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RESEARCH ARTICLE

Road Transportation Development and Land Use Changes in Semarang City, Central Java, Indonesia

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Abstract. This research aims to make a historical mapping of the development of road infrastructure and the impact on land use changes. A historical analysis was conducted based on the documents and reports of transportation development, road construction, and urban planning in Semarang City, the capital city of Central Java, Indonesia. From a historical perspective, the transportation development and the land use change of Semarang City were determined by economic activities from the early period of colonialism, especially when this city was devoted as a port city in Java with massive coastal inhabitants. Along with this economic activity, ports and roads were built, accelerating the city's development until the mid of 20th century. Road construction generated urban problems such as rapid urbanization, and environmental problems. Meanwhile, the road construction also accelerated the city agglomeration, connecting Semarang City with other cities on the Java North Coast. However, in the 1990s the symptom of the use of private transportation occurred in Semarang which became the most critical issue in the later periods.

1. Introduction

From historical data, road construction can be beneficial for rural or underdeveloped areas. Roads are needed to transport goods and people from rural areas to the city, and vice versa. On the contrary, in the case of a metropolis city and a port city, the expansion of road constructions can create urban problems, such as the expansion of squatter settlements, traffic jams, pollution, and other environmental damages. The problems of transportation in the port city come from the fact that it connects the hinterland area and the global market that creating a congested mobilization (Dick & Rmmer, 2003). A large scale of commodities from the hinterland are transported every day to the port city, waiting to be sent off for the global market or other areas. Along with this economic mobilization, industrialization, which mostly thrives near the port city, has accelerated urbanization. This pattern can be found in several port cities in Southeast Asia such as Semarang, Surabaya, Jakarta, Bangkok, Manila, and Kuala Lumpur.

In the case of Semarang City, the problem of road construction becomes more complex. In 2020, Semarang is the most populated city in Central Java, inhabited by 1.2 million people. As the capital city of Central Java, this city is also struggling to overcome urban problems such as the side effect of land use changes, natural disasters, urbanization, demographic issues, and developmental planning (Martono et al., 2022). Such as other big cities on the north coast of Java that are traversed by the *Jalan Pantai Utara* or Pantura (Java North Coast highway), Semarang City has experienced rapid development in the transportation sector (Suprapti et al., 2017; Trihatmoko et al., 2021). From a theoretical perspective, the core of transportation development is about facilitating the movement of a person or things with the shortest time and the least force from one area to another. Transportation development can be triggered by the willingness of society to improve the quality of social and political life of society or even as political and military strategies (Charles H. Cooley, 1894). From the socio-economic perspective, transportation development, such as in the form of road construction, indicates the efforts to improve the market, production, and consumption (Leksono et al., 2019; White & Senior, 1983). The development of transportation improves the mobility of things or people which contributes to social and economic progress (Pawson, 1979). Taaffe suggests that in understanding a city that is connected to other cities through transportation facilities, the development can be seen through two theoretical models, namely the theory of gravity and linkage models. Based on the theory of gravity model, it is stated that the development of a city can be seen by connecting two or more factors influencing the number of flows or interactions between two or more points, namely population, and distance. While, linkage, in the aspect of transportation geography, is defined as the relationship between one spatial point or place to another spatial point (Taaffe et al., 1996). For example, a city that is connected to another city. The relationship between these points is tied to a system called a network. The inter-spatial or spatial relationship model can be carried out with gravity and road network models. The land transportation system through the highway can connect between spatial points, namely a city with other cities, however, the empirical sources had shown the contradictory effects of transportation development (Howe, 2019). The development of transportation in some areas, especially in a developing country, had generated a negative impact such as social changes caused by migration, the changes in land use, and environmental degradation such

as deforestation in Amazonia, Africa, and Asia. Furthermore, the recent study of transportation has revealed that road constructions create marginalization and stigmatization of certain groups and also the fragmented narrative of road construction from local, national, and global levels (Alexis & Mikael, 2020).

One essential problem that should be considered is the relationship between the development of transportation and land use problems. Land use can be seen as the outcome of the activities and dynamics of human activity (Dimyati et al., 2021; Giuliano, 1995). The development of transportation needs land to be used. For example, the road construction along the Java North Coast has shifted the land use from mountains or farm areas to the toll road routes. Meanwhile, the changes in land use also can be found in the city such as the changes in the residential area for toll roads that change the order of the urban area. Transportation development has a mutual relationship with land use in which the development of transportation, networks, infrastructure, economic factors, and demographic factors can affect the industry and population of the city (Rietveld & van Nierop, 1995). The relationship can be explained in the concept of the transport land-use feedback cycle. The concept of the transport land-use feedback cycle explains that the increase in transportation can improve accessibility, activities, and urban development. Inside of the cycle, the endogenous effect in the form of an economic process, socio-demographic and cultural factors can drive the dynamics of the variables. The exogenous influence in the form of technological innovations, mobility policy, and infrastructure investment also plays an important role. Besides that, the accessibility and activities can also be affected by regional demand, spatial policy, land availability, and area attractiveness (Wegener & Fürst, 1999). Transportation development is closely associated with economic and population growth that leads to the conversion of land into industrial or residential areas. Those variables are moving dynamically in the cycle shaping complex mechanism (Giuliano, 2004). The development of transportation can attract increased productive resources such as the labor force and also social and environmental problems (Deng, 2013).

In the context of Indonesia, transport development and economic growth have several distinctive characteristics. First, the history of Indonesia showed a political and economic conjectural that impacts the ups and downs of transportation and road construction. It means the history of road construction does not move in a linear line. The early 20th century can be seen as the first peak of road construction when the Dutch Colonial Government, based on their political and economic interests, used roads to build an empire. However, after the end of World War II, most of the roads were destroyed and it took a long time to reconstruct the road at least until the 1970s to 1980s when the resurgence of national economic and investment activity (Huff & Angeles, 2011). Second, the direction of road construction in Indonesia should be perceived from local, regional, and global levels in which the roads themselves integrated Indonesia into Southeast Asia. There are strong connections between the hinterland and port cities at the regional and global levels, such as between the hinterland area, Semarang, and Singapore (Dick & Rimmer, 2003). Third, the impact of road construction in Indonesia can be paradoxical. The paradoxical impacts of the transportation system on economic and land use changes had been examined by several historians. Colombijn's research explained the relationship between the development of rods built at Pekanbaru to Dumai and the social and environmental changes on the Sumatra East Coast, Indonesia. (Colombijn, 2002). Another example can be found in the Java North Coast. The construction of the Groote Postweg from 1808 to 1811 supported the military, and later economy, of the colonialists but at the same time, many people were dead in the process of reconstruction (Hartatik, 2018). From those points of view, it can be highlighted that transportation development coincidences with social-economic developments, but it cannot be used generally to explain the pattern of global transportation development. Transportation development can generate a positive or negative impact on the social-economic, and political life of society. Those theoretical discussions provide a framework for analysis of the relationship between road construction, economic growth, land use, and environmental problems in Indonesia over time. Several determinant factors of transportation and development, such as political and economic interest, can be the main factors of transportation development in Indonesia. The result of transportation development can generate positive and negative impacts on society, for example, land use change or environmental problems. Therefore, it is necessary to examine the history of road construction, transportation development, and urban spatial change of Semarang from the Dutch Colonial to the New Order Era. A historical analysis will give reflection for the present and future projects of road construction particularly in answering the question about the long impact of road construction on the economic activity, land use, urban spatial changes, and environment of Semarang city and also Indonesia in general.

2. Methods

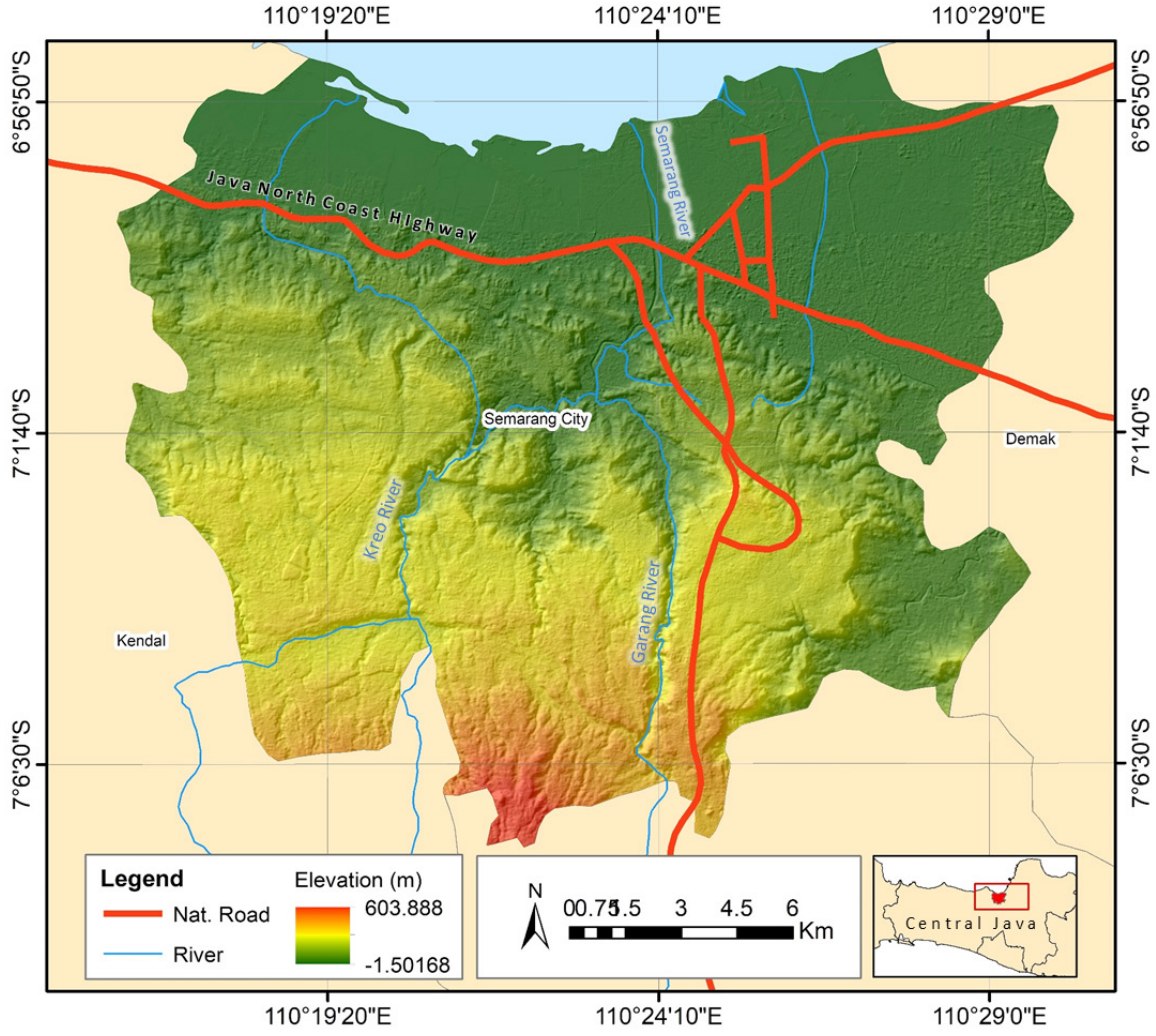
The historical sources were collected by digging the data from archives, documents, historical sites, and oral history related to the detailed data of the Java North Coast such as road construction, road maintenance, and road transportation mode (Wasino & Hartatik, 2017). The archives and documents were found in the Central Java Provincial Archives, the Library of Semarang City Development Planning Agency, and the Central Java Statistic Bureau Library. The documents were selected as the primary sources including the report of Semarang Central Bureau of Statistic (1968, 1971, 1973, 1977, 1982 1990), Semarang Dalam Angka (1971) as the official report of the city government, Jawa Tengah Dalam Angka (1983, 1985, 1988) as the official report of Provincial Government, and the data from Semarang District Police (1977). The data were analyzed based on qualitative and quantitative approaches. The field observation was conducted on the road of Java North Coast to draw the land use changes in the area of roads, settlements, the enclave of economic activity, and transportation systems such as the bus station. Oral sources were distinguished as the primary sources because they consisted of different perspectives and information aside from written sources (Purwanto, 2006). The life story interview based on the individual model had been made to the historical actors and people affected by the development of transportation systems, such as the policymakers, police officers, gas station officials, public transportation drivers, and food stall sellers (Slim, 1998). In the second stage, the data were interpreted through an analysis and synthesis approach to reconstruct the development of the transportation system in the Java North Coast area and its social and spatial changes in the 1970-1990s.

3. Result and Discussion

From the traditional ports to the Colonial City

The history of road construction and the city order changes of Semarang City can be traced back to the era of the traditional kingdom in the 15th century, especially when this city became the most important trade center for the economic activities of the traditional kingdoms. From the 15th to 16th century, Semarang City became one of the ports in the North Coast of Java organized by the hereditary local rulers under the reign of the Demak Kingdom (now presented as Demak Regency, a regency next to Semarang City) (Figure 1) and then the Mataram Kingdom (Hartatik, 2014). The commodities from the hinterland area in the interior of Java Island, such as rice and teak wood, were sent to Semarang through land or water transportation (Reid, 1988). The mobilization of goods, from the interior area to the coastal area, became the impetus of road construction and the city order of Semarang in the later periods. As the entrepot, the city order of Semarang City at that time was shaped by the economic activities of local people. Although no documents explained the map of the city, it can be assumed that the city order of Semarang before the seventeenth century was determined by economic and political patterns, which was similar to other ports in other areas of the archipelago such as in Aceh, North coast of Sumatra, and Banten, west coast of Java. The city plans uphold the natural landscape of Semarang City, which consisted of rivers and hills (Figure 1). There were markets, anchorage, settlements, bulwarks, royal palaces, and farms along the coast. The downtown of Semarang City was located near the Semarang River and its branches. The firth of the river could only navigate as far as 4 kilometers from the seashore, creating a pattern of ethnic settlement in Semarang. Besides the water transportation, there was a dirt road that connected the port to the interior area of the local rulers (Brommer et al., 1995).

When the Vereenigde Oost-Indische Compagnie (VOC) or the Dutch East India Company took over the North Coast Java, including Semarang, from the local kingdoms in the 17th century, the city order was gradually changed. Semarang was then appointed as headquarters of VOC on the Java North Coast. The city was then developed based on the political approach, particularly as the port city for regional and global military and trade activities. The VOC's headquarter was located in the middle area represented by the Governor Official building in Semarang Utara. To defend their position, VOC then built a fortress named Vijfhoek surrounded by wester-wal-straat, norder-wal-straat, ooster-wal-straat, and zuider-wal-straat. The citizens inhabited a settlement around the walled VOC's town. They built colonies based on ethnicities such as Javanese, Malays, and Chinese (Knaap, 2015). In the later periods, the European settlement started to widen to the south part of Vijfhoek. As a result, the Chinese settlement, which was colonized in the south part of the Vijfhoek after the Chinese War (1740-1742), was evicted to the riverside of Semarang River. On the eastern side of the Semarang River lies Javanese and Malay settlements. Meanwhile, on the west side a local representation from the Javanese kingdom, Mataram,



Figrue 1. Semarang City map with hills and rivers (Garang, Kreo, and Semarang)

was located near the Javanese settlement. To connect those settlements, roads were built on the western and eastern sides of Vijfhoek. Moreover, to support colonial activities, several roads were built to link the areas around the town and other cities on the North Coast of Java (Wasino et al., 2022). In 1705, there were several existing roads connecting Semarang with other areas such as Batavia, Surabaya, Surakarta, and Yogyakarta (Stevens, 1762). A passage from Batavia, the capital of the colonial government located on the west side of Java Island, to Semarang spent 10 to 14 days (Groenewold, 1989). Some of the roads were passable by horse carts but most of them were only small-dirt roads. From 1808 to 1811, Herman Willem Daendels expand the roads, connecting Anyer in West Java to Panarukan in East Java. The existing roads, especially in the Java north coast area, were maintained and extended to become The Groote Postweg. The road was not only intended to develop social and economic activities of society but rather to military strategy to defend Java against the British Army (Hartatik, 2018).

The road increasingly gave economic and social impacts on society on the north coast of Java. The construction of The Groote Postweg triggered spatial changes in cities including Semarang, especially in the area of Kalibanteng to Bojong Stree, located in the Semarang Barat area. The wall around the VOC's town was demolished and the center of the city was enlarged to the west area, integrating with the part of the Groote Postweg, called Bojong Street. Bojong Street was used for the high-rank residential area. This also translocated the city developmental area of Semarang. After the road construction, many ethnic settlements occurred along the Java North Coast. Moreover, the mode of transportation had shifted from water transportation to become land transportation with horse carts, trams, etc. At the same moment, along with these land use changes, the Semarang River increasingly became swallowed (Nas & Pratiwo, 2002). The highway is connected to the port for the mobility of goods to and from the city of Semarang. So, road development is related to port construction. In 1850, to enhance the capacity as a commercial port, post douane was built about 2 kilometers from the firth of Semarang River. It had the function to inspect boats and ships. For hoarding inspection, Groote Boom was built near the Semarang. To expand the capacity of the port, small ports connected with canals namely New Havenkanal were built. In 1870, along with the Agrarian Constitution, the number of import commodities had significantly improved. In response to the improvement of import activities, the colonial government-appointed Semarang port as the Export-Import Port in the Dutch East Indies in 1873. The development of several systems and modes of transportation shaped the city order and supported the industrialization of Semarang in the early 20th century. A plan to build a new port near New Havenkanal embarked in 1904 and was started built-in 1910. Overall, the construction of the port was completed in 1924 (Wasino et al., 2022).

Along with the port construction, at the end of the 19th century, Semarang became the laboratory for housing and town planning in Java. This can be proved by the fact that Semarang became the pioneer of railroad construction in the Java North Coast area. In 1867, the Nederlandsch Indië Spoor Maatschappij (NIS) was established and built a railroad network for southern areas of Semarang such as Temanggung through Surakarta and Yogyakarta areas. The function of the railroads was to transport agricultural products, especially sugar, tobacco, and indigo from the area of Surakarta and Yogyakarta, which was located in the middle of Java Island, to Semarang as the port city (Suryo, 1982). Since then, NIS has had a railroad transportation network that connects Semarang with other areas in the mid of Java. In 1887, Semarang-Joeana Stroomtram Maatschappij (SJS), a subsidiary of NIS, built the railroads to the eastern areas of Semarang City from Semarang Regency, Mayong, Demak, and Blora. In 1889, SJS expanded its railways' operation by constructing a steam tram network in Semarang City. These railroads connect some train stations inside of the city such as Jurnatan Train Station, as a central station was built in 1882, Bulu Train Station, and Jomblang Train Station. In 1908, Semarang-Cirebon Stoomtram Maatschappij (SCS) opened a tram network for western areas of Semarang from Semarang to Cirebon far to the westward in West Java Province. The construction of this railroad has opened up opportunities for residents to be able to take advantage of this railroad as a mode of transportation, besides the roads. (Hartatik, 2014). The growth of the railway line connects Semarang City with plantation centers in Central Java. This phenomenon is in line with the development of plantation capitalism which developed from the early nineteenth century to the early twentieth century (Wasino & Hartatik, 2017).

The development of settlements and roads drove up since the Ordinance 1906 that appointed Semarang City as *Gemeente* or municipalities. Based on the ordinance, the area of Semarang City extends from the coastal area on the north side to the Candi mountains on the south side or called as Candisari area. The west and east sides of the city were limited by canals. The city was divided into four districts namely South Semarang, which consisted of 25 villages; Semarang Tengah, Semarang Barat, which consisted of 13 villages; and Semarang Timur, which consisted of 8 villages. Along with the city development, roads were built connecting the areas of the city. Road construction became involute, especially in the villages. At least about 262 streets, which were built in the 1900s, can be identified until the 1960s. Most of them were changeless. Large industries such as the food and beverage industry, textile industry, furniture industry, cigarette industry, and printing industry in Semarang City areas had been established since the early 20th century. The industrial areas are located in the eastern of Semarang City (Leertouwer, 1941). The most visible effect was the migration of people to Semarang, creating labor settlement and social problems (Cobban, 1974). The economic crisis in 1930 followed by World War II destroyed those industries and until the 1960s, there were only several small industries in Semarang City. After the independence era, most of the roads in the North Coast Java were demolished in the independence war (1945-1949). The reconstruction and rehabilitation of roads took a long time due to the political turbulence and unstable economic condition from the 1950s to the 1960s. The development of transportation in Semarang City could not be separated from the economic investment in the 1970s along with the coming of foreign investors and large industries that drive the resurgence of large industrialization in Semarang. The Indonesian economy entered the early stage of economic rehabilitation and import substitution manufacturing from 1965 to the mid-1970s and industrial deepening policy from the mid-1970 to the early 1980 (Robinson, 1988).

The capital and industrial city

After the independence, Semarang City, as the capital city and one of the important ports in Central Java, had been appointed as the center of an industrial area in Central Java.

Three areas were promoted as industrial zones in Semarang namely: (1) the District of Genuk in the east initiated in 1981 and intended for heavy, medium, light, and small industries, the District of Tugu in the west designated for industrial estates, and The District of Plamongansari in the southeast Semarang for agricultural industries (Hadi, 1993). The opening of industrial activity in Semarang caused two impacts namely the expansion of roads and urban problems in terms of land use in the urban area. Road constructions were needed to support the process of production and distribution. The road condition in Semarang (1984) can be seen in Table 1.

Table 1 The Roads distribution in Semarang 1984

City	Primary Arterial	Secondary Arterial	Local Roads	Total
Semarang	42.6	12.7	403.6	458.9

Sources: Bina Marga, 1984

Table 1 shows that Semarang already had local roads of about 403.6. However, the number of secondary arterials and primary arterials needed to be extended. Consequently, the city government decided to improve the quantity and quality of the roads. In the 1980s and 1990s, road construction in Semarang had reached its peak. The ring roads, arterial roads, and toll roads had been built connecting the inner and outer areas of the city. Most of the roads in the industrial zone were built autonomously by each industry (*Perencanaan Penyediaan Infrastruktur Pendukung Kawasan Industri Di Jawa Tengah*, 1983). Meanwhile, some of the roads near the industrial zone were built by the private developer company and the Department of Industry of Central Java. Apart from the industrial zone, the city government also built roads in other areas of Semarang City. Road construction posed urban problems in terms of urbanization and the management of transportation. The process of urbanization in Semarang increased from 1950 to 1990. Consequently, the total population in Semarang City increased significantly from the 1970s to the 1990s (Table 2 and Figure 2).

Table 2 Total Population in Semarang City (1970 to 1990s)

Years	Population			Total
	Native People	Descendant Citizen	Foreign nationals	
1990	876.026	223.193	49.786	1.149.008
1986	846.128	218.437	47.123	1.111.688
1981	779.433	211.374	45.077	1.035.884
1975	563.008	126.105	26.957	716.070
1971	389.162	98.959	21.169	509.290

Source: Semarang Central Bureau of Statistic, 1971 & 1990; *Semarang dalam Angka,* 1971

The increase in population can be seen as the result of industrialization and road construction that accelerate the social mobilization in Semarang. Many of the people from other areas came to Semarang as urbanites or commuters. In 1960 the number of industrial workers increased significantly from 2254 in 1960s to 40.573 in the 1990s. The description of urbanites in Semarang City can be seen in Table 3.

Table 3 The Urbanites based on the type of Work in Semarang (1976-1990)

Type of Work	Years			
	1950	1960	1976	1990
Businessman	224	338	817	4.305
Industrial Worker	1.493	2.254	5.446	40.573
Construction Workers	1.269	1.916	4.629	29.831
Tradesman	672	1.015	2.451	23.773
Shipment	373	564	1.362	7.115
Civil servant	1.045	1.578	3.812	27.254
Services	2.090	3.156	7.624	48.008
Total	7.166	21.031	26.151	180.859

Source: Semarang Central Bureau of Statistics, 1968 & 1990

In facing the increase of urbanites, the city government of Semarang City put attention to urban transportation management by improving the quality of city agency manpower to handle the problems (Dimitriou, 1988). The road construction towards the inner area of Semarang triggered several changes in the city that can be seen in the development of public transportation facilities such as bus terminals or parking areas. In 1983, the Semarang City Government realized that the Jurnatan Terminal Bus (Located in Semarang Tengah), whose building lies in the ex-Jurnatan Train Station, was overwhelmed. The development of public transportation in Semarang City from the 1970s to the 1990s can be seen in table 4:

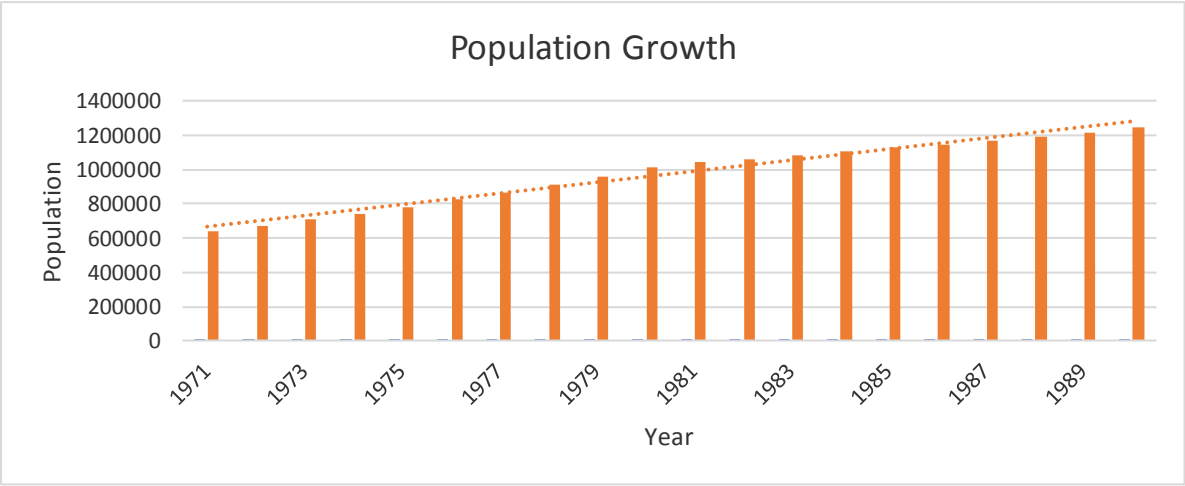


Figure 2. Population growth chart in Semarang City up to 0.033 in the research period (source: https://worldpopulationreview.com/)

Table 4 The Increase of Public Transportation in Semarang

No	Years	Microbus	Minibus
1.	1970	150	242
2.	1977	422	562
3.	1980	576	717
4,	1990	2320	1017

Source: Semarang Central Bureau of Statistic, 1973,1977,1982, &1990

The development of public transportation in Semarang increased from 242 to 1017 from the 1970s to the 1990s. In supporting the public transportation system, the city government decided to translocate the bus terminal from Jurnatan to the new area in Terboyo, Genuk, the eastern north area of Semarang. After three years of construction, the Terboyo Terminal Bus (located in Semarang Utara) was firstly operated in 1985 as an intercity bus station for passengers or commuters from other cities. To support Terboyo Bus Terminal, the city government also built five sub-terminals namely Taman Lele, Watu Gong or Banyumanik, Pedurungan, Jalan Gatot Subroto, and Sendowo. These sub-terminals have functions to be the bus stop areas and the buffer zone for the flow of transportation. Sendowo Bus Terminal was located in the center of the city. In the south areas, there are Banyumanik Sub-terminal, Pedurungan Sub-terminal, and Gatot Subroto Sub-terminal (located in Semarang Barat). These sub-terminals were built in the strategic areas of Semarang and facilitated the passenger and commuters to transport easily around the city.

Along with road construction and public transportation, the use of railroad transportation systems experienced a decline in the 1980s. However, in 1981, trains began to be abandoned because of the emergence of better road transportation facilities that can reach the countryside. Several routes were not utilized anymore due to the lack of passengers, including the Semarang City-Blora Regency route via Purwodadi Regency and Semarang City-Rembang Regency, a regency far to the eastward close to the East Java Province. This phenomenon is caused by the development of trucks and buses that were more flexible to deliver or transport trade and human commodities from rural areas to urban areas. However, in the 1990s, the symptom of the decline of public transportation occurred. Based on Barter's research, Semarang in the 1990s was categorized as a city with a relative role for public transport (Barter, 2000). It means that other modes of transportation, especially private transportation, started to become a trend in Semarang. The impact of the existence of a large number of vehicles on transportation facilities is the unbalanced parking places. In managing the volume of vehicles that were parked in the streets near the trade center such as Johar Market, MT Haryono Street, or Agus Salim Street, the Semarang City government, 1980, was conducted the construction of parking facilities on Pungkuran Street or Yaik Permai Market Complex and Pasar Johar located in Semarang Tengah. These parking facilities consist of five floors. This first floor of the parking building was used for street vendors. The second floor to the fifth floor served as four-wheeled vehicle parking places that can accommodate about 400 vehicles. The operation of the parking building was carried out in December 1989.

The historical experiences of road construction in Semarang have a similar pattern to Colombijn's research about the impact of road construction in Pekan Baru and Dumai that led to the environmental impacts. As in other developing countries, Indonesia has also experienced the impact of the development of the transportation system which led to the reduction of fertile agricultural land in the transportation route due to the conversion of productive land which resulted in built-up land (Nas & Pratiwo, 2002). This change occurred in terms of quantity, quality, and physical patterns of land use. Indeed, the development of the transportation system is not the only factor causing these changes, whether directly or not. Another impact of road construction and the increase of vehicles is the traffic problems and highly polluted air (Hadi, 1993). Based on the report of Natural Disain Consulting Firm, the road infrastructures in the industrial zone, especially in District Genuk, were insufficient to accommodate the daily traffic that was calculated at about 7823 daily trips (*Evaluasi Planning Kotamadia Semarang (Planning Evaluation of Semarang)*, 1991). This firm suggested widening the roads to accommodate the demand for industrialization.

Along with the development of public transportation, road construction in the Semarang area had strengthened the outer city connections, especially with other cities along the north coast through the network of Java North Coast highway or Pantura. The construction of the Pantura was continued with the construction of the intersection and other main roads that have made the flow of goods, services, and people transportation run smoothly and consume a relatively short time. The depiction of the city connection in the Java North Coast can be seen in the increase of roads in the Central Java area.

Table 5 shows that from 1977 to 1979, the Provincial Government extended the city street and district street. Moreover, the country road and provincial road also had been extended from 1980 to 1982. This connection created a city agglomeration in Central Java. The case Semarang City, which serves as the center of trade and services on the north coast of Central Java, eventually became an industrial city by grouping its certain areas, namely Candi Industrial Area in Candisari, Bugangan Small Industrial Environment, the border areas of Semarang City such as Ungaran and Plamongan in the south side of Semarang City. As an industrial city, it has certainly become a magnet for small cities such as Demak, Kendal Salatiga, Grobogan, and others. Many people came to Semarang City permanently, while others chose to be commuters. Most of the commuters came to

Table 5 Roads in Central Java

Years	Country Road	Provincial Road	District Street	City Street	Total
1982	415,636	1806,590	10367,444	1595,608	14185,478
1981	414,660	1851,591	9860,784	1595,487	13722,522
1980	416,636	1806,590	9251,722	1595,487	13096,435
1979	415,636	1806,590	8894,615	1590,391	12707,232
1978	415,636	1806,590	8492,996	1579,139	12294,362
1977	415,636	1806,590	8235,980	1551,322	12009,528

Source: *Jawa Tengah dalam Angka,* 1983; *Jawa Tengah dalam Angka, 1985*

become industrial workers or blue-collar workers in Semarang City. By looking at these industrial areas' grouping, there are primary agglomerations and also secondary agglomerations. Agglomeration in Semarang City can occur due to a large and skilled workforce, easy transportation due to the development of Semarang, and the development of companies that have existed since the beginning of the twentieth century, for example, the industry of herbal medicine, textiles, food and so forth. The best example of this connection is in the case of the Semarang City and Pekalongan connection. Pekalongan is the center of the batik industry on the north coast located next to the Kendal Regency on the west side of Semarang City. Road construction is required to support the batik distribution from Pekalongan to other cities. The position of Semarang becomes essential because it has a commercial airport (1966) and Tanjung Mas Port (Hartatik, 2018). This caused economic agglomeration and trade networks along with the north coast areas.

Table 6 Motorized Vehicles in Central Java 1969 – 1991

Years	Type of Vehicles		Passengers
	Freight Transportation	Public Transportation	
1990	114.216	16.300	120.667
1985	86.272	11.926	76.645
1980	69.307	5.580	66.124
1975	24.512	3.164	25.574
1970	9.921	1.346	17.883

Source: Semarang District Police, 1977; *Jawa Tengah Selayang Pandang*, 1985; dan *Jawa Tengah dalam Angka*, 1988.

Table 6 shows the data about the motorized vehicles in Central Java that indicate the intensity of social mobilization in the area. The number of freight transportation shows the trade networks among the cities in Central Java. The trade networks between cities and ports can encourage economic integration. The sea network using ships can be analogous to the land network using land transportation starting from a two-wheeled bullock cart, or bus, to its connection with the train. Besides, the road network must be connected to a broader network of sea networks that have emerged in port cities along the north coast of Java. Referring to the port concept, the activity of the Semarang City port is very much determined by the productivity of the hinterland in producing export commodities and the purchasing power of its inhabitants to consume imported commodities. In connection with this, infrastructure and facilities are needed, especially transportation to facilitate economic relations between the port and hinterland. It is undeniable that the development of infrastructure, especially transportation infrastructure and facilities that have been built between ports and hinterlands, are driven by the demands of the need to transport export and import commodities such as sugar or agricultural commodities (Wasino & Hartatik, 2017). Based on this logic, the roads are a part of the Java Sea network. In other words, there is a "linkage distribution" between the distribution of products through the sea and those through the land. The sea network of Java and the land network of Java North Coast can be developed not only in the distribution aspect. The impact of the distribution network has resulted in an increase in production in trading cities or related regions. Besides, it also has given an impact on the influence of the consumption pattern of society which is strongly influenced by the global network of capitalism.

Road constructions in Semarang from 1970 to the 1990s have shaped the network of roads in Semarang today (Figure 3 and Figure 4). This period can be seen as the starting point of the modern urban problems in Semarang such as traffic problems, land use changes, and demographic problems. Road constructions, which supported economic activities, cannot be used to solve the urban problem anymore. The history

Figure 3. The comparison of Semarang City in 1930s (Bromer et al., 1995) (a) and the present situation located in Pahlawan Street, Semarang Tengah (b). The picture b shows the Governor Building on the right side.

Figure 4. Detail land use change in the 1930s (Bromer et al., 1995) (a) and the present situation located in Lompok Lama Steet in Gayamsari (b).

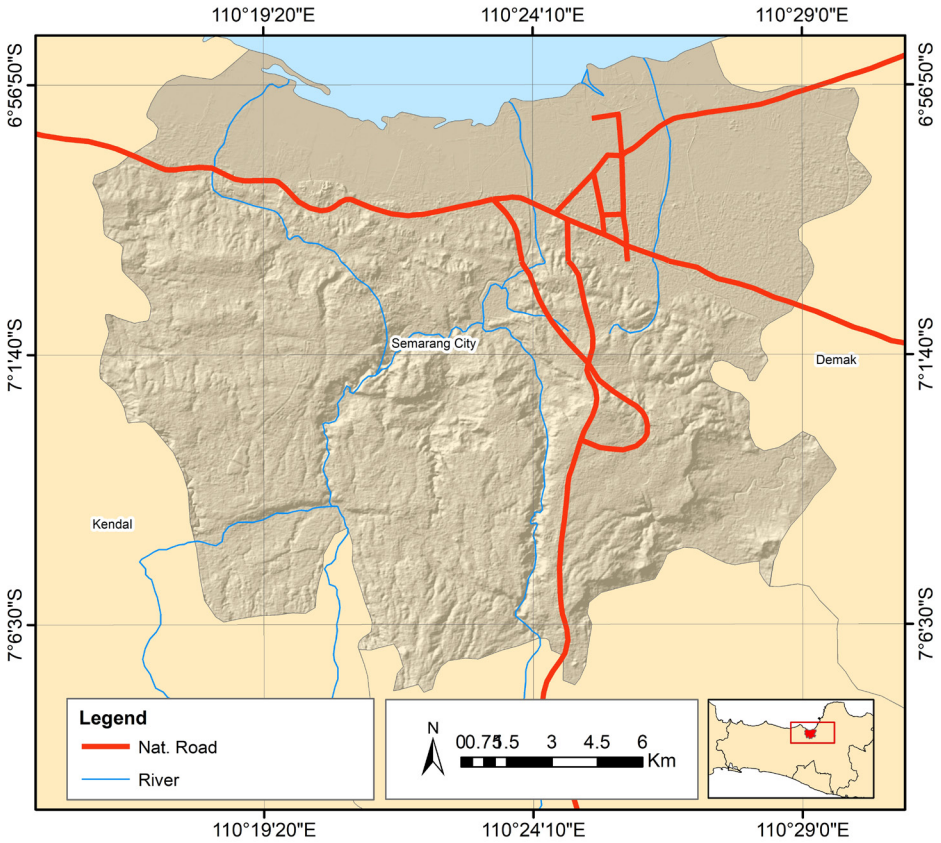


Figure 5. Minimum road information and development in Semarang City around the 1960s (modification map) (Universiteit Leiden, 2022)

of road construction in Semarang from 1970 to 1990 proved that road construction mostly impacted negatively on society and triggered a long-term problem in the future. Semarang can be seen as an *entrepot* city. The rapid development of transportation will bring the city to become a metropole. However, from a historical point of view, road construction has not solved the urban problems. This condition will eventually increase the number of accidents, violations reduced traffic manners, and increased air pollution. Therefore, it is necessary to think about a transportation policy that is full of environmental insight. Three main aspects determine the intensity of the impact on the environment, especially air pollution, noise, and energy used, namely: the aspect of transportation planning which includes goods, people, and services; the aspect of transportation engineering, including transportation mode flow patterns, road facilities, traffic systems, and other transportation factors, and mechanical aspects and the source of energy or fuel for the vehicle.

The development of the road transportation sector has brought influences on economic growth, especially in the centers of trade activities. Urban space in Semarang City has been widely used so that its growth reaches beyond the limits of the city administration, especially in areas that have direct access to Semarang City, namely areas located in the east which have access to the main highways of Semarang-Demak and Semarang-Purwodadi. In the west corridor, the highway that connects Semarang City with Kendal and the North Coastal cities of Central Java is the Semarang-Kendal highway. The south corridor highways that connect Semarang Regency and inland cities are Semarang City to Surakarta, Semarang Regency, Magelang, and Yogyakarta, and Semarang City, Temanggung, Purwokerto, and Cilacap. The transportation development in Semarang City from 1970 (Figure 5) to the 1990s shaped the pattern of further development in that area in the later periods in which the economic growth is always accompanied by road construction and transportation development that, unfortunately, triggers urban problems and

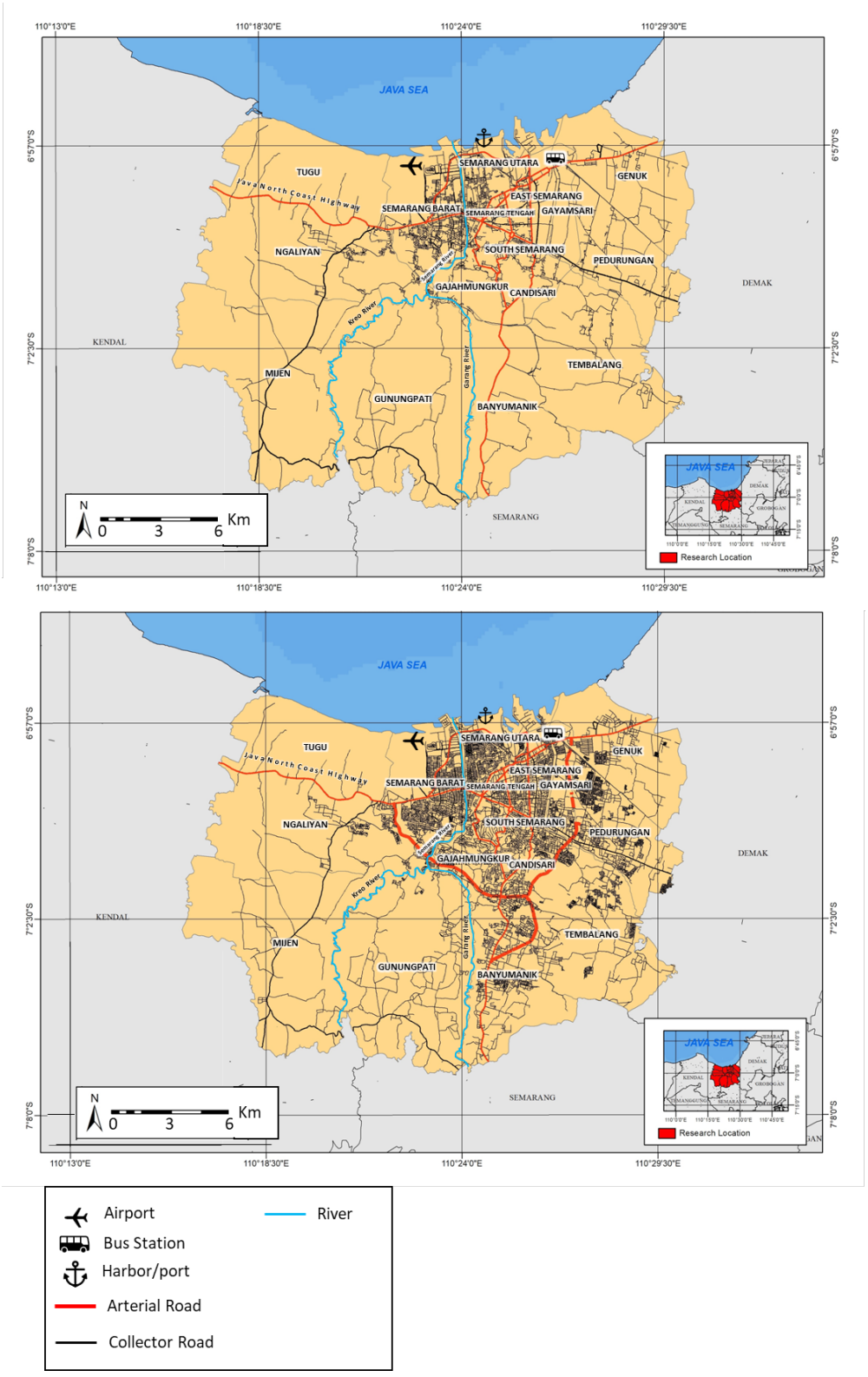


Figure 6. The dense road network in Semarang City in 1964 (first picture) (source: Regional Spatial Planning (Bappeda) of Semarang City) and 2021 (second picture) (Indonesia Geospatial Information Agency (BIG)). The main port, airport, and bus station can be seen in the north part of the city

environmental problems. Those variables become the important factors in determining the land use changes of Semarang City today as shown in Figure 6.

Figure 3-6 indicates the development of Semarang City is affected by the transportation development in Semarang from 1970 to the 1990s. It reveals the massive development from the early stage (before 1970) to the present day (Table 7 and Table 8). The picture also shows us that the development induces all road classes (national to local) to superimpose each other in one concentrated area.

The road development as shown in Table 7 and 8 directly affects the land use and triggering some changes in Semarang City. The land use change has seen in the rice field declining from 1999 to 2018 as shown in Figure 7, extracted from statistic of Semarang City (BPS, 2022).

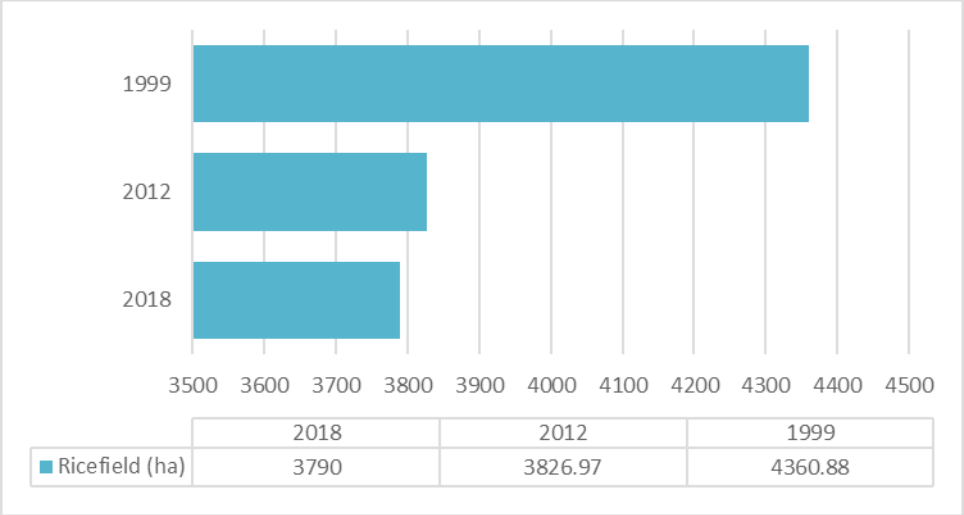


Figure 7. Declining of the rice field area in Semarang City since 1999 to 2018 (BPS, 2022)

Table 7. The roads length development

Years	Toll Road (km)	Country Road (km)	Provincial Road (km)	District-City Street (km)
1964	-	136.65	63.136144	1,424.34
2021	44.40	138.85	63.79	3,478.98

Table 8. The roads segment development

Years	Toll Road	Country Road	Provincial Road	District-City Street
1964		1,018	344	11,839
2021	148	1,036	348	30,984

4. Conclusion

The findings of the research show road transportation in the city of Semarang have existed since the Dutch colonial period, but it was not the primary transportation medium. Changes occurred during the New Order era when the government placed roads as the primary means of land transportation. The transportation development in the 1970s was triggered by the wave of industrialization of Semarang. Roads were built by private companies, the city government, and the provincial government to support industrialization. Road construction generated urban problems such as land use changes, urbanization, and environmental problems. The change is due to many migrations carried out by people who were outside the industrial city to try their luck to work as industrial workers, construction workers, domestic workers, and so forth. Besides, the increasing number of motorized vehicles in the city also contributed to the local government's adoption of policies to reduce city density by making arterial and toll roads. Another land use change as a result of the transportation system in Semarang which is related to environmental changes that have given a negative impact is the emergence of floods at several points in Semarang. Meanwhile, the road construction also accelerated the city agglomeration, connecting Semarang with other cities in the Java North Coast and the Mid Java. However, in the 1990s the symptom of the use of private transportation occurred in Semarang which became the most critical issue in the later periods. The pattern of road construction, transportation development, and land use changes in Semarang from 1970 to the 1990s shaped the city and connection of Semarang until today. The construction of roads along the Java North Coast or inside of Semarang City has given economic and social impacts at first glance. However, road construction also gives a long-term impact on urban problems and environmental problems. This should be considered by many parties to perceive the recent transportation development in Semarang and also Indonesia.

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