human resource capabilities (Prihandoko & Setiabudi, 2022). Each year, the population of Jakarta continues to increase, which contributes to the growing amount of waste and negatively impacts health and the environment. Without proper waste management, this issue is unlikely to be resolved. The capacity of TPST Bantargebang is nearly inadequate, raising concerns among both the government and the public. This calls for a review of existing regulations and laws related to waste management and the environment.

The legal aspects of the current waste management system have yet to fully address the waste problem. Planning has primarily focused on managing waste after it is generated, with an overreliance on landfills. Some behaviors in society still reflect a lack of awareness of the importance of waste issues, with the government bearing full responsibility. Efforts made today will impact the future. Therefore, it is necessary to take anticipatory steps to reduce waste at its source. However, many people remain indifferent to the current waste situation.

The need for involvement in waste cleanup policy. The success of waste cleanup policy planning relies heavily on the integrity of the region's cultural context, the community's social conditions, natural factors, organizational or institutional aspects, economic factors, and the availability of technology and skills among all community stakeholders. Social and environmental factors include the motivation required for local community involvement. These management strategies engage the community with transparency and responsibility, comprehensive and transparent participation among communities to discuss solutions, gender structures, transfer of ownership, and social integration in actions that must be acceptable to the community, as well as dynamic change management and cooperation.

Institutional factors involve the engagement of community organizations such as NGOs and the involvement of the private sector to reduce costs. Strengthening the capacity of institutions involves collaboration and coordination between the government, community organizations, and the private sector, as well as the dynamics of organizational change. Economic factors include the sustainability of the economic system related to appropriate pricing and financing for investment and routine expenditures. Economic conditions will determine the cost of waste cleanup programs in all regions. Technological factors emphasize the importance of selecting and implementing appropriate technology to achieve waste cleanup in an area. Affordability, knowledge, and training are necessary for the community operating this technology. It is hoped that the technology used will not harm society and its environment. Regulations and public knowledge are also required in social, environmental, and technical fields to encourage sustainable waste cleanup actions.

Output and outcome. The output includes the development of concepts and action plans to achieve proper and sustainable waste management, as well as the availability of waste management facilities with a segregated system. The outcome is the implementation of systems and procedures for sustainable waste management. Changes in public behavior will significantly affect daily waste management practices.

Basic strategies. Waste reduction and management at the source are considered solutions that need to be optimally implemented to reduce waste generation over time. This involves developing technology related to products or packaging that can be recycled and are biodegradable. It also requires promoting a culture of limiting plastic bag usage by replacing them with more environmentally friendly shopping bags. Direct or social media campaigns and education on 3R (reduce, reuse, recycle) waste management must be enhanced. The government plays a crucial role in providing waste management services, improving the capacity and quality of human resources, enforcing laws, managing budgets,

optimizing the waste recycling industry, promoting composting efforts, and providing environmentally conscious landfills. Cooperation with the local environmental agency and the community must also be well established.

According to data from the Environmental Agency of DKI Jakarta Province, waste management in DKI Jakarta is based on the following legal and policy frameworks: (1) Law Number 18 of 2008 concerning Waste Management; (2) Minister of Home Affairs Regulation Number 33 of 2010 concerning Waste Management Guidelines; (3) Government Regulation Number 81 of 2012 concerning Household Waste Management and Household-like Waste; (4) Regional Regulation Number 3 of 2013 concerning Waste Management, amended by Regional Regulation Number 4 of 2019; (5) Ministry of Public Works Regulation Number 3 of 2013 concerning the Implementation of Waste Infrastructure and Facilities in the Management of Household Waste and Household-like Waste; and (6) Strategic Plan 2017–2022 of the Environmental Agency of DKI Jakarta Province.

Based on data from the Environmental Agency of DKI Jakarta Province, the 2020 Work Plan Program related to waste management includes optimizing 3R Temporary Waste Storage (TPS) facilities in the region, providing services, managing waste, repairing/rehabilitating TPS facilities, improving waste processing at TPS, developing waste management policies, planning the construction of waste management facilities, establishing and enhancing waste banks, monitoring waste management performance in DKI Jakarta Province, maintaining infrastructure and facilities at TPST Bantargebang, optimizing the lifespan of TPST Bantargebang, procuring waste handling support, increasing B3 Waste TPS at the district level, maintaining motor vehicle trucks (ATPM), maintaining operational road sweeper vehicles (ATPM), maintaining operational motorized carts, and others.

Waste management can have a positive impact on society and the environment. A clean environment can start with simple actions such as maintaining personal hygiene and keeping one's home and surroundings clean. If every individual adopts these practices, it can lead to a habit of living clean and healthy lives without waste, thereby preventing the spread of various diseases. As we know, cleanliness is part of faith. Environmental cleanliness is realized by adhering to the implementation of regulations such as Law Number 32 of 2009 concerning Environmental Protection and Management. All parties, the government, and the community must observe and implement regulations related to waste management and environmental cleanliness to achieve a common goal: a clean environment and optimal waste management services (Dahri et al., 2022).

In many cases, people currently manage waste by burning it. Although this method is considered an easier way to reduce the amount of waste, it is not recommended because it has many adverse effects on humans and the environment. Waste burning produces smoke that pollutes the air, contributing to toxic substances such as nitrogen oxides (NO), carbon monoxide (CO), and other gases. Additionally, these toxic substances can cause health problems in humans, including respiratory disorders, irritation, and reproductive system issues, and even lead to cancer or death (Puspitasri et al., 2022).

According to Anugerah & Yahya (2022), if waste management is not handled thoughtfully, it can lead to various problems such as: (1) Health issues, as waste piles can become breeding grounds for various diseases. Flies can act as vectors for disease transmission, and long-standing scattered waste can lead to diseases caused by rats, such as fever and arboviral infections. For example, after the 2020 flood disaster in Jakarta, leptospirosis cases increased due to the large amount of waste accumulated in the city; (2) Poor waste management can become a source of fire due to the accumulation of waste; (3) Health problems caused by floods are often due to large amounts of waste in rivers and waterways, which block water flow.

It's important to note that a significant portion of river water pollution, around 60-70%, is a direct result of the community's habit of littering in rivers or waterways. This highlights the need for individual responsibility and the collective effort required to maintain the cleanliness of our water bodies.

4. Conclusions

The development of the Jakarta Province area is dominated by land use for residential purposes due to the growing population, which has led to limited land availability. Green spaces have become very scarce, primarily in West and East Jakarta. The increase in the population of Jakarta has resulted in a significant rise in waste generation, with the waste volume in Jakarta Province increasing by nearly 54% from 2019 to 2021. According to the 2021 waste generation data analysis, based on measurements from the first period using data from the Environmental and Cleanliness Information System (SILIKA) of the Jakarta Environmental Agency in 2023, East Jakarta recorded the highest waste generation at 2,247.39 tons, while Central Jakarta had the lowest, with 787 tons of waste.

Acknowledgement
Author would like to express our sincere gratitude to the editorial team and reviewers for their invaluable contributions in evaluating and reviewing this scientific article. Their insightful comments, constructive feedback, and meticulous assessment have significantly enhanced the quality and rigor of this work.

Author Contribution
Author have equally contributed to the conception, writing, and revision of this article, ensuring its accuracy and integrity.

Funding
This research received no external funding.

Ethical Review Board Statement
Not available.

Informed Consent Statement
Not available.

Data Availability Statement
Not available.

Conflicts of Interest
The author declare no conflict of interest.

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