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MORALITY BEFORE KNOWLEDGE

The impact of urban density on the form and function of public spaces in sustainable city planning

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ABSTRACT

Background: This study examines the impact of population growth on land use changes in North Jakarta. As one of the rapidly developing coastal areas, North Jakarta has undergone significant transformations in land use patterns due to urbanization pressures and the increasing demand for residential, industrial, and infrastructure space. **Methods:** Based on data from the Central Bureau of Statistics (BPS) and previous literature studies, there was a substantial population increase from 2008 to 2018, accompanied by a dominant shift in land use from open spaces and agricultural land to built-up areas. **Findings:** Population growth has also led to intensive land conversion in strategic areas with direct access to key infrastructure, such as Tanjung Priok Port. **Conclusion:** This study suggests the implementation of more sustainable spatial planning to address environmental challenges and maintain the balance of the urban ecosystem. **Novelty/Originality of This Study:** This study provides a novel perspective by analyzing the spatial dynamics of land conversion in North Jakarta, highlighting the direct impact of population growth on strategic urban areas with key infrastructure access.

KEYWORDS: land use change; North Jakarta City; population; population density.

1. Introduction

Indonesia is the world's largest archipelagic country, with a maritime area of 5.1 million km^2 and the longest coastline in Asia, reaching 108,920 km (Muhlis, 2011). Indonesia consists of 16,056 islands, with nearly three-quarters of its total territory being ocean (BPS, 2019). Globally, Indonesia ranks second after Brazil in terms of the number of islands and is recognized as a maritime nation with one of the longest coastlines in the world, approximately 99,093 km.

Indonesia ranks as the fourth most populous country in the world, following China, India, and the United States. The population growth rate in Indonesia was recorded at 1.1% in 2021. According to the population census data from the Central Bureau of Statistics (BPS), Indonesia's population reached 270.2 million as of September 2020 (BPS, 2021). Fuadi (2021) stated that when comparing the 2020 population census data with that of 2010, the population increased by 32.56 million, with an average annual growth of 3.26 million people.

The large population in Indonesia can pose significant challenges, particularly in urban areas. Cities are considered highly attractive due to the facilities they offer, influencing people to migrate to urban centers. This phenomenon impacts urban

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development, both in terms of continuous population growth and the expansion of buildings and their functions within the city (Nasution, 2014).

The development of the Special Capital Region (DKI) of Jakarta continues to advance, establishing itself as a key economic hub that supports urban development. However, as urban expansion accelerates, the level of urbanization also increases. Urbanization is a primary factor contributing to population growth in cities. According to the population projections from the 2015 DKI Jakarta census, the city's population reached 10.18 million, rising to 10.28 million in 2016, and further increasing to 10.37 million in 2017. This indicates that within two years, Jakarta's population grew by approximately 269 people per day or 11 people per hour (Prakoso & Herdiansyah, 2019).

The rise in population is accompanied by an increasing demand for residential space and employment opportunities, which in turn accelerates the conversion of urban green areas into built environments to accommodate these needs. This phenomenon is not only concentrated in the city center but also extends to the urban periphery.

North Jakarta, a municipality in DKI Jakarta Province, covers an area of approximately 7,133.51 km^2. It consists of six districts: Penjaringan, Pademangan, Tanjung Priok, Koja, Cilincing, and Kelapa Gading. The land area of North Jakarta extends from west to east for 35 km, protruding inland between 4 and 10 km, and is geographically located at 106° 20' 00" east longitude and 06° 10' 00" south latitude. The elevation of North Jakarta ranges from 0 to 20 meters above sea level (BPS, 2021; Putra & Marfai, 2012).

North Jakarta, as a coastal area and part of the Jakarta metropolitan region, experiences rapid spatial development each year, marked by the construction of high-rise buildings and increasing population activities. This expansion contributes to the growth of built-up land within the city. The rising population in North Jakarta has led to an increasing conversion of land into built-up areas. Additionally, population growth necessitates the development of urban infrastructure and facilities, which require significant land resources, despite the city's limited available land. Consequently, non-built land is progressively transformed into built-up areas. This study aims to provide an overview of changes in population density and land use in North Jakarta between 2008 and 2018.

1.1 Environmental science

Environmental science, according to Miller & Spoolman (2016), is the study of interactions among the physical, chemical, and biological components of the environment, as well as how human activities influence and are influenced by the environment. It is an interdisciplinary field that integrates chemistry, physics, and biology to examine environmental issues and the impacts of human activities on ecosystems (Wang & Nielsen, 2020).

According to Soesilo (2024), based on various expert opinions, environmental science is defined as the study of realities and efforts that humans must undertake to manage the environment in accordance with its roles and functions, to support life and enhance the well-being of humans and other living organisms. The fundamental principles of environmental science are based on ecological concepts that form the theoretical foundation of the field, including interaction, interdependency, diversity, harmony, and sustainability (Krebs, 2008).

1.2 The concept of sustainability

Miller & Spoolman (2016) define sustainability as the ability of all systems on Earth to endure and adapt to changing environmental conditions indefinitely. The fundamental principles of sustainability encompass social, economic, and environmental sustainability. Several definitions link sustainability with sustainable development as a means to preserve ecosystem functions and ensure that future generations can continue to meet their needs (Nogueira et al., 2023).

Sustainability is the ability of Earth's systems to endure and adapt to changing environmental conditions indefinitely (Miller & Spoolman, 2016). This concept encompasses three main pillars: social, economic, and environmental sustainability. Social sustainability focuses on the well-being of communities, ensuring fair access to resources and opportunities while maintaining social cohesion. Economic sustainability emphasizes stable and inclusive growth that does not harm the environment or society. Environmental sustainability prioritizes ecosystem preservation and biodiversity conservation to support life on Earth.

Sustainable development is an approach that integrates these three aspects to meet present needs without compromising the ability of future generations to meet their own (Nogueira et al., 2023). This concept was first introduced by the World Commission on Environment and Development in 1987, highlighting the importance of balancing economic growth, social well-being, and environmental conservation. In this context, sustainable development does not solely focus on economic progress but also considers quality of life and environmental preservation.

Achieving sustainable development requires a holistic approach that considers the interconnections between various sectors and factors influencing human life and the environment. This includes careful planning, supportive policies, and active participation from all stakeholders, including governments, the private sector, and civil society. Additionally, education and awareness of sustainability play a crucial role in promoting behavioral changes and more responsible decision-making.

The implementation of sustainable development faces several challenges, such as climate change, environmental degradation, social inequality, and economic pressures. Therefore, innovation, collaboration, and strong commitment from all parties are essential to overcoming these obstacles and achieving sustainability goals. Thus, sustainability is not just a concept but also a commitment to maintaining a balance between human needs and the Earth's capacity in the long term.

1.3 Sustainable development

Sustainable development must be based on a balance between social, economic, and environmental progress (Frey & Yaneske, 2007). Achieving equilibrium between urban development, environmental protection, and social equity is essential across various aspects of urban life, including access to employment, housing, public facilities, adequate infrastructure, and reliable public transportation (Hiremath et al., 2013). Therefore, it is crucial to design long-term sustainable development strategies to enhance the standard and quality of life for urban communities.

According to Nassar & Elsayed (2018), several key points are essential in shaping a densely populated community that applies sustainable principles. First, maximizing economic growth and reducing unemployment can be achieved by creating job opportunities in both the service and production sectors at the regional level (Kooy, 2014). Additionally, investing in emerging business sectors, such as manufacturing and agriculture, plays a crucial role in ensuring economic stability. Improving the quality of education for future generations is also a vital factor, as a well-established education system contributes to enhanced community safety (Yang et al., 2013). Furthermore, providing essential services in housing and transportation supports urban development and ensures residents' well-being. The construction of urban social spaces fosters community engagement and strengthens social cohesion. Another important aspect is encouraging literacy and a reading culture through non-governmental organizations (NGOs) to enhance knowledge and awareness within the community. Collaboration with community training programs is necessary to develop skills that align with labor market needs, thereby improving employment opportunities. Environmental sustainability is also a major concern. Establishing water purification facilities helps prevent waterborne diseases and mitigates water shortages (Saniti, 2012). Additionally, recycling organic and inorganic solid waste not only promotes environmental awareness but also creates new job opportunities. Through

these integrated efforts, sustainable development can be effectively implemented in densely populated urban communities.

1.4 Urbanization

Urbanization, or the large-scale migration of people from rural to urban areas, significantly contributes to changes in biodiversity and ecosystems on a global scale. The continuous growth of the global population places immense pressure on urban areas to meet the increasing demands of their inhabitants (McPhearson et al., 2016). Urbanization directly affects land requirements, as land use in cities tends to be much higher than in rural areas (Alemie et al., 2015; Baye et al., 2020). One of the primary consequences of rapid urban population growth is the urgent need for housing (Baye et al., 2020). High population growth rates often lead to unplanned infrastructure development, the emergence of slums and informal settlements, demographic shifts, economic fluctuations, pollution, climate change, and water contamination. These challenges contribute to environmental degradation in urban areas, increasing the risks of climate change-related disasters such as storms and heatwaves (McPhearson et al., 2016).

1.5 Urban ecology

Urban ecology is a field of research and practice that reflects the primary habitat of humans, largely dominating land cover and significantly altering Earth's ecosystems (Osmond & Pelleri, 2017). According to Barot et al. (2019), the global human population is increasingly concentrating in urban areas, exerting a profound impact on the biosphere. Urban ecology can also be defined as the study of spatial-temporal patterns, environmental impacts, and the sustainability of urbanization, which places pressure on biodiversity, ecosystem processes, and ecosystem services (Robbins, 2012; Wu, 2014).

Urban areas encompass numerous development activities aimed at supporting human needs and improving quality of life. However, these activities often lead to environmental changes. The components of the urban environment include biodiversity in city parks, the diversity of animals and trees, human populations and socio-economic groups, infrastructure development such as roads and buildings, public services, finance, healthcare, waste management, urban agriculture, and other aspects (Verma et al., 2020). In general, urban ecology is the study of interactions between living organisms and the urban environment, examining how human activities shape and impact ecological systems within cities.

1.6 Urban environment

Human settlements have historically emerged around agricultural systems. The transition from a nomadic hunter-gatherer lifestyle to a more settled existence began in the Middle East during the Neolithic Period, around 9500 BCE. By 3500 BCE, the first cities had been established in Mesopotamia, in what is now modern-day Iraq. Today, human settlements range in size from small village clusters to towns, large cities, and megacities that support more than 10 million inhabitants. Globally, there were 740 urban areas with populations exceeding 500,000 in 2008, including 22 megacities with populations over 10 million. The proportion of Earth's surface classified as urban is currently estimated at 3% and continues to grow. However, the ecological impact of cities and urban populations extends far beyond urban boundaries. The demand for stable housing has driven settlement expansion into cooler coastal regions with high biodiversity.

Modern techniques and technology now enable large-scale human habitation in previously inhospitable landscapes, such as deserts. For example, the Phoenix metropolitan area in Arizona, United States, is home to over 4.2 million people, while Dubai in the United Arab Emirates has a population exceeding 2.4 million. Coastal areas have the highest urban land cover and the greatest human population density among all six major ecosystems

(Indrasari, 2020). The theory of human habitat selection suggests that people choose their living environments to maximize individual fitness. Historically, this meant selecting habitats with abundant food and clean water, safe shelter, and minimal threats from other humans or dangerous wildlife. This theory assumes that people have the option to relocate when they perceive potential benefits in doing so (Parris, 2016).

1.7 Urban heat island effect

Urban heat islands (UHIs) form in metropolitan areas because materials used in buildings, roads, and sidewalks absorb and retain more solar heat than naturally vegetated surfaces. The heat absorbed during the day is then released back into the atmosphere at night. Additionally, heat generated by industrial activities, vehicles, and heating or cooling (air conditioning) systems in buildings further contributes to the urban heat island effect. Other factors, such as particulate air pollution and reduced wind speeds in cities, also exacerbate this phenomenon.

1.8 Community responses to urbanization

The impact of urbanization on ecological communities focuses on four key processes: community-level selection, ecological shifts, ecological dispersal, and diversification. Various ecological theories and models, including ecological niche theory, environmental gradients, resource competition models, food webs, and community theory, apply to urban environments. Urbanization also significantly affects terrestrial, freshwater, and marine communities beyond the geographical boundaries of cities (Harris, 2012; Parris, 2016).

1.9 Human urban ecology

In its worst conditions, a city can become a hub of unemployment, violence, poverty, filth, and human despair. The vastness of a city and its high population density can create a sense of alienation. The poorest residents in many cities live in substandard housing—overcrowded, unsafe, often lacking effective heating and cooling, with inadequate ventilation and sanitation, or without access to clean drinking water (Putri, 2019; WHO, 2018, 2020). In most cities, poorer neighborhoods tend to have lower vegetation cover, fewer parks and street trees, and a higher proportion of impervious surfaces. A stark contrast in green cover can be observed between the lush Atlanta Botanical Garden, in a city known for its tree canopy, and the densely populated Favela settlements in Brazil, as illustrated in Fig. 1.

(a) (b)

Fig.1. Contrasting urban green cover:
(a) Atlanta Botanical Garden in Atlanta, Georgia, USA, (b) Favela settlement in Brazil
(Parris, 2016)

The urban human experience can vary within the same location over time, as cities follow different trajectories—from their initial formation to expansion and industrialization, followed by periods of recession, urban decay, and, in some cases, further urban renewal. The characteristics of urban form can either promote or hinder the health and well-being of the human population.

2. Methods

2.1 Research approach

In this study, the research approach used is a qualitative approach with an analytical descriptive method. According to Sugiyono (2017), the qualitative approach is based on post-positivism philosophy to examine the condition of the research object naturally, where the researcher acts as the primary instrument, while the subjects take part in the study as the experiment. The data collection technique applies the triangulation (combination) concept, and the data analysis is inductive, commonly referred to as qualitative. A qualitative approach is used to explore and understand the meanings that individuals or groups attribute to a social issue. This research process involves several questions and procedures, with data collected from actual conditions experienced by research participants. The data analysis follows an inductive pattern, progressing from specific themes to more general ones, ultimately requiring the researcher to interpret the research findings (Creswell, 2014). The data collection technique in this study is entirely conducted through a literature review, utilizing various journals and research studies, commonly referred to as a literature study.

2.2 Time and location of research

This research begins with literature study and proceeds to data analysis using various journals as references for writing this paper. The study is conducted in North Jakarta, selected as the research location due to its status as an urban area experiencing rapid spatial changes driven by rapid development and high population density. The research is carried out over one month, from September 25, 2024, to October 25, 2024. Further details on the research location will be presented in the results and discussion section.

2.3 Population and research sample

The research population is not merely the number of objects studied but also includes the characteristics or attributes of those objects (Sugiyono, 2017). Based on this definition, the research population consists of a collection of data with similar characteristics, specifically previous studies and journals related to population density and land-use changes in urban areas. Meanwhile, the sample for this study focuses on population density and land-use changes, particularly in North Jakarta.

2.4 Research data

The research data used in this study is entirely based on secondary data obtained from literature studies. This data is used to explain the predetermined research objectives. The collection of secondary data is conducted through a literature review to gather demographic data on the population and information on land-use changes. The data used in this study is presented in Table 1.

Table 1. Data variable

No	Variable	Data source	Collection Instruments
1	Population	Population density data for North Jakarta City 2008, 2018-2022 (BPS Data)	Literature review

2	Area	Area data (BPS)	Literature review
3	Land use	Land use data of North Jakarta City 2008, 2018-2022 (Previous Research Data)	Literature review

2.5 Method of analysis

The analytical method used in this study is the descriptive-analytic method, which is employed to provide an overview and describe the state of the research object or objectives (Sugiyono, 2017). According to Nazir (2003), the purpose of the descriptive-analytic method is to create a systematic, factual, and accurate description containing characteristics, facts, and relationships between the studied phenomena. Therefore, in this research, data related to population density is collected through a literature study and then specifically analyzed to draw conclusions for North Jakarta.

3. Results and Discussion

3.1 Overview of research location

According to Governor's Decree Number 171 of 2009, North Jakarta covers an area of 146.66 km^2, with an elevation ranging from 0 to 2 meters below sea level. Geographically, North Jakarta is located between 106° 20’ 00” East Longitude and 06° 10’ 00” South Latitude. Administratively, the region is bordered to the south by West Jakarta, Central Jakarta, and East Jakarta, while to the east, it shares a boundary with East Jakarta and Bekasi Regency. To the west, North Jakarta is adjacent to Tangerang Regency and West Jakarta, and to the north, it faces the Java Sea.

As a coastal region, North Jakarta serves as the gateway to the capital city due to its historical significance and strategic location. This role dates back to the late 18th century when the Dutch East Indies government developed the Tanjung Priok area as the new Batavia Port, replacing the older Sunda Kelapa Port. Over time, this development positioned Tanjung Priok as the busiest and most congested port in Indonesia, playing a crucial role in the country's trade and economic activities.

3.2 Land area

According to the Central Bureau of Statistic, North Jakarta (BPS, 2020a) consists of six districts: Penjaringan, Pademangan, Tanjung Priok, Koja, Kelapa Gading, and Cilincing. Each of these districts contributes to the overall urban landscape of North Jakarta, which continues to experience rapid development due to population growth and economic activities. The land area of North Jakarta, categorized by district, is presented in the following Table 2.

Table 2. Land area based on district in North Jakarta City

Sub-District	District Capital	Area (km2)	Percentage (%)
Penjaringan	Penjaringan	45.41	30.96
Pademangan	West Pademangan	11.92	8.13
Tanjung Priok	Kebon Bawang	22.52	15.35
Koja	Lagoa	12.25	8.36
Kelapa Gading	East Kelapa Gading	14.87	10.14
Cilincing	Cilincing	39.70	27.07
North Jakarta	Tanjung Priok	146.66	100.00

Based on Table 2, the largest district in North Jakarta is Penjaringan, covering an area of 45.41 km^2 (30.96%), with its administrative center located in Penjaringan Village. This is followed by Cilincing District, which spans 39.70 km^2 (27.07%) with its administrative center in Cilincing Village. Tanjung Priok District ranks third with an area of 22.52 km^2 (15.35%), and its administrative center is located in Kebon Bawang Village. Next is Kelapa

Gading District, covering 14.87 km^2 (10.14%), with its administrative center in Kelapa Gading Timur Village. Koja District follows, occupying 12.25 km^2 (8.36%), with its administrative center in Lagoa Village. The smallest district in North Jakarta is Pademangan, which covers 11.92 km^2 (8.36%) of the total area.

3.3 Total population

According to data from the Central Bureau of Statistics (BPS, 2024), the total population of North Jakarta in 2023 was 1,801,963 people. In terms of gender distribution, the male population exceeded the female population, with 908,269 males and 893,694 females. This is reflected in the overall sex ratio of North Jakarta, which stands at 101.63%. Among the districts, only Kelapa Gading had a sex ratio below 100%, recorded at 94.08%. A sex ratio below 100% indicates that the number of female residents in Kelapa Gading is higher than that of males. The population distribution of North Jakarta in 2023 is presented in Table 3.

Table 3. Population of North Jakarta City in 2023

Sub-District	Population (people)	Population growth rate 2022-2023 (%)
Penjaringan	314,187	-0.11
Pademangan	164,668	0.41
Tanjung Priok	404,529	0.26
Koja	340,955	0.97
Kelapa Gading	136,984	-0.40
Cilincing	440,640	0.99
North Jakarta	1,801,963	0.47

Table 3 provides an overview of the population distribution across districts in North Jakarta in 2023. The district with the highest population is Cilincing, with a total of 440,640 residents, while Kelapa Gading has the lowest population, totaling 136,984 residents. The population growth rate in North Jakarta from 2022 to 2023 showed an increase of 0.47%. This study will also examine changes in the population of North Jakarta in 2008 and 2018, which are presented in Table 4.

Table 4. Population of North Jakarta City in 2008 and 2018

Sub-District	Population in 2008 (people)	Population in 2018 (people)	Population Addition 2008-2018 (people)
Penjaringan	186,528	346,680	160,152
Pademangan	120,286	165,180	44,894
Tanjung Priok	312,113	392,820	80,707
Koja	233,109	314,130	81,021
Kelapa Gading	108,604	158,480	49,876
Cilincing	240,791	420,000	179,209
North Jakarta	1,375,553	1,747,320	317,767

Based on Table 4, there was a significant increase in the population of North Jakarta from 2008 to 2018, amounting to 317,767 people. In 2008, the population was recorded at 1,375,553, which increased to 1,747,320 in 2018. The district that experienced the highest population growth was Cilincing, while the district with the smallest increase in population was Pademangan. This population growth has driven the demand for land for residential, industrial, and other infrastructure developments, leading to significant changes in land use patterns in the region.

3.4 Population density

Population density is defined as the number of inhabitants in a province or district/city divided by the total land area in square kilometers (km^2) (Wardani and Wahono, 2020). The population density of North Jakarta in 2023 is presented in Table 5. The data indicates that

the district with the highest population density in North Jakarta is Cilincing, while the district with the lowest population density is Kelapa Gading.

Table 5. Population density of North Jakarta City in 2023

Sub-District	Population (people)
Penjaringan	314,187
Pademangan	164,668
Tanjung Priok	404,529
Koja	340,955
Kelapa Gading	136,984
Cilincing	440,640
North Jakarta	1,801,963

Table 6 indicates that the population density in North Jakarta experienced an increase of 2,662 people/km^2 between 2008 and 2018. In 2008, the population density was recorded at 8,609 people/km^2, which rose to 11,271 people/km^2 by 2018. The district with the highest increase in population density was Koja, with an addition of 5,969 people/km^2, while Pademangan saw the smallest increase, with only 504 people/km^2.

Table 6. Population density of North Jakarta City in 2008 and 2018

Sub-District	Population Density 2008 (people/km2)	Population Density 2018 (people/km2)	Increase in Population Density 2008-2018 (people)
Penjaringan	5,256	6,785	1,529
Pademangan	12,127	12,631	504
Tanjung Priok	12,422	16,740	4,318
Koja	17,655	23,624	5,969
Kelapa Gading	6,737	10,411	3,674
Cilincing	6,065	9,403	3,338
North Jakarta	8,609	11,271	2,662

3.5 Land use

The land use in North Jakarta, as described in this study, includes facilities and infrastructure, residential areas, industries and warehouses, offices/commercial and service areas, open spaces (green open spaces, cemeteries, plantations, agriculture, and vacant land), as well as other designated uses. The land use data analyzed in this research is from the years 2008 and 2018, obtained from secondary sources based on literature studies. The selection of these two years is due to the limited availability of secondary data from previous research. The land use data for North Jakarta in 2008 and 2018 is presented in Appendix 1.

App. 1 illustrates the changes in land use in North Jakarta, highlighting the dominant use of land for residential purposes. In 2008, residential land covered approximately 5,708.6 hectares, but by 2018, it had decreased to 4,221.3 hectares. Similarly, open spaces, including green open spaces, cemeteries, agricultural land, and vacant land, initially covered 2,661.6 hectares but declined to 2,620.7 hectares by 2018. A significant shift occurred in industrial and warehousing land use, which expanded from 1,344.7 hectares in 2008 to 2,448 hectares in 2018.

Several factors contributed to these land use changes. Spatially, districts with direct access to the port and well-developed infrastructure, including connectivity to key activity centers and road networks, experienced the most significant transformations. The construction of the Jakarta Outer Ring Road (JORR) played a crucial role in driving land conversion, particularly in Cilincing District. The shift from agricultural to non-agricultural land, including vacant land and fishery areas, in Cilincing was driven by increasing land rent values. In urban environments, manufacturers and industrial firms are willing to pay higher land rents based on accessibility and land fertility. Areas with higher populations also tend to attract more diverse activities and facilities, further influencing land conversion trends.

Cilincing District underwent the most extensive transformation, primarily due to the expansion of industrial zones that leveraged its strategic location near the port and access to major road networks like the JORR. This phenomenon highlights the strong correlation between population growth, infrastructure development, and land conversion in urban areas (Meehan, 2014). Moreover, these land use changes have significant implications for coastal ecosystem sustainability in North Jakarta. Uncontrolled development can reduce green open spaces, increase flood risks, and weaken the city's resilience to climate change. Therefore, stricter and more strategic spatial planning regulations are necessary to ensure urban growth does not come at the cost of environmental sustainability. Implementing ecological approaches, such as preserving green spaces and integrating them with industrial land use planning, is crucial. Policymakers and stakeholders must collaborate to develop strategies that balance economic and infrastructure development with environmental conservation.

The increasing rate of urbanization in North Jakarta also presents social challenges, including the expansion of slum areas and unequal access to urban facilities. To address these issues, spatial planning must prioritize a balanced distribution of functional spaces and the integration of residential areas, industrial zones, and public spaces. An urban development approach that incorporates social, economic, and environmental sustainability principles can help North Jakarta become more resilient to urban pressures while maintaining a high quality of life and environmental integrity.

At the ecological community level, the process of selection depends on functional differences between species and among individuals of the same species. These differences influence how each species interacts with its environment and with other species it encounters. Selection can be constant—when the capabilities of an individual within a species remain unchanged and interspecies differences occur consistently—or density-dependent, where an individual's capabilities within a species are influenced by the density of its own species and/or other species within the community. Whether constant or density-dependent, selection can also vary across space and time (Parris, 2016).

An ecological niche is a multidimensional environmental space where a species can survive. The term "niche" was first introduced in ecology as a multidimensional environmental space in which a species can exist. Each spatial dimension represents an environmental variable or resource relevant to the species in question, making it a continuum or gradient (Huang et al., 2023).

An environmental gradient refers to a systematic variation in abiotic factors across space, often manifesting as gradual changes in specific environmental conditions, such as temperature and precipitation gradients. McDonnal & Pickett (1990) first introduced the concept of the rural-urban gradient, which posits that urban and rural areas occupy opposite ends of a continuum of human impact on the Earth and its ecosystems. Viewing urbanization as a gradient rather than a simple binary classification (urban or non-urban) marked a significant advancement in urban ecology. The rural-urban gradient is often complex, representing a range of environmental variables that change across space as one moves from urban to rural environments.

Habitat models are conceptual or statistical models that link response variables (such as the likelihood of species occurrence, species abundance, or the richness of an ecological community) to one or more environmental variables. Conceptual habitat models, commonly known as habitat suitability indices, can be developed with minimal or no field data, instead relying on expert opinions to determine the relationships between target species or communities and the environmental variables affecting their distribution.

Habitat models can also be used to identify key environmental variables that influence the persistence of specific habitat types or ecological communities within urban landscapes. A case study illustrating this application includes the potential conversion of agricultural land on the outskirts of Beijing, China, into residential or industrial areas (Parris, 2016).

Ecological guilds refer to groups of sympatric species that exploit the same class of environmental resources (such as specific food types, shelter, or nesting sites) in a similar manner. Instead of considering all species within an ecological community as potential

competitors, categorizing sympatric species into guilds provides an effective approach to focus on groups with specific functional relationships. Species adapted to disturbed environments primarily forage in areas with dense vegetation, making them particularly sensitive to urbanization (Parris, 2016).

When two or more species with overlapping fundamental niches occupy the same geographical area, competition for resources often arises. This competition plays a significant role in shaping the actual distribution or realized niche of each species within the area. The competitive exclusion principle predicts that two species with identical fundamental niches cannot coexist indefinitely, as one species—the superior competitor—will eventually outcompete and exclude the other.

Ecological drift occurs when species abundance fluctuates randomly over time because species within the same ecological group are functionally equivalent, or because specialized species with small population sizes go extinct due to demographic stochasticity. Although not all species within a community are ecologically equivalent, drift may occur among neutral species within a larger community.

Ecological drift causes species abundance to fluctuate randomly, reducing biodiversity within communities and increasing differences among equivalent communities. In the neutral theory of species diversity, ecosystem composition evolves without selection. Randomly lost species niches can be filled by similar existing species, newly evolved species, or species migrating from other regions. Climate change can accelerate the process of species shifts (Parris, 2016).

According to Law Number 26 of 2007, Article 1, Paragraphs (2, 3, and 4), spatial planning is defined as the manifestation of spatial structures and spatial patterns. Spatial structure refers to the arrangement of settlement centers and infrastructure systems that support socio-economic activities within a hierarchical functional relationship. Meanwhile, spatial patterns involve the distribution of land use within a region, encompassing areas designated for conservation functions and areas allocated for cultivation functions.

Spatial planning is structured at national, regional, and local levels. At the national level, it is formulated as the National Spatial Plan (RT/RWN), which is then elaborated into the Provincial Spatial Plan (RTRWP) and further detailed into the City Spatial Plan (RT/RWK). In a broader sense, spatial planning encompasses the integration and harmony of land use, water use, air use, and resource allocation through coordination and conflict resolution efforts among different interests.

According to Law Number 26 of 2007, spatial planning is an engineered approach or method for regulating spatial development in the future. Spatial planning involves the processes of spatial planning, space utilization, and spatial use control. Meanwhile, spatial planning itself is a process of determining spatial structures and patterns, including the formulation and establishment of spatial plans.

Hamid Shirvani (1985) stated that every urban design must consider existing design elements to ensure that a city possesses a clear and distinctive character. There are eight key elements that shape a city, particularly its central areas: land use, building form and massing, open space, parking and circulation, signage, pedestrian pathways, activity support, and preservation. These elements collectively contribute to the functionality and aesthetic appeal of urban spaces, ensuring a balance between development and sustainability.

Land use must take into account or adapt to issues related to urban development. Zoning ordinances serve as a practical and beneficial control mechanism in urban design. The primary emphasis is on three-dimensional aspects, particularly the harmonious relationship between buildings and the quality of the environment. This principle forms the foundation of urban spatial planning, ensuring that development is well-structured, sustainable, and conducive to a balanced urban ecosystem.

Population refers to all individuals residing within the geographical territory of the Republic of Indonesia who have lived there for at least six months or intend to settle permanently even if they have been there for a shorter period (BPS, 2023). Population

density is defined as the number of people in a province, regency, or city divided by the land area in square kilometers (Wardani & Wahono, 2020).

In Indonesia, population density has consistently increased over the years. The rising population growth leads to an increasing demand for land as a space for human activities (Noeraga et al., 2020). The growing population also drives a greater need for primary necessities such as food, water, and other essential resources. Additionally, urban development intensifies as cities expand to accommodate the increasing number of inhabitants.

4. Conclusions

The increasing population in North Jakarta has significantly impacted land use and spatial planning in the region. Research findings indicate that rapid population growth, particularly in areas such as Cilincing and Penjaringan, has driven large-scale transformations of open land and agricultural areas into industrial zones and residential developments. The primary driver of this land conversion is the high demand for space to accommodate population growth and the rapidly expanding economic activities.

With the development of infrastructure, such as toll roads and the proximity to Tanjung Priok Port, North Jakarta has become a strategic hub for industrial and warehousing activities. This has led to a shift in land use dominance, with industrial areas expanding significantly while green open spaces are diminishing. Although this growth provides economic benefits, its environmental impact is substantial. The reduction of green open spaces weakens the city's capacity to mitigate flooding and climate change, while also diminishing the quality of life for local residents. Therefore, more sustainable spatial planning policies are needed to balance development needs with environmental conservation.

The success of spatial planning in North Jakarta will heavily depend on the integration of policies involving the government, private sector, and the community. Planned development that considers social, economic, and environmental aspects can make North Jakarta a model of a sustainable coastal city amid the pressures of rapid urbanization.

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Appendix 1. Land Use in North Jakarta City in 2008 and 2018 in Hectares

No	Sub-district	Facilities & Amenities		Settlement		Industry & Warehousing		Office, Trade and Services		Open Space (RTH, Cemeteries, Agriculture and Vacant Land)		Other Uses	
		2008	2018	2008	2018	2008	2018	2008	2018	2008	2018	2008	2018
1	Penjaringan	132.18	140.77	1497.5	993.8	173.28	463.74	252.84	177.11	420.18	591.94	435.49	584.51
2	Pademangan	105.34	137.44	532.17	300.24	136.18	149.44	150.3	110.65	138.12	177.82	11.09	150.3
3	Tanjung Priok	186.08	131.87	1,327	871.11	282.26	518.69	17.12	154.41	98.30	169.97	111.25	83.63
4	Koja	142.99	117.95	723.83	533.59	75.397	215.09	21.68	67.25	67.75	90.12	4.35	24.85
5	Kelapa Gading	134.73	132.43	843.99	646.35	203.58	144.71	9.74	171.87	122.91	225.77	129.01	21.85
6	Cilincing	37.05	344.37	784.09	876.21	47404	956.29	9.28	54,328	1,814.3	1,365.1	581.55	175.44
Total		748.37	1,004.8	5,708.6	4,221.3	1,344.7	2,448	460.99	735.62	2,661.6	2,620.7	1,272.8	1,040.6

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