Impact of land use and transport interaction on transmition of Covid-19 in Jakarta

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ABSTRACT

Land use and transportation are well known to interact and influence one another. The coronavirus COVID-19 pandemic is the global health crisis. The world faces difficulties managing disasters while making efforts to slowing the spread of COVID-19. The COVID-19 pandemic spreads quickly through physical contact, making it easy to spread in public places. The purpose of this study to determine the effects of land use and transportation interactions on COVID-19 transmission. The quantitative descriptive analysis and spatial statistical methods in Geographic Information Systems (GIS) have been used in this study. Descriptive analysis to describe data related to land use characteristics in the research area. Spatial Statistical Method in GIS to analyze data from both structured and spatial observations. Cross-checking the land use from Google Street View around the bus stop within a 400 meter radius with the existing land use directly yielded the observations. The findings revealed that the type of land use demonstrated an intensity of activity that had a high potential for spreading COVID-19 because at the bus stop with land use around the trading center, shopping centers, and office buildings that have a high activity intensity, it appears that they have a high positive number of COVID-19.

Keywords: land use; bus stop; COVID-19; disaster; intensity.

INTRODUCTION

Jakarta is a metropolitan city with a population of over one million people (Atika, 2013). The city of Jakarta, as the center of government and commerce, creates an allure that results in an increase in the number of residents each year, with 10.55 million residents in 2019. As the population grows, so does the demand for individual movement to carry out activities (Errampalli et al., 2020). As a result, the demand for transportation increased (Christiana, 2017). The Transjakarta bus rapid transit system is one of the modes of public transportation available in Jakarta. The state of transportation facilities and the flow of people, goods, and services reflect regional interaction (Guzman et al., 2017). The transportation system will facilitate movement between regions, allowing residents to interact more easily. Transportation can be used to improve an area's accessibility. Humans travel between land uses in urban transportation systems to meet their needs. This causes a flow of people, vehicles, and goods, resulting in a variety of interactions.

In urban transportation systems to meet their needs, humans travel between land uses. This causes a flow of people, vehicles, and goods, resulting in a variety of interactions. Transportation and land use are inextricably linked, what happens or changes in land use have an impact on transportation, and every transportation movement has an impact on land use (Hanson, Susan; Genevieve, 2017). Transportation and land use always related, what happens or changes in land use will have an impact on transportation. Every transportation movement will influence land use. Land use creates a network of activities that both 'generate' movement (traffic generation) and can 'attract' movement (traffic attraction). The urban transportation system and land use have a strong correlation that is influenced by the amount of land used (Michael, 2003). The amount of movement caused is directly proportional to the type and intensity of the activities performed (Saragi, 2015). Generation and attraction are influenced by two aspects of land use: the type of land use and the amount (and intensity) of activity (and intensity) in that land use (Tamin, 2000).

Accessibility is closely related to the ease of reaching a location. Accessibility is a concept that combines a geographic land use management system with a transportation network system that connects it. Defines accessibility as the ease with which a location is connected to other locations so

that they can interact (connect) with each other via the existing transportation network, which consists of road infrastructure and transportation equipment that moves on it (Miro, 2005). Population mobility will result from easy access (Castelli & Sulis, 2017). The same thing, that the level of convenience (access) can affect (increase and decrease) mobility (Miro, 2005). Because there is a one-way relationship between accessibility and mobility, the greater the accessibility, the greater the mobility of people moving from one location to another.

The ease with which people can move from one location to another is linked to the spread of infectious diseases. Infectious diseases could only spread as quickly and as far as people could walk, ride, and sail in boats a few centuries ago (Tatem et al., 2006). Quantification of human mobility in a city is substantial for assessing the large-scale spatial transmission of infectious diseases and improving epidemic control (Hackl & Dubernet, 2019). Convenient transportation networks lead to rapid mobilization in the context of globalization, which is an important factor underlying the rapid spread of infectious diseases (Li et al., 2021).

The existence of modern modes of transportation hastens the emergence of previously unknown diseases and raises people's risk of contracting them. Discovered that taking public buses or trams was a significant risk factor for acquiring infectious respiratory diseases (Troko, 2011). Commuters who think that the risk of being infected with the virus in public transport is higher have a lower probability of choosing rail transit (Tan & Ma, 2021).

COVID-19 has been designated as an international disaster pandemic by the World Health Organization (WHO). COVID-19 is a kind of risk, and COVID-19 related communications should have similar features to those for natural disaster risk communications. Meanwhile, COVID-19 is invisible and cannot be detected, like earthquakes or floods, before people are infected (Zhang et al., 2020).

The spatial space of a city is not resilient to the COVID-19 pandemic, and there is disruption in the urban transportation sector as a result of changes in community mobility as a result of social distancing. The transportation system is a critical piece of infrastructure for society. When the system is subjected to a shock, this is clearly demonstrated. Transportation infrastructure that is resilient and sustainable will continue to be critical in dealing with pandemics COVID-19.

There is a significant positive relation between the frequency of bus and the positive cases of COVID-19 (Zheng et al., 2020). The presence of a bus stop that causes there are a passenger of bus rapid transit Transjakarta corridor 01 (Blok M- Kota) with a positive cases COVID-19 in the service area by bus rapid transit Transjakarta corridor 01 (Blok M- Kota). Crowd management waiting at bus stops is very important to minimize the spread of the COVID-19 virus, because crowded stops (buses) have a high probability of increasing the spread of the virus and increasing infection rates due to physical distancing (social distancing) (Tirachini & Cats, 2020). Stations serving as transportation hubs in regions have a higher cumulative number of COVID-19 cases with shorter spread times (Zhang et al., 2020). Kind of mode transportation are bus, trains, and planes in spreading COVID-19.

Based on these conditions, it is necessary to determine the relationship between the characteristics of the source of land use generation at a radius within 400 meters from the location of the Transjakarta bus stop corridor 01 (Blok M- Kota) which is expected to affect Transjakarta users at the stop location and the transmission of COVID-19. The purpose of this research is to investigate the impact of land use and transportation interactions on COVID-19 transmission. So that it can be used as an input for preventive measures aimed at reducing and preventing the spread of an infectious disease in a given area.
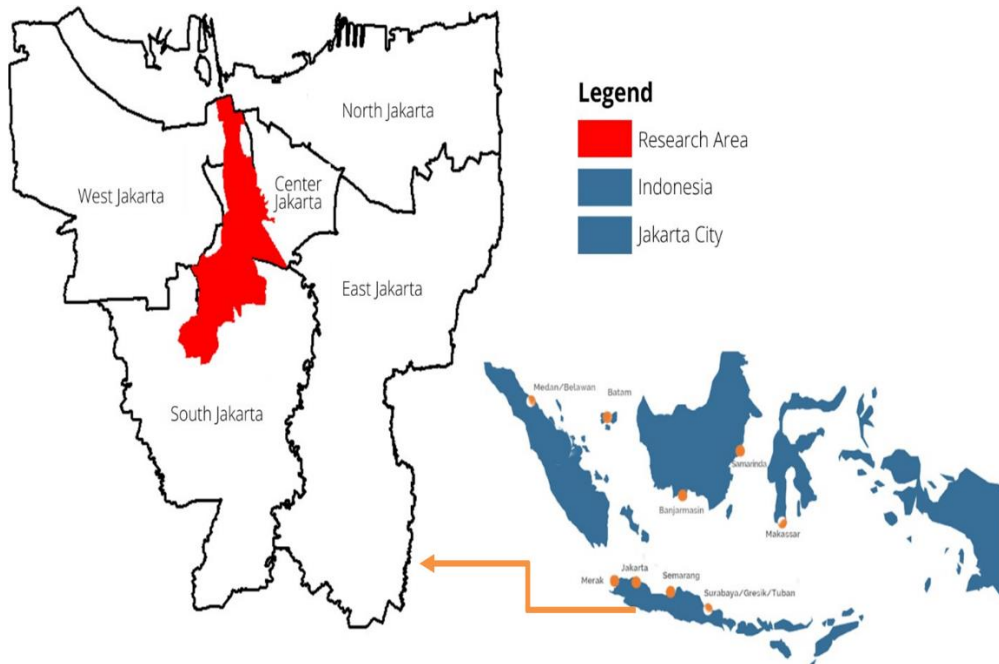
Figure 1. The orientation of the Jakarta to Indonesia

RESEARCH METHODS

The study location is in an area that is in Jakarta City passed by bus rapid transit Transjakarta Corridor 01 (Blok M-Kota) which serves 29 "Kelurahan" as the boundary of the research area. Law Number 32 of 2004 on Regional Government, that kelurahan is a Regency/city regional apparatus formed in the sub-district area and is a regional apparatus lowest district/city. The Law PP. 73 of 2005 on the "Kelurahan". The establishment of a kelurahan as referred to in paragraph (1) must at least qualify: (a) total population; (b) an area; (c) part of the work area; (d) government facilities and infrastructure. The "Kelurahan" in the Java region at least 6,000 inhabitants or 1,200 household heads.

The data used in this study are primary and secondary data. Methods for obtaining primary data include observing and photographing the land use conditions around the bus stop and the activities of bus rapid transit Transjakarta users at each of the 19 bus stops on corridor 01 (Blok M- Kota). While the secondary data used in this study was from April 2020 to February 2021, which was obtained from the official website corona.jakarta.go.id regarding positive COVID-19 data in "Kelurahan". The analysis used in this research is quantitative descriptive analysis and mapping method.

The research area is bounded by the bus rapid transit Transjakarta Corridor 01 (Blok M- Kota) service area, which serves 29 "Kelurahan". This study relied on both primary and secondary data. Observing and photographing the land use conditions surrounding the bus stop, as well as the activities of bus rapid transit Transjakarta users at each of the 19 bus stops on corridor 01 (Blok M- Kota), are methods for obtaining primary data. While the secondary data used in this study ranged from April 2020 to February 2021, it was obtained from the official website corona.jakarta.go.id in the case of positive COVID-19 data, according to "Kelurahan". The quantitative descriptive analysis and mapping method were used in this study.

Spatial Statistical Method

Spatial Statistical Method is physical form of shopping places. Observation at a radius of 400 meters from the bus stop distinguishes it into shopping types of centers and shopping mall according to the criteria. The criteria for a shopping center is a shopping complex consisting of shop booths, shop

booths are for rent, there is a food court, there is a parking area. The criteria for shopping malls are shopping centers with one stop and the main entrance as seen from the side of the road.

Spatial statistical method is used to analyze data from both structured and spatial observations in Geographic Information Systems (GIS). Cross-checking the land use from Google Street View around the bus stop within a 400-meter radius with the existing land use directly yielded the observations. The land use is overlaid with a positive COVID-19 map to show which land use around the bus stop overlaps with the "Kelurahan" that has a high number of positive COVID- 19 cases. Positive COVID-19 data is classified into three levels (high, medium, and low) using the natural breaks method. The natural breaks method is method of creating an interval class system in which each class range is determined based on the distribution of frequency data. The data used has a range from to the smallest to the largest. The data is then divided by the three of classes.

Observations were made on 19 bus stop in corridor 01 (Blok M- kota) are Blok M bus stop, Masjid Agung bus stop, Bundaran Senayan bus stop, Gelora Bung Karno bus stop, Polda Metro Jaya bus stop, Bendungan Hilir bus stop, Karet Sudirman bus stop, Dukuh Atas bus stop, Tosari bus stop, Bundaran HI bus stop, Sarinah bus stop, Bank Indonesia bus stop, Monumen Nasional bus stop, Harmoni bus stop, Sawah Besar bus stop, Mangga Besar bus stop, Olimo bus stop, Glodok bus stop and Kota bus stop. Criteria for commercial land use which are included in the physical form of shopping places. Observation at a radius of 400 meters from the bus stop distinguishes it into shopping types center and shopping mall according to the criteria. The criteria for a shopping center are a shopping complex consisting of shop booths, shop booths are for rent, there is a food court, there is a parking area. The criteria for shopping malls are shopping centers with one stop and the main entrance as seen from the side of the road.

Descriptive Analysis Method

Descriptive analysis is used to describe data related to land use characteristics in the area traversed by the Transjakarta corridor 01 bus rapid transit system (Blok M- Kota). Humans travel between land uses in urban transportation systems to meet their needs. This results in the movement of human flows (Guzman et al., 2017). Generation and attraction are influenced by two aspects of land use: the type of land use and the amount (and intensity) of activity (and intensity) in that land use (Tamin, 2000). The area that evokes travel is the region housing, while the areas that tend to attract travel are office areas, education, shops and recreation areas (Tamin, 2000).

RESULTS AND DISCUSSION

Bus Rapid Transit Transjakarta Corridor 01 (Blok M- Kota) is a bus rapid transit line that runs through twentynine "Kelurahan". The twentynine of "Kelurahan" have land use functions as residential, worship, defense, and security, socio-cultural, commercial, and other. The pattern of land use in the corridor area 01 (Blok M- Kota) which has different types of land use has an impact on the generation of a land use. Generation and attraction depend on two aspects of land use, namely the type of land use and the amount of activity (and intensity) in that land use (Tamin, 2000). Types of land use that make a major contribution to traffic flow are settlements, trade & services, schools (education) and public areas (public facilities). Because the three types of land use have high activity. In this case the distribution pattern that plays a very important role is the distribution of office areas, residential areas, entertainment centers and schools.

Overview of the service area by bus rapid transit Transjakarta corridor 01 (Blok M- Kota): Bus rapid transit relies on a speed system (Zolnik et al., 2018). Bus rapid transit Transjakarta uses a closed system where passengers can get on and off only at the bus stops on each route. Activity boarding, dropping and transit passengers can only be done at certain stops which are access points bus rapid transit Transjakarta. Access point Bus rapid transit Transjakarta corridor 01 (Blok M- Kota) is an access point in the form of a bus stop that is guarded by officers. Bus rapid transit Transjakarta corridor 01 (Blok M- Kota) focuses on connecting Blok M bus stop and shopping areas in South Jakarta City to the Old Town area in West Jakarta City. Service area by bus rapid transit Transjakarta corridor 01 (Blok M-Kota) is a very busy and congested area. Corridor 01 (Blok M- Kota) is one of the routes that will continue to be operated at this time there is a policy to change the operation of the Transjakarta BRT during the COVID-19 Pandemic.

Character of land use: In general, corridor 01 (Blok M- Kota) passes through three different characteristics of land use, namely housing mixed with office buildings (Blok M bus stop and Masjid Agung bus stop), luxury offices and upscale apartments (Bundaran Senayan bus stop, Gelora Bung Karno bus stop, Polda Metro Jaya bus stop, Bendungan Hilir bus stop, Karet bus stop, Setiabudi bus stop, Dukuh Atas bus stop, Tosari bus stop, Bundaran Hotel Indonesia bus stop, Sarinah bus stop, Bank Indonesia bus stop). Office buildings area mixed with commercial (Monumen Nasional bus stop, Harmoni bus stop, Sawah Besar bus stop, Mangga Besar bus stop, Olimo bus stop, Glodok bus stop and Kota bus stop).

Land use has an impact on the generation of activities because the impact is a condition felt by an object in this case the Transjakarta bus stop due to an activity taking place on the land use. The source of generation to the bus stop is one of the main factors in the use of the Transjakarta bus stop corridor 01 (Blok M- Kota). In the following, we will discuss the sources of land use generation in each location around the Transjakarta bus stop corridor 01 (Blok M- Kota) at a radius of 400 meters.
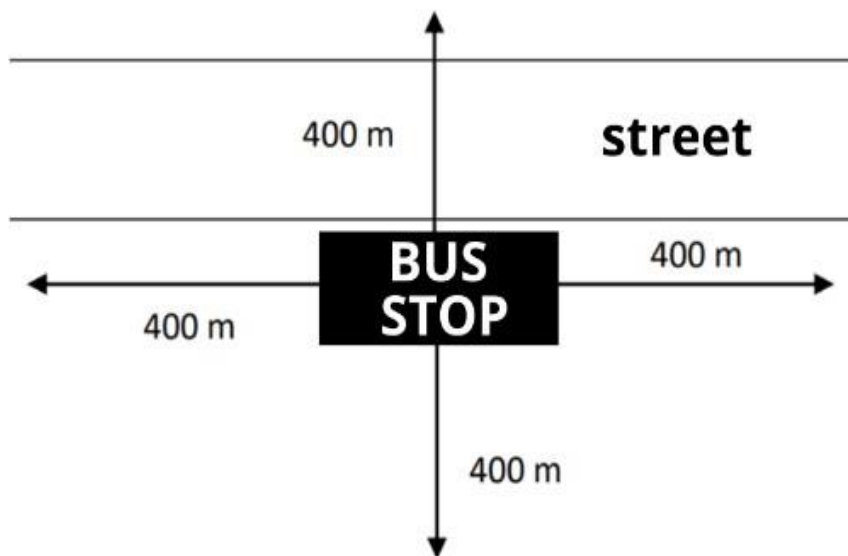

FigURE 2. Radius of Data Collection for Generating Sources

The land use function is divided into five are residential, worship, defense, and security, socio-cultural, commercial, and other. The land use function included in residential land use, specifically small houses, medium houses, large houses, official houses, boarding houses, dormitories, guest houses, nursing homes, orphanages, and orphanages. Land use function worship consists of houses of worship such as prayer rooms, mosques, churches, and temples. The use function socio-cultural land, namely education services, health services, museums, city parks, offices of social institutions and organizations. The land use of commercial namely cafes, restaurants, shopping mall and shopping center. Based on the results of field observations and grouped into four land uses with shopping center activities, government offices, shopping malls and offices
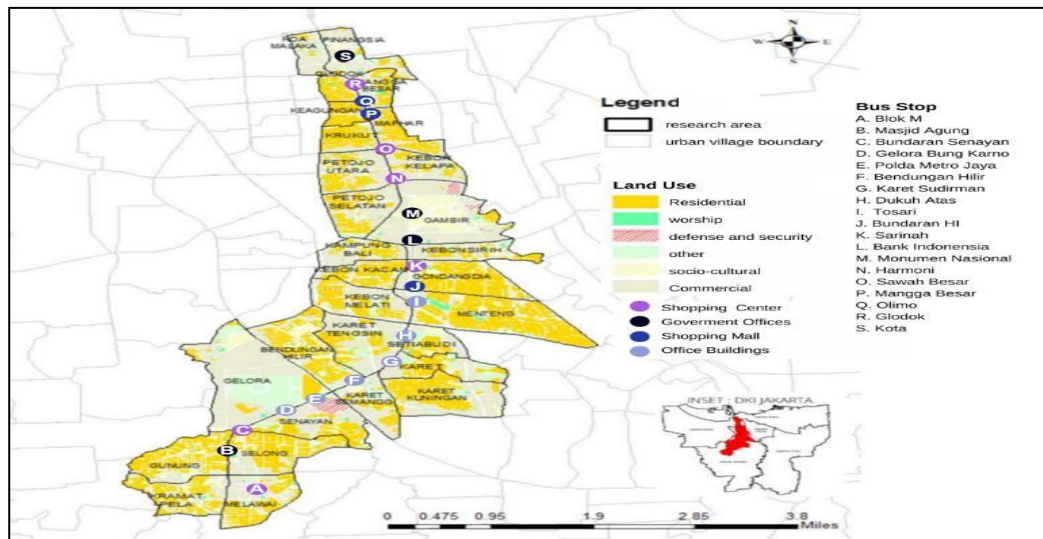
Figure 3. Land Use in Transjakarta Corridor 01 (Blok M- Kota)

The scope of the research area, color dominance is indicated by yellow and beige. Yellow color signifies use residential land with a total area of 15.44 Km2 and beige signifies business land use with a total area of 13.82 Km2. Settlement is one part of the land use is the most important aspect in creating movement largest in urban areas. The research area is 45.56 Km2, where "Kelurahan" Gelora and "Kelurahan" Gambir occupy the highest position with an area of 2.59 km2 and 2.58 Km2. In the bus stops in the corridor area of corridor 01 (Blok M- Kota), this impact arises because of the existing land use that has different features. The land use function is a source of generation for the Transjakarta bus stop, which is located at corridor area 01 (Blok M- Kota). The source of getting up to the bus stop is one of the factors main uses of the Transjakarta bus stop is corridor 01 (Blok M- Kota). The following will be discussed source of land use generation around the Transjakarta bus stop location corridor 01 (Blok M- Kota) at a radius of 400 meters.
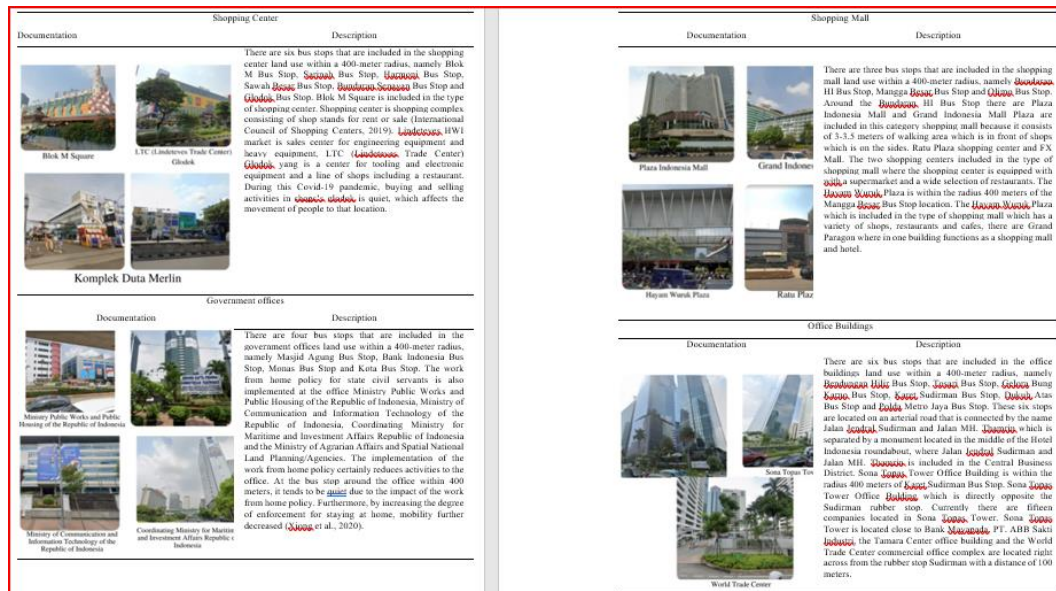

Figure 4. Visualization of Data in Sine Wave Form

Blok M bus stop, Sarinah bus stop, Harmoni bus stop, Sawah Besar bus stop, Bundaran Senayan bus stop and Glodok bus stop located in "Kelurahan" with land use around the bus stop, namely trading land use in the form of a shopping center shopping center in the form of Blok m square,

Sarinah building, Kompek Duta Merlin, Gajah Mada Plaza, Ratu Plaza, Lindeteves Trade Center (electronic center). The definition of a shopping center, which is a shopping complex consisting of shop stands that are rented or sold.

Masjid Agung bus stop, Bank Indonesia bus stop, Monumen Nasional bus stop and Kota bus stop are located in "Kelurahan" with service land uses, namely the government office of the Coordinating Ministry for Maritime Affairs and Investment of the Republic of Indonesia, the office of the Ministry of Religion, Sub- Division of Equipment and BMN, the office of the Financial Services Authority of Bank Indonesia, the office of the Ministry Communication and Information, Ministry of Tourism office, Ministry of Defense office and Ministry of Transportation office.

The Bundaran HI bus stop, Mangga Besar bus stop and Olimo bus stop located in "Kelurahan" with a commercial land use in the form of a shopping mall. The main characteristic of a shopping mall is that it is a shopping center under one roof or one stop. The arrangement of shopping malls is often found with a single corridor design with a width of 3-3.5 meters of walking area in front of the shops on the sides ((Levy, M., & Weitz, 2009). Grand Indonesia Mall, Plaza Indonesia Mall, Hayam Wuruk Plaza have the characteristics of a shopping center under one roof or one stop.

Bendungan Hilir bus stop, Tosari bus stop, Gelora Bung Karno bus stop, Karet Sudirman bus stop, Dukuh Atas bus stop and Polda Metro Jaya bus stop located in "Kelurahan" with service land uses in the form of office buildings. one of the office space containers with the type of high-rise building. The rental office is designed with an approach to space efficiency and flexibility so that it can meet the needs of two or more users1. The World Trade Center, Wisma KEIAI office, Sona Topas Tower are included in office buildings that are used by several companies in one building and have complete facilities.

The condition of land use that has a high attraction causes the high total passanger bus rapid transit Transjakarta users wait the bus or transit at the bus stop. In a pandemic condition, every Transjakarta bus stop is installed with instructions to maintain distance (physical distancing) in the form of a sticker on the floor of the bus stop. But still found passanger at the transjakarta bus stop still found standing side by side tightly and not standing according to the sign of keeping a distance and leaned back and touched the side of the bus stop railing. Even though objects are media that can be massive mode of transmission.
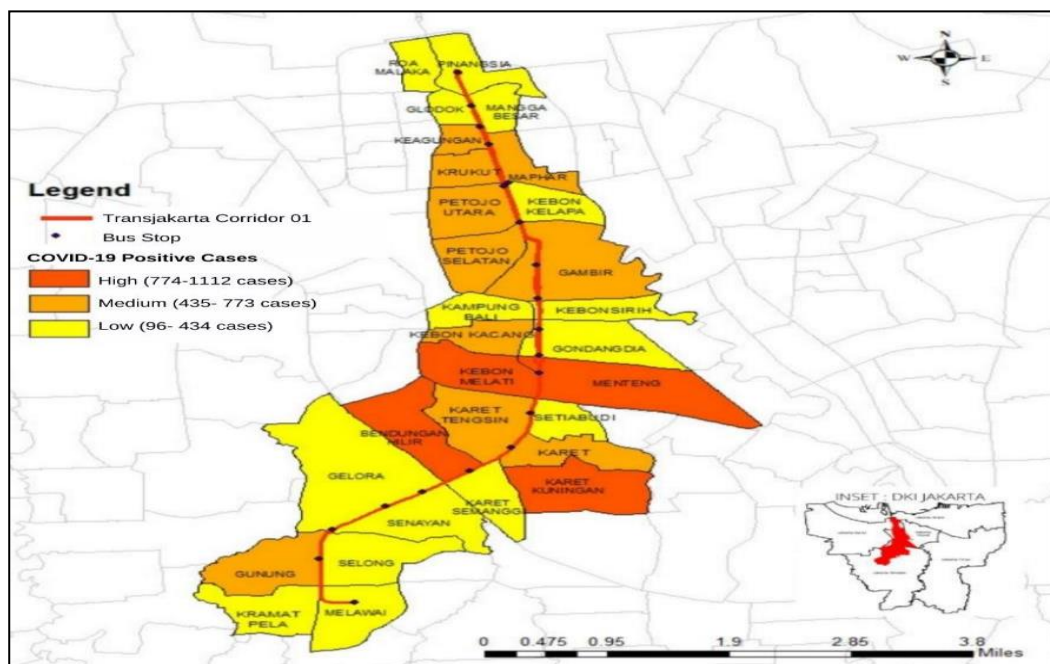

Figure 5. Positive Level of COVID-19 in the Transjakarta Corridor 01 Area (Blok M- Kota)

"Kelurahan" are included in the class group that have a high positive COVID-19 are marked in red, namely "Kelurahan" Kebon Melati and "Kelurahan" Bendungan Hilir. The ten of "Kelurahan" are included in the COVID- 19 positive class group which are being marked in orange, namely Senayan, Karet Kuningan, Karet Tengsin, Menteng, Kebon Kacang, Gambi, Petojo Selatan, Maphar, Krukut and Keagungan. Meanwhile, the other seventeen "Kelurahan" that have a positive number of COVID-19 that fall into the low class are marked in yellow, namely "Kelurahan" Melawai, "Kelurahan" Kramat Pela, "Kelurahan" Selong, "Kelurahan" Gunung, "Kelurahan" Gelora, "Kelurahan" Karet Semanggi, "Kelurahan" Karet, "Kelurahan" Setiabudi, "Kelurahan" Gondangdia, "Kelurahan" Kebon Sirih, "Kelurahan" Kampung Bali, "Kelurahan" Kebon Kelapa, "Kelurahan" Petojo Utara, "Kelurahan" Mangga Besar, "Kelurahan" Glodok, "Kelurahan" Pinangsia and "Kelurahan" Roa Malaka.

Impact of Land Use and Transportation Interaction on the Spread of COVID-19: Land use affects people's travel, where the type of shopping mall and office building in the location has the potential to attract high passengers. So that "Kelurahan" with generation around bus stops in the form of shopping malls and offices that are used by several companies in one building are located in villages with high and moderate COVID-19 positive levels.
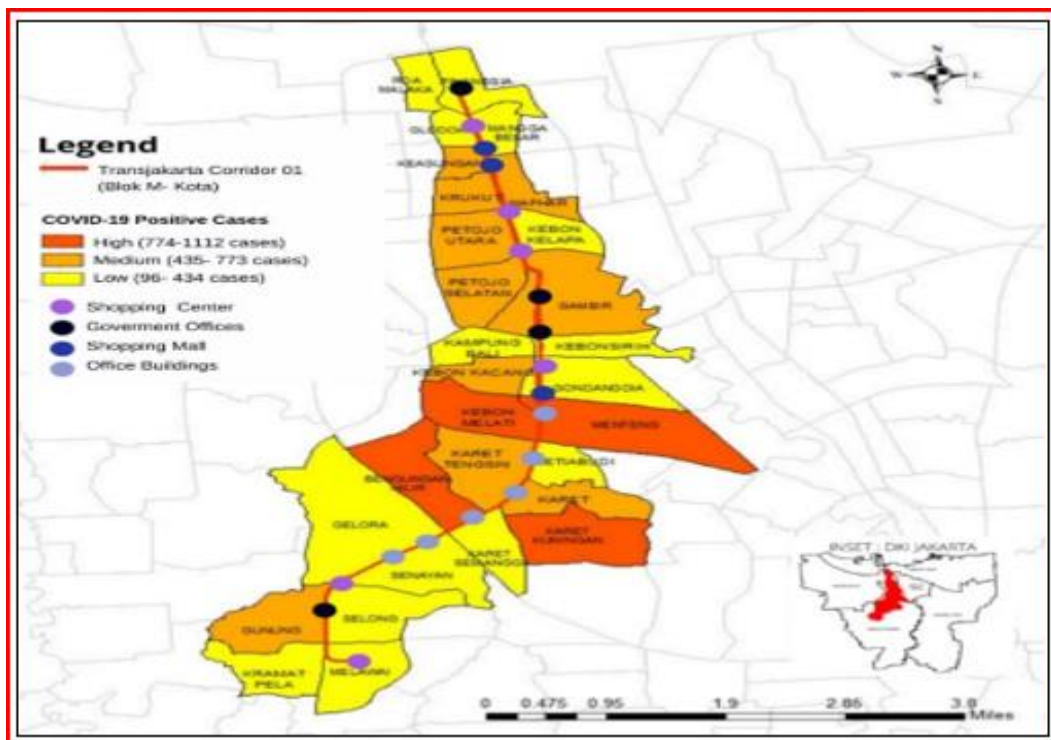

Figure 6. Positive Level of COVID-19 and Land Use in the Transjakarta Corridor 01 Area (Blok M- Kota)

CONCLUSION

Based on the results of the analysis described previously, it can be seen that locations with a high level of spread of COVID-19 have land uses around bus stops in the form of office buildings and shopping malls. The type of land use demonstrated an intensity of activity that had a high potential for spreading COVID-19. This is because the land use is still an attraction for people to travel to the location even during the COVID-19 pandemic and has various types of activities that are essential so that it is not possible to enforce a work from home policy. In this case, natural disasters related to COVID-19 are increasing due to the movement of people from one land use to another by of means transportation. Therefore, it is necessary to prevent its spread by responding to Covid-19 through human surveillance and inspection of transportation means.

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