

한-아세안(신남방) 스마트도시수출 거점 HUB

GU&I R ISSUE PAPER

No. 15

2023. 10. 15

[기본연구] 자카르타 철도기본계획과 인도네시아 스마트도시 기술수요

자카르타 철도기본계획과 인도네시아 스마트도시 기술수요

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ABSTRACT

Over the past decade, Indonesia has demonstrated a remarkable commitment to infrastructure development, allocating a substantial US\$ 210 billion from 2014 to 2023, with plans for an additional US\$ 27.3 billion in the 2024 state budget. The emphasis on railway infrastructure, particularly in Jakarta and the JABODETABEK agglomeration, showcases a forward-thinking approach to enhancing national transportation infrastructure, recognized as a transformative catalyst for mobility. This paper explores the relationship between the railway master plan and the urban layout of Jakarta and Greater Jakarta. With a focus on lines extending beyond Jakarta City, the analysis aims to offer insightful perspectives and proposes a refined set of prioritization criteria for each railway line. The comprehensive examination of the railway master plan underscores its alignment with the urban sprawl of the JABODETABEK area, indicating a thoughtful approach to extending services where needed most.

Acknowledging Indonesia's fiscal constraints, the government must find sustainable solutions for financing the expansive railway master plan. A content analysis of urban sprawl, city center locations, and 2019 commuter ridership informs a prioritization framework. Line 8, strategically aligned with the urban sprawl and southern cluster ridership, takes precedence, followed by three east-west axis lines—Line 2, Line 5, and Line 6. An Outer Loop Line is proposed for connectivity, prioritizing the Jakarta area, followed by the west and east sides in a sequential construction approach. This research contributes valuable insights for optimizing infrastructure development in the face of rapid urbanization.

인도네시아는 지난 10년간 인프라 개발에 대한 놀라운 약속을 보여주었습니다. 2014년부터 2023년까지 2,100억 달러를 할당했으며, 2024년 주 예산에 273억 달러를 추가로 할당할 계획입니다. 특히 자카르타와 JABODTABEK 집적지에서 철도 인프라에 대한 강조는 이동성의 혁신적인 촉매제로 인식되는 국가 교통 인프라 개선을 위한 전향적 접근 방식을 보여줍니다.

이 논문은 자카르타와 그레이터 자카르타의 철도 기본 계획과 도시 배치 사이의 관계를 탐구합니다. 자카르타 시를 넘어 연장되는 노선에 초점을 맞춘 이 분석은 통찰력 있는 관점을 제공하는 것을 목표로 하며 각 철도 노선에 대한 정제된 우선순위 기준 세트를 제안합니다. 철도 기본 계획의 포괄적인 검토는 자보데타벡 지역의 도시 스프롤 현상과 일치하는 것을 강조하며, 가장 필요한 곳에서 서비스를 확장하기 위한 사려 깊은 접근 방식을 나타냅니다.

인도네시아의 재정적 제약을 인정하고, 정부는 확장적인 철도 기본 계획에 자금을 조달할 수 있는 지속 가능한 해결책을 찾아야 합니다. 도시 스프롤 현상, 도심 위치 및 2019년 통근자 탑승률에 대한 내용 분석을 통해 우선순위 프레임워크를 알 수 있습니다. 도시 스프롤 현상과 남부 클러스터 탑승률에 전략적으로 정렬된 8호선이 가장 우선적이고, 동서축 3개 노선인 2호선, 5호선, 6호선이 그 뒤를 이었습니다. 순차적 건설 방식으로 자카르타 지역을 우선시하는 연결성을 위해 외부 루프 라인이 제안됩니다. 이 연구는 급속한 도시화에 직면하여 인프라 개발을 최적화하는 데 유용한 통찰력을 제공합니다.

In the course of the past ten years, Indonesia has made remarkable progress in infrastructure development, exemplified by the deployment of a substantial US\$ 210 billion from 2014 to 2023 [4], with plans for an additional allocation of US\$ 27.3 billion from the 2024 state budget (APBN) [5]. This unprecedented level of financial commitment underscores Indonesia's robust dedication to advancing its infrastructure and fostering national progress.

A pivotal element of this developmental momentum is the prioritization of railway infrastructure, recognized as a trans-formative catalyst for enhancing mobility. The government's strategic focus on railway projects, particularly in Jakarta and the extensive JABODETABEK agglomeration (encompassing Jakarta City and its satellite cities), reflects a forward-thinking approach to fortifying the country's transportation infrastructure.

Within the broader context of urban development, railway infrastructure emerges as a crucial component, operating as a sophisticated extension of pedestrian networks designed to seamlessly accommodate city mobility. It serves not only as the point of origin and destination for urban commuters but also exerts a considerable influence on the overall urban layout of the city. This comprehensive perspective highlights the interconnectedness of transportation and urban development.

The significance of Jakarta City and the JABODETABEK agglomeration becomes evident in the substantial commuter population, exceeding 3.2 million individuals, as reported by Badan Pusat Statistik (BPS) [2]. This staggering figure underscores the critical role that efficient railway systems play in shaping the daily lives and spatial dynamics of Jakarta and Greater Jakarta residents.

This research paper aims to thoroughly explore the relationship between the railway master plan and the urban layout of Jakarta and Greater Jakarta. Through a detailed examination of the railway master plan, with special consideration given to lines extending beyond Jakarta City's perimeter, the analysis aims to provide insightful perspectives. Furthermore, the conclusion of this study will propose a refined set of prioritization criteria for each railway line within the comprehensive master plan for Jakarta and Greater Jakarta, contributing valuable recommendations to inform and optimize ongoing infrastructure development initiatives.

Jakarta, officially known as DKI Jakarta or "Daerah Khusus Ibukota" Jakarta, translates to the Special Capital City Region of Jakarta. Positioned as a province, it shares borders with Banten and Jawa Barat Province. The broader metropolitan area encompassing Jakarta City is commonly referred

to as JABODETABEK, an acronym representing Jakarta, Bogor, Depok, Tangerang, and Bekasi, all situated within the provinces of Banten and Jawa Barat.

Recognized as a hub of constant movement, Jakarta stands out as a city characterized by its dynamic nature. According to data from the Statistical Center of Indonesia (BPS) in 2019 [2], the city hosted a staggering daily commuter population exceeding 3.2 million. This figure, however, experienced a temporary decline during the COVID-19 pandemic but has been on the rise in the post-pandemic period.

It's noteworthy that the commuting activity extends beyond the informal term of Jakarta itself, encompassing the entirety of the Greater Jakarta area, or JABODETABEK. The resurgence of commuter mobility post-COVID-19 indicates a revival of the city's vibrant economic and social life, as the movement is not restricted solely to Jakarta but involves the interconnected urban structure of the entire JABODETABEK region.



[Fig. 1] JABODETABEK and Cross Province Border

3.1. JABODETABEK, The Greater Jakarta

As outlined in section 2.1, the term JABODETABEK designates an inter-provincial region, forming an acronym that encompasses Jakarta, Bogor, Depok, Tangerang, and Bekasi. Taking a closer look, JABODETABEK comprises a total of 13 distinct administrative cities. The Jakarta province includes five cities, while Tangerang and Bekasi boast three and two areas, respectively. Contributing to the composite region, Depok has 1 area and Bogor has 2 areas.



[Fig. 2] JABODETABEK and list of administrative cities.

The DKI Jakarta province is further divided into five separate cities based on their geographical locations: Central Jakarta, North Jakarta, West Jakarta, East Jakarta, and South Jakarta. Each of these urban centers operates under distinct administrative and jurisdictional frameworks, collectively referred to as "Kota" or City. Consequently, DKI Jakarta was formed by consolidating these five major cities, establishing a distinctive province that serves as the capital of Indonesia.

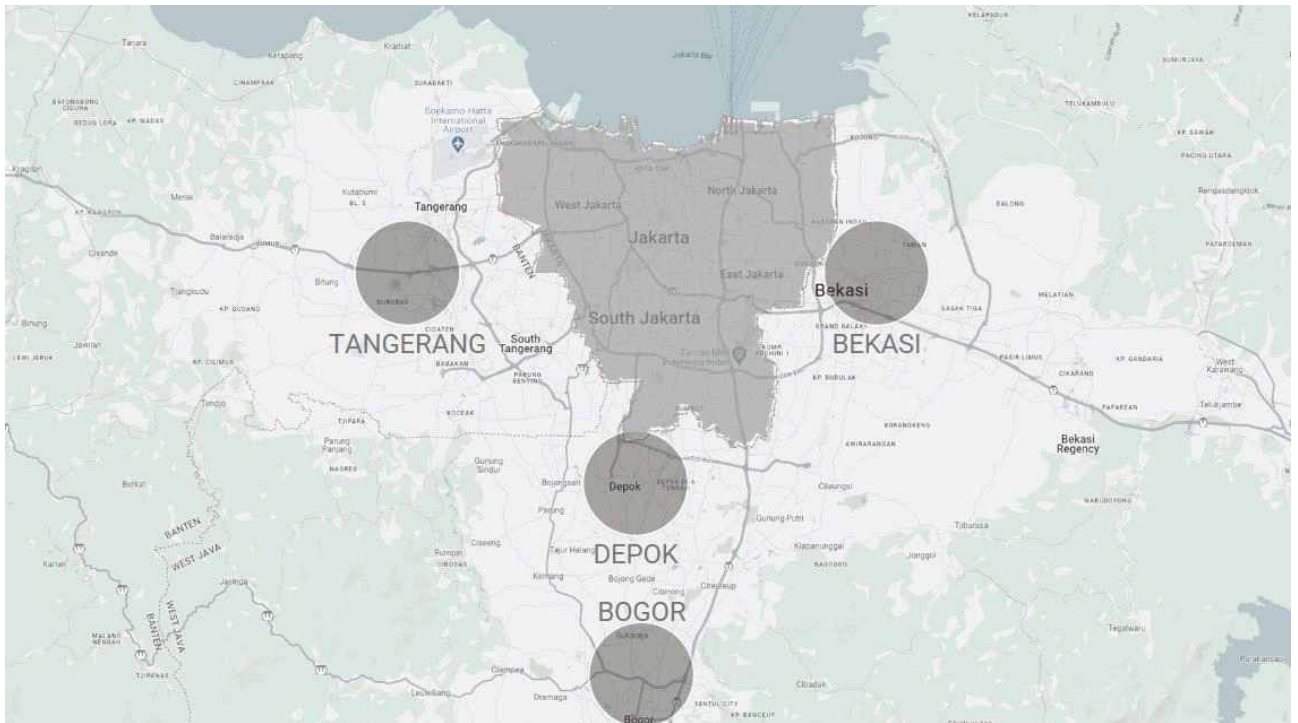
In contrast, other regions employ varied administrative structures. Referred to as "Kabupaten" or regency in English, these areas typically boast larger land areas, but lower population densities compared to cities. Distinct from urban centers, Kabupaten areas across Indonesia generally operate with a smaller annual budget, given their predominant residential land use.

Shifting to specific locations, the Tangerang region, positioned to the west of Jakarta's provincial border, comprises three sub-administrations: Tangerang City, South Tangerang City, and Tangerang Regency. On the southern border of Jakarta, three distinct areas emerge: Depok City, Bogor City, and Bogor Regency. Meanwhile, the Bekasi area, situated to the east of Jakarta, encompasses two different zones: Bekasi City and Bekasi Regency.

3.2. Regional Urbanization

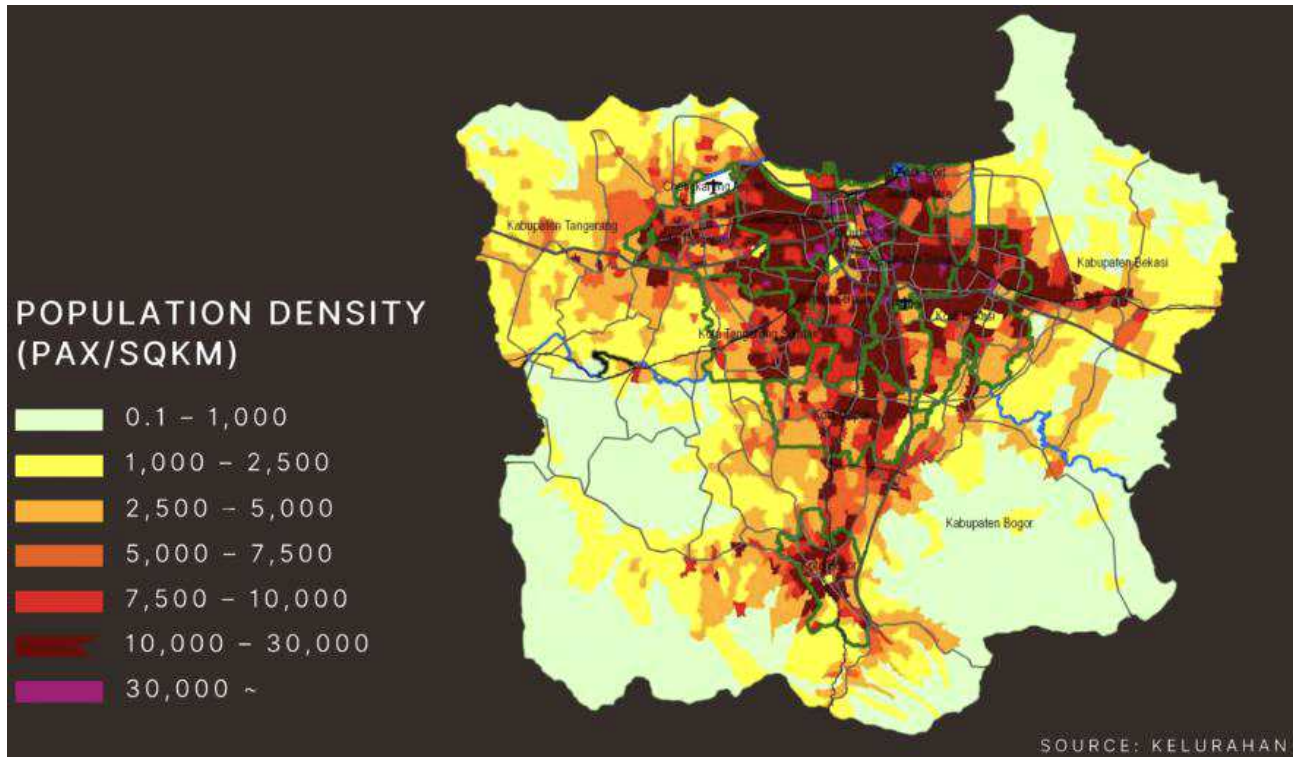
In the theories related to regional urbanization, the growing population in a city renders it increasingly unaffordable, prompting a cyclical pattern where the city undergoes densification, subsequently compelling inhabitants to relocate beyond its traditional borders. This leads to an outward expansion of the city's coverage area, encroaching upon regions outside its established limits.

The initial development of the Jakarta Provincial area preceded that of four adjacent regions, commencing within inner Jakarta and culminating in the establishment of four distinct cities: Bogor, Depok, Tangerang, and Bekasi. These were strategically designated as satellite cities in the initial phase of regional urbanization. Bogor City was positioned approximately 60km south of Jakarta, while Depok City emerged around 30km from Jakarta, strategically positioned between Bogor City and the capital. In the west, the Tangerang area extended about 31km from Jakarta, and to the east, Bekasi City was established approximately 24km away.



[Fig. 3] JABODETABEK regional urbanizations

In the contemporary phase of the JABODETABEK scenario, the trajectory of broader regional urbanization is influenced by several catalysts. This expansion is not confined solely from the Jakarta Provincial area but also originates from four pinpoint locations. The Jakarta Provincial area, functioning as the agglomeration core, along with Tangerang City, Depok City, Bogor City, and Bekasi City, collectively serve as the focal points for regional urbanization. Consequently, simultaneous urbanization from these five city centers results in a sprawling interconnected network encompassing the Jakarta Provincial area.



[Fig. 4] Urban sprawl of JABODETABEK

An analysis of the urban sprawl illustration above reveals that the density expansion in JABODETABEK predominantly follows an east–west orientation. While density is also observed to the south, the catalyzing role of Bogor City in regional urbanization, along with its greater distance from other cities, concentrates the urban sprawl more significantly along the east–west axis.

IV

Infrastructure Development in Jakarta

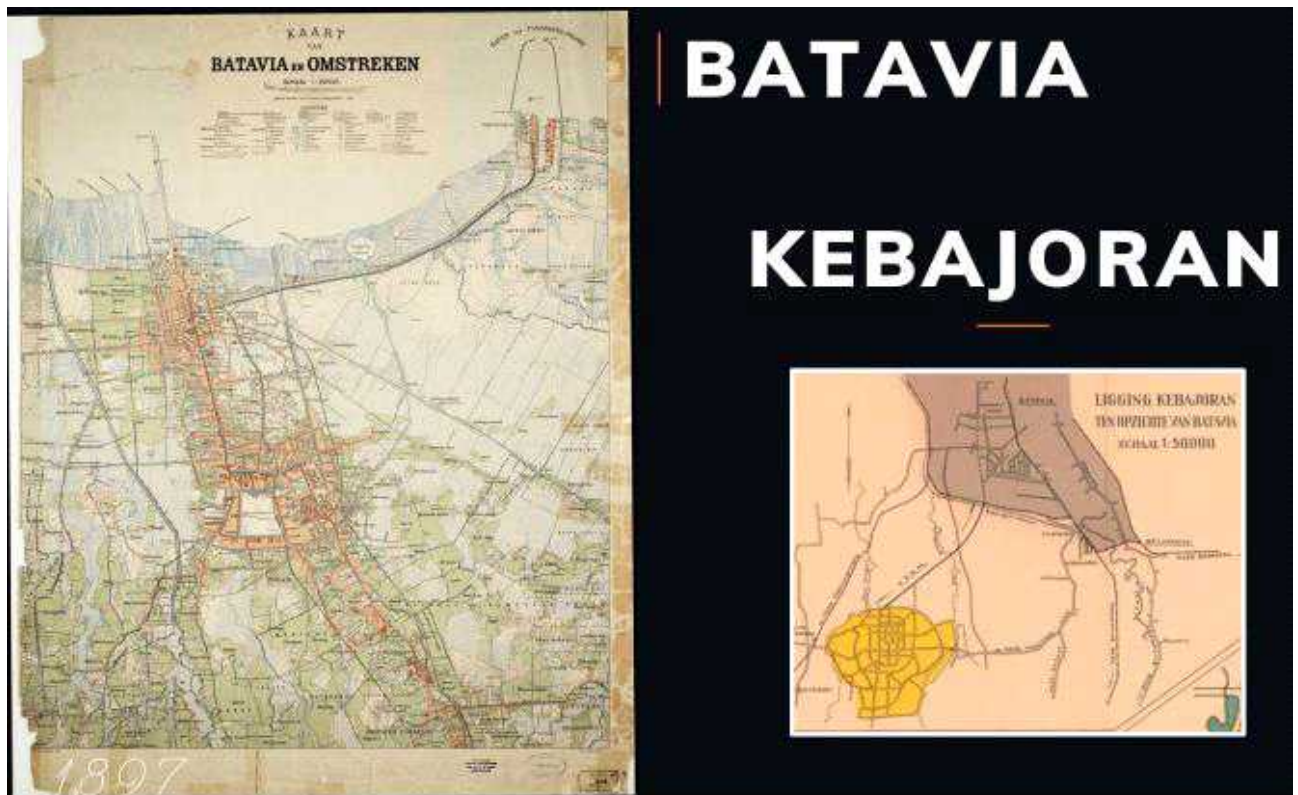
Jakarta, historically functioning as a vital port city, has played this role since its establishment. Its origins trace back to the colonial era when, in the year 1897, it bore the name Batavia. Throughout this period, Jakarta served as a pivotal hub for extensive supply chain management in the Asia–Pacific region. This encompassed not only its fundamental role as a maritime gateway but also as a strategic center for overseeing the intricate logistics and trade networks that spanned the diverse and expansive territories within the Asia–Pacific realm. The city's prominence as a port and its integral role in supply chain dynamics during the colonial era significantly contributed to shaping its historical and economic significance.

4.1. North–South Development

As explained in section 2.3, Jakarta's origin as a port city dictated the initiation of urban development in North Jakarta. The expansion radiated from the seaport towards the southern direction, progressively moving away from the coastline. Simultaneously, amid this period of

unrestrained urbanization, the establishment of Kebajoran, a new satellite city, took place. Positioned approximately 4.5km from the central city of Batavia, Kebajoran emerged in response to the spatial challenges posed by unchecked urban growth.

Importantly, the city of Kebajoran was meticulously planned with the fundamental concept of a "Garden City." This urban planning approach aimed to infuse green spaces and a harmonious balance between nature and development, embodying a vision of sustainable and aesthetically pleasing urban living.



[Fig. 5] Ommelandden, Batavia and Kebajoran

Additionally, the government made a deliberate decision to strategize the infrastructure development between the two city centers. In order to enhance mobility and accessibility between these urban areas, a network of roads and bridges was implemented to establish connectivity. Subsequently, this marked a pivotal shift in the orientation of infrastructure and urban development, aligning along a North-South axis.

Furthermore, in Bogor in the year 1950, significant development occurred with the establishment of one of the six Indonesian Presidential Palaces. This event not only held political significance but also served as a catalyst for further development, steering the trajectory of growth further southward. The establishment of the Presidential Palace in Bogor played a crucial role in shaping the southern direction of development and influencing subsequent urban planning endeavors.

4.2. MRT Jakarta

In 2019, Jakarta City achieved a significant milestone with the inauguration of its first modernized railway system. As the most densely populated city in Indonesia, Jakarta's residents have long sought an effective public transportation solution to address the persistent issue of congestion. The advent of MRT Jakarta not only played a pivotal role in revitalizing the urban public infrastructure landscape but also left a lasting impact on the daily lives of Jakarta's inhabitants, despite its modest 16-kilometer length and 13 stations.

Beyond merely facilitating residential mobility, the establishment of MRT Jakarta has emerged as a catalyst for infrastructural development within the city. Notably, the presence of MRT stations has acted as a magnet, drawing a substantial influx of people to the surrounding areas. For instance, Thamrin Station, a key station along the MRT Jakarta Phase 2 north-south line, witnessed a remarkable demand of more than 300,000 Peak Hour Peak Destination Traffic (PHPDT). The initiation of construction brought about significant enhancements in the vicinity, ranging from the implementation of pedestrian-friendly zones to the initiation of underground interconnections linking the station to other public buildings.



[Fig. 6] Jakarta's transportation infrastructure

Numerous railway lines were proposed in the Railway Masterplan for Jakarta. However, in 2013, the Jakarta government made a noteworthy decision to prioritize the construction of the North-South line as the city's inaugural railway line. This decision is particularly intriguing in light of the information presented in section 2.2.2, which highlights that the urban sprawl of the JABODETABEK region is predominantly characterized by an east-west axis.

4.3. Railway Masterplan for Jakarta and Greater Jakarta

Similar to urban planning, the development of a city's railway system necessitates a comprehensive master plan. This is crucial not only because railway infrastructure is an integral part of urban development but also because it demonstrates a strong commitment to society by providing tangible plans for enhancing city infrastructure. In the case of Jakarta City, the government unveiled the latest railway master plan in 2018 [1], which has undergone multiple updates to address issues such as outdated urban growth situations, land disputes, and institutional challenges. As of now, the ongoing study of railway master planning reflects a dynamic process of adaptation to the evolving needs and circumstances.



[Fig. 7] Draft of JABODETABEK railway masterplan [1]

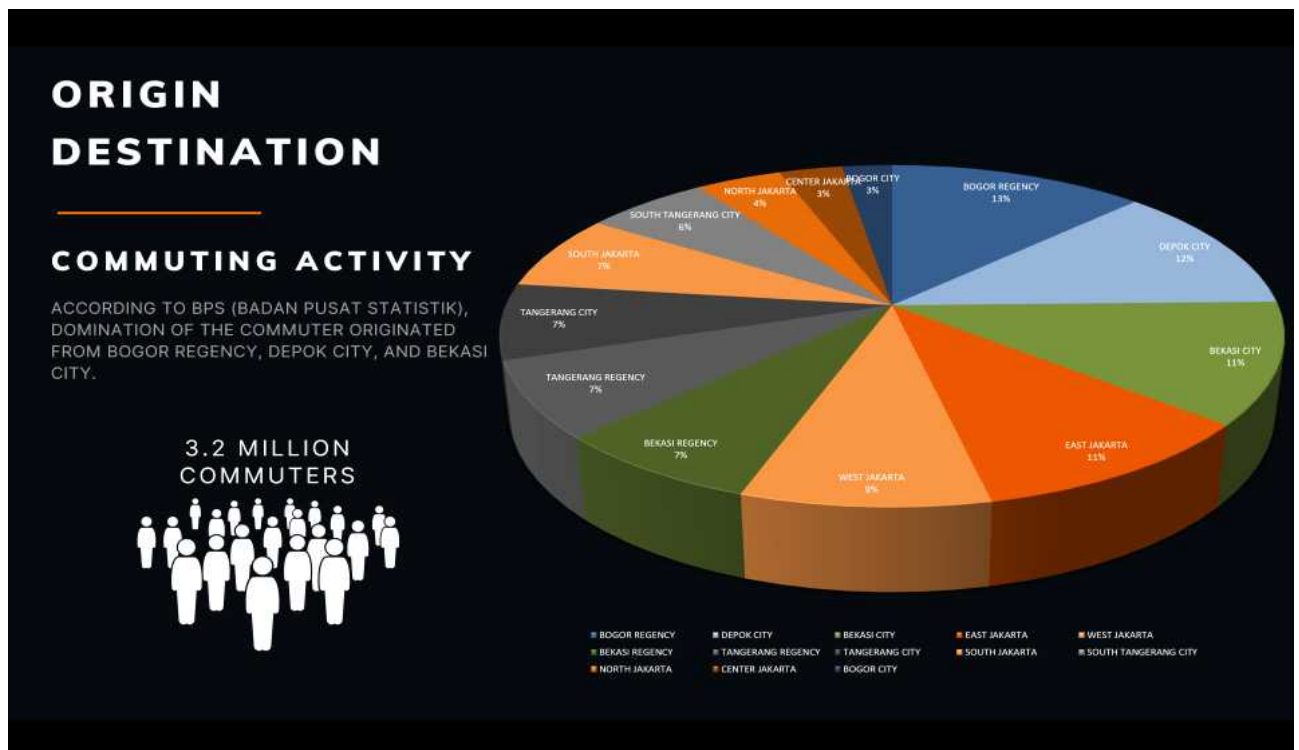
The most recent iteration of the urban railway master plan for JABODETABEK outlines the inclusion of 10 distinct MRT lines. The primary objective of this planning initiative is ambitious, aiming to establish a total of 425.5 km of MRT lines throughout JABODETABEK. Presently, however, the region only boasts 16 km of railway lines, highlighting a substantial gap between the current state and the ultimate goal. Given the prevailing traffic congestion in Jakarta and the greater Jakarta area, coupled with the enthusiasm of the local population, there is an urgent need for a more concrete and expeditious execution plan to realize the envisioned railway development.

[Table. 8] Table of railway lines in JABODETABEK [1]

LINE	LOCATION	ORIENTATION	LENGTH (KM)
Line 1	Lebak Bulus – Kampung Bandan	North – South	23
Line 2	Cikarang – Balaraja	East – West	87.3
Line 3	Kota – Soekarno-Hatta Airport Terminal	East – West	24.4
Line 4	Fatmawati – Marunda	North – South	37.8
Line 5	Karawaci – South Cikarang	East – West	66.7
Line 6	Lebak Bulus – Karawaci	East – West	33.6
Line 7	Bekasi City North-South Line	North – South	13.6
Line 8	Pluit – Depok	North – South	38.3
Line 9	Outer Loop Line	Circular	63.1
Line 10	Inner Loop Line	Circular	37.9

4.4. Origin Destination

As explained in section 2.1, according to Badan Pusat Statistik (BPS) [2], an Indonesian statistics institution, there were more than 3.2 million people who commuted in the JABODETABEK area during the year 2019. The number stopped growing during the COVID period, but now it has reached a peak number again and the number keeps growing. It is very unfortunate up until now, the data for 2023 has not been released yet by the BPS, but it will be periodically updated with the closest one being during the year 2024.



[Fig. 8] Draft of JABODETABEK railway masterplan [2]

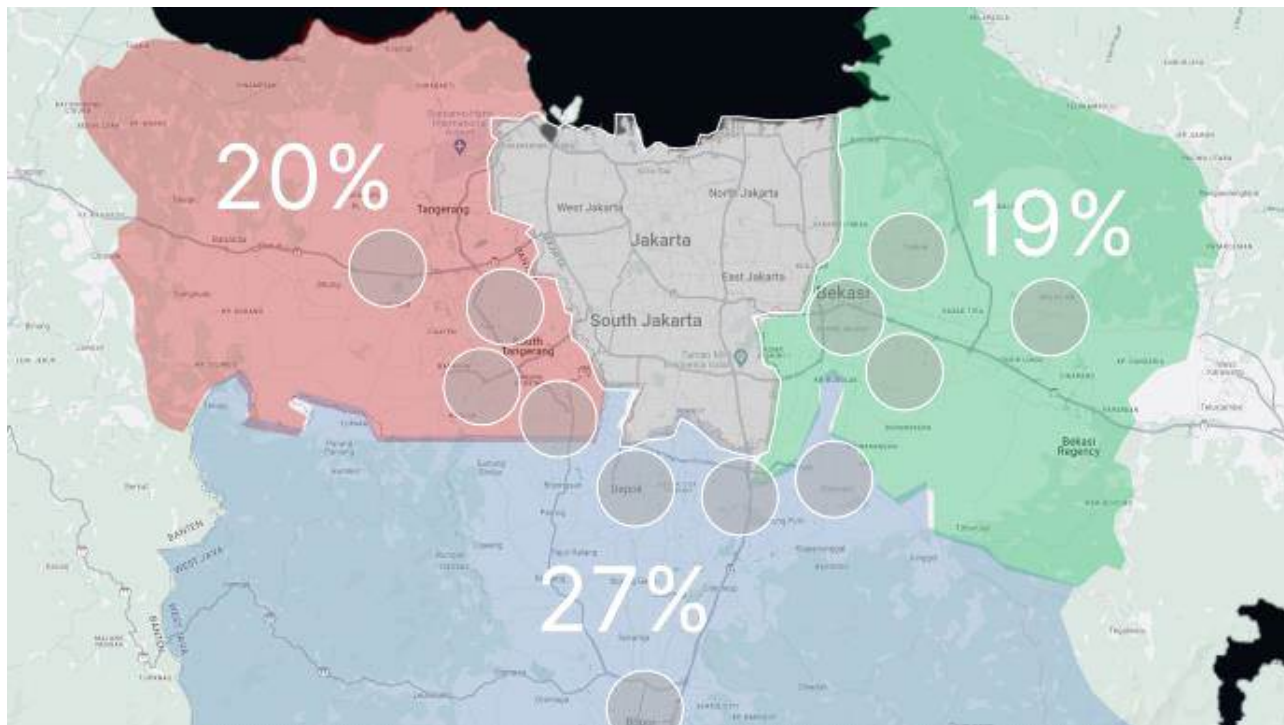
To provide a more detailed breakdown of commuter statistics, Bogor City recorded the lowest origin area with 80,325 commuters, while the highest number of commuters originated from Bogor Regency, totaling 408,874 individuals. Additionally, according to the pie chart depicted in Figure 8, Depok City claimed the second-highest position, with a commuter count of 395,093. This visual representation underscores that, in 2019, the southern areas of Jakarta predominantly dominated the ridership landscape, as evidenced by the commuter figures.

[Table. 9] Commuters in JABODETABEK [2]

AREA	COMMUTERS
Central Jakarta	100,692
North Jakarta	137,956
West Jakarta	283,069
East Jakarta	341,591
South Jakarta	231,383
Bogor City	80,325
Bogor Regency	408,874
Depok City	395,093
Tangerang City	234,137
Tangerang Regency	236,284
South Tangerang City	197,168
Bekasi City	373,125
Bekasi Regency	240,197
TOTAL	3,259,894

When the data is reorganized based on zoning and the dispersity of population density, intriguing perspectives emerge. Categorizing commuters into three zones—East Zone, West Zone, and South Zone—reveals that the east–west zone axis continues to dominate, accounting for 39% of commuters. In contrast, the South Zone stands out as a single-handed contributor with 27% of commuters. This zoning approach proves to be valid, considering the linear functionality of railway ridership. The lines extending to Bekasi Regency, for instance, are shared with Bekasi City, indicating a linear operational pattern. Consequently, the railway lines operate along the east–west axis, contingent upon the ultimate destination of each line.

Furthermore, the Bekasi region and Tangerang region are poised to collaborate in a collective manner, as they function along the same axis—the east–west axis. This interconnectivity underscores the significance of regional alignment in shaping the commuting patterns and overall effectiveness of the railway network.



[Fig.9] Commuters zoning

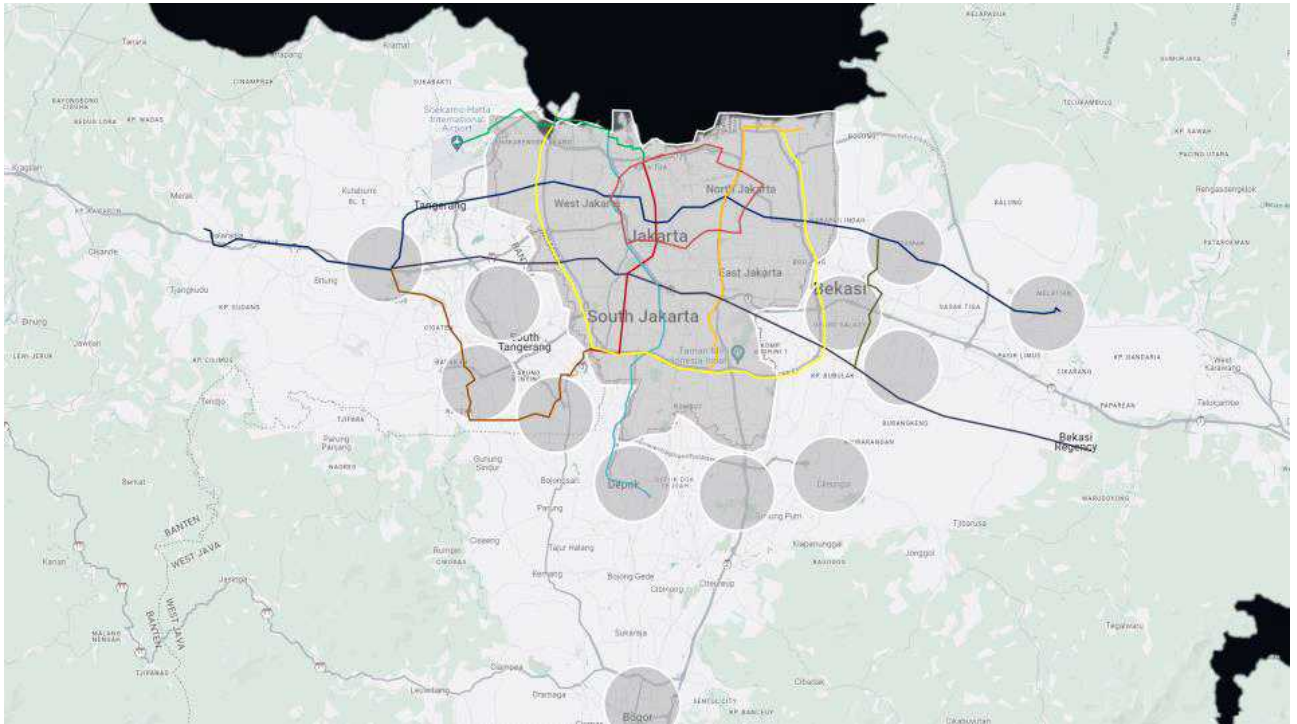
V Conclusion

5.1. Service Coverage

The service coverage of the railway lines has effectively extended to strategically located areas with high population density. Virtually all city centers or regions characterized by significant population density are encompassed by the lines. While there are inevitably some areas that remain uncovered, this absence is not attributed to any misalignment with the orientation of the lines. Upon analysis, it becomes evident that the orientation of the railway master plan aligns seamlessly with the urban sprawl of the JABODETABEK area. This synchronization underscores a thoughtful and deliberate approach to extending railway services to areas where they are most needed, contributing to a well-coordinated urban transportation network.

5.2. Recommendation of Priority Line

As elucidated in the Introduction, Indonesia's robust appetite for infrastructure development underscores the significance of judiciously managing the national budget, which cannot be taken for granted. Considering Indonesia's fiscal space, with a Gross Domestic Product slightly above 1.1 trillion US\$, the government faces the imperative of finding sustainable solutions to finance, plan, and execute the expansive railway master plan.



[fig. 10] Lines coverage and city centers on the JABODETABEK

Informed by a content analysis of factors such as urban sprawl, city center locations, and commuter ridership in 2019, a prioritization framework for the railway lines emerges. Line 8 takes precedence, given its strategic location aligning with the urban sprawl and the predominant ridership in the southern cluster of JABODETABEK. Subsequently, three east–west axis lines—Line 2, Line 5, and Line 6—are prioritized together. Following this, an Outer Loop Line is proposed to act as an intersection facilitating connectivity between each line.

Recognizing the high mobility within Jakarta Province's perimeter, prioritizing the construction sequence emphasizes urgency. The initial focus is on the area within Jakarta, followed by the western side, with the east side slated for development last. This sequential approach ensures a methodical and efficient rollout of the railway lines, addressing the immediate needs of high–mobility areas first before extending to peripheral regions.

References

- [1] Peraturan Presiden Republik Indonesia, Rencana Induk Transportasi Jakarta, Bogor, Depok, Tangerang, dan Bekasi, Presiden Republik Indonesia, (2018) Available from: 2018
- [2] Badan Pusat Statistik, Statistik Komuter Jabodetabek, Hasil Survey Komuter Jabodetabek (2019) Available from: 2019
- [3] <https://www.statista.com/statistics/1147908/indonesia-government-infrastructure-budget>, Dec 1 (2023)
- [4] <https://www.pwc.com/id/en/media-centre/infrastructure-news/november-2023/2024-infrastructure-development-will-be-accelerated.html>, Dec 1 (2023)