

## Land Potential Analysis for Health Service Facilities (Puskesmas) in the Pinangsia Village, DKI Jakarta Province

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### Abstract

*Provision of Health Facilities is one of the government's mandates in ensuring public health in accordance with the 1945 Constitution article 34 paragraph 3 Law No. 36 of 2009 article 15. Based on data from the Health Service it shows there are still health service facilities that operate not on land owned by the Provincial Government of DKI Jakarta. Government health services located on land with a lease or contract mechanism are very prone to experiencing problems such as contract extensions, permits, etc. Through a geographic information system, a model of the priority locations for the procurement of health services was developed to become a recommendation for the DKI Jakarta government. Based on the results of the analysis, the number of potential parcels obtained is 23 potential parcels which are dominated by potential parcels with priority category 2 with a total of 16 parcels, followed by priority category 1 with a total of 7 parcels. The results of this study are expected to provide the right location for the DKI Jakarta government in carrying out land acquisition for the construction of PUSKESMAS in the Pinangsia sub-district by considering its territorial and socio-economic aspects.*

**Keywords:** health service facilities, GIS, Geospatial Analysis

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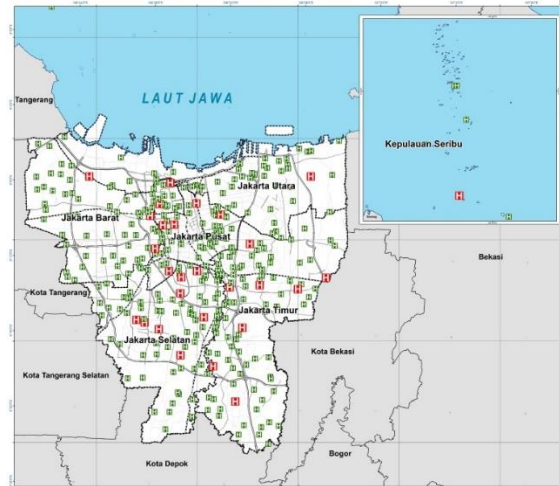
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### 1. Introduction

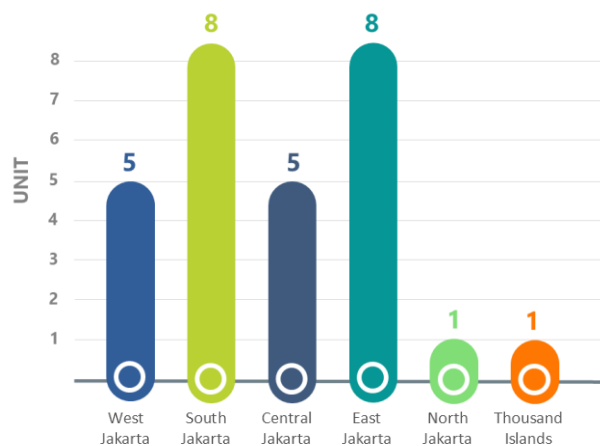
Based on the 1945 Constitution article 34 paragraph 3, the state is responsible for providing proper health service facilities and public service facilities. The mandate of Law No. 36 of 2009 concerning Health as stated in article 15 states that the availability of the environment, the physical and social arrangement of health facilities is the government's responsibility to achieve the highest level of Health. Decent here in terms

of facilities and location of service facilities. No matter who provides the health facilities, the most important thing is where to locate or built a new hospital to provide, both facility location and attractiveness (Soltani & Marandi, 2011). Currently there are still 28 Community Health Centers in Indonesia capital city (DKI) Jakarta that still use the Contract/Lease Land mechanism. Problems will arise when the land owner wants to use or utilize his land when the contract period expires so that the Health Services that should have remained moved and of course this will cause confusion in the community.



**Figure 1.** Hospitals Distribution in DKI Jakarta

DKI itself has provided health centers to serve its people in every village. Puskesmas (medical facilities) is really needed for the community, especially for the lower middle class. Based on the distribution, data from DKI Provincial Government for 2022 shows that the largest number of Puskesmas use the Contract/Lease mechanism, namely in East and South Jakarta, there are 8 medical facilities (Puskesmas)



**Figure 2.** Number of Puskesmas use the Contract/Lease mechanism chart

One of the efforts to find potential land locations for Community Health Centers can be done through social, economic and regional studies based on geographic information systems. To present spatial modeling, GIS technology provide effective tools that can make relationship between spatial data by using topological mapping (Valencia

& Rusnock, 2017). The expected outcome of this activity is to increase the transparency of the land acquisition preparation process and help facilitate the selection of locations to be prepared for land acquisition. Hospital proper site selection will be important role for hospital construction and management (Triantaphyllou & Mann, 1995; Wu & Zhou, 2012).

According World Health Organization (WHO), medical services offered in every hospital in each country will vary due to differences in factors that affect the hospital environment (Albert & Assad, 2019). This study not only provides information on potential locations for PUSKESMAS land procurement in general as in previous studies but also provides detailed information on potential land plot locations. The activity of compiling the Study of Land Documents for the Land Acquisition Plan for Health Services (Puskesmas) includes a series of processing of supporting data and main data resulting from field surveys. These data will be processed using the help of mapping software and complemented by academic studies. The output of this activity is expected to become one of the references for land acquisition for the government conducting land acquisition.

## 2. Method

### A. GIS Based Multi Criteria Analysis

GIS-MCA is a process that makes a parameter or criterion of geographic data) and the knowledge of the producer is used as the final assessment of the decision results. Based on (Albert & Assad, 2019), GIS-MCA consists of two important parts, namely basic parameters and inhibiting parameters for selecting the location of the hospital. Several studies used GIS techniques and spatial data products to analysis the problem of identifying the best locations for building hospitals and planning health services (Astell-Burt et al., 2011; Hare & Barcus, 2007). GIS-based MCA provides a more technological, convenient and precise way for hospital site selection (Rezayee, 2020).

### B. Spatial Analysis

This research using variables/indicators for assessing priority locations for the development of puskesmas in DKI Jakarta are formulated as follows:

1. Accessibility of the Clean Water source network
2. Conditions of road network accessibility
3. Affordability of public transport routes
4. Vulnerability to floods
5. Vulnerability to fire disaster
6. Ability to develop intensity
7. Detailed Spatial Plan

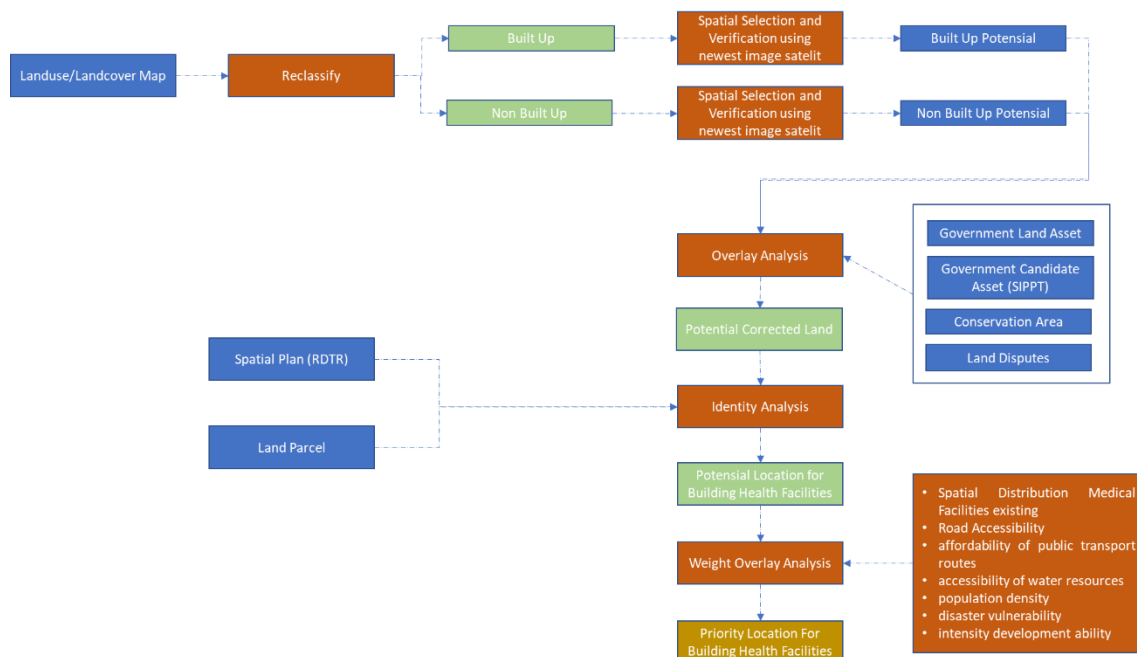
The following is the result of the formulation of the parameters of each variable/indicator for assessing the priority locations for the development of puskesmas.

**Table 1.** Variables/Indicators of Priority Assessment of Health Center Development in DKI Jakarta

| Indicator                                            |       |                                 | Parameter    |
|------------------------------------------------------|-------|---------------------------------|--------------|
| Accessibility of Clean Water/Drinking Source Network | Water | Proximity to Clean Water Access | $\leq 50$ m  |
|                                                      |       |                                 | 50 - 100 m   |
|                                                      |       |                                 | $\geq 100$ m |
|                                                      |       | Proximity to Road Access        | $\leq 50$ m  |

|                                          |                    |                                                                                              |
|------------------------------------------|--------------------|----------------------------------------------------------------------------------------------|
| Road Accessibility                       | Network Conditions | Proximity to Road Access 50 - 100 m                                                          |
|                                          |                    | Proximity to Road Access $\geq 100$ m                                                        |
|                                          |                    | Passed Directly by Public Transportation                                                     |
| Affordability of Public Transport Routes |                    | Not Followed Directly by Public Transport But Still Can Be Continued by Walking $\leq 500$ m |
|                                          |                    | Not Passed Directly by Public Transportation                                                 |
|                                          |                    | No Events of Flood Disaster Within 1 year                                                    |
| Flood Vulnerability                      |                    | There was a Flood Disaster 1x in 1 year                                                      |
|                                          |                    | There is a Flood Disaster $> 1x$ in 1 year                                                   |
| Fire Vulnerability                       | Disaster           | No Fire Disaster Events                                                                      |
|                                          |                    | There's a Fire Disaster                                                                      |
| Ability Intensity                        | Development        | High Developability (Allowed $\geq 5$ Floors)                                                |
|                                          |                    | Moderate Development Ability (3-4 Floors Allowed)                                            |
|                                          |                    | Low Expandability (Allowed $\leq 2$ Floors)                                                  |
| Detailed Spatial Plan                    |                    | Enter the Cultivation Area and SPU Zone                                                      |
|                                          |                    | Enter the Cultivation Area But Not the SPU Zone                                              |
|                                          |                    | Inside Protected/Conservation Zone                                                           |

GIS-Multi criteria analysis of the above variables is carried out, namely GIS-Multi criteria Analysis of the previous analysis by excluding government asset land, government candidate assets, conservation areas and land disputes

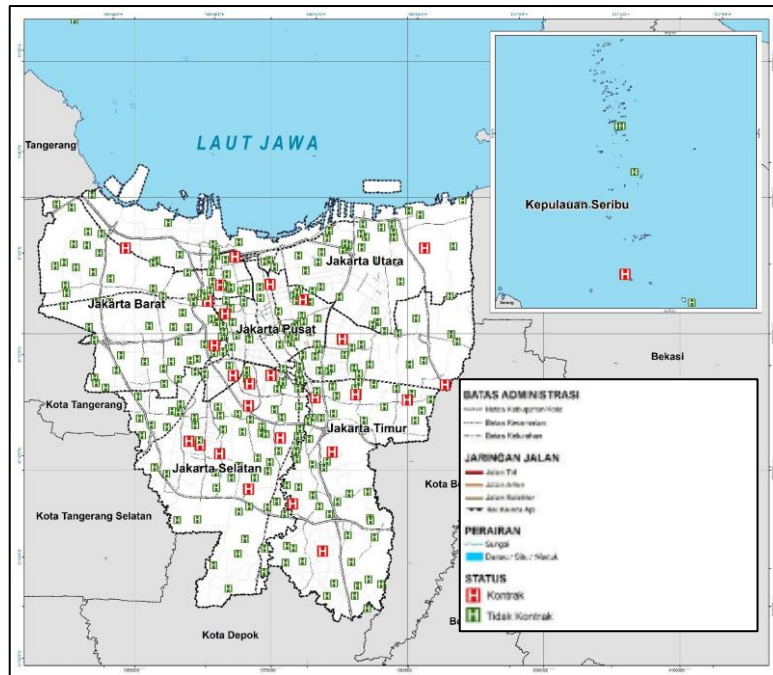


**Figure 3.** Research Flow Chart

### 3. Result and Discussion

#### A. Medical Facilities in DKI Jakarta Village

The Village Health Center is a Service Unit of the Sub-District Health Center in implementing health services in the Village Area. The Village Health Center is led by a Head of Service Unit called the Head of the Village Health Center, who is under and responsible to the Head of the Sub-District Health Center.

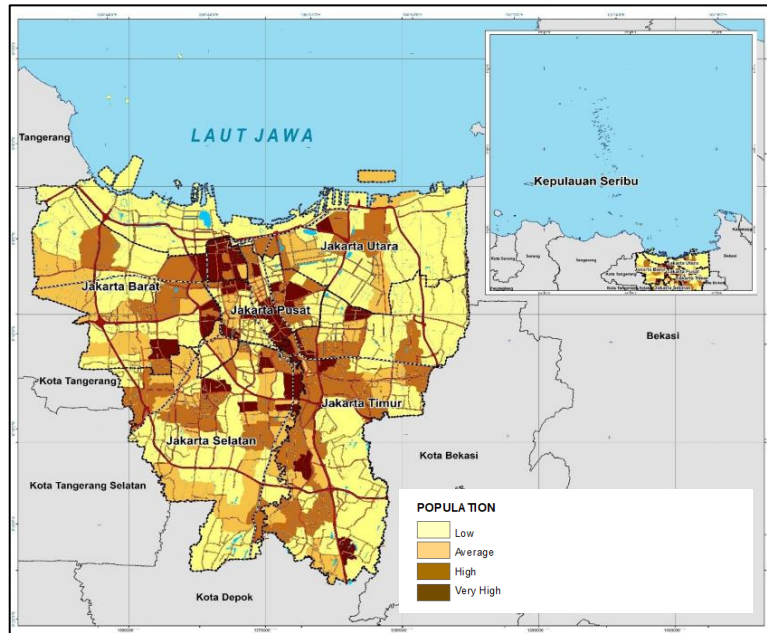


**Figure 4.** Map Distribution of Public Medical Facilities (PUSKESMAS) in DKI Jakarta

Based on Puskesmas data sourced from the DKI Jakarta Provincial Government Health Service in 2020, as many as 271 Village Health Centers in each administrative city area have non-contract status or have occupied the designated asset land for puskesmas, but there are still 27 Puskesmas with contract status spread throughout the city area. Administration. The status of Village Health Centers in DKI Jakarta Province, the number of Village Health Centers in DKI Jakarta Province, and the Distribution Map of Village Health Centers in DKI Province can be seen in the table and figure 4.

#### B. Population Density

A higher population ( $\geq 5000$  inhabitants according to the standards) is suitable for the establishment of a new health center (MBI Bienvenu Magloire et al., 2022). Placement of hospitals near housing is an important factor to ensure accessibility (Rezayee, 2020). Based on population data sourced from the Directorate General of Population and Civil Registration of the Ministry of Home Affairs in 2021, DKI Jakarta Province according to the classification of densely populated areas has four classifications of densely populated areas, namely: Low ( $<150$  People/Ha), Moderate (151-200 People/ Ha), High (201-400 People/Ha) and Very High ( $> 400$  People/Ha). The classification of densely populated areas for each sub-district in DKI Jakarta Province can be seen in Figure 5 below



**Figure 5.** Map of Population Density in DKI Jakarta

*C. The Urgency of Needs for Development of Community Health Centers Based on the Need for Replacement Land*

Based on the results of the analysis of data on the distribution of health centers, there are several health centers which are still contract status health center buildings, namely seven (7) village DKI Jakarta as shown in the following table:

**Table 2.** Village Priority for Public Health Center Procurement Based on land status

| No | Village                | Information                                                                               |
|----|------------------------|-------------------------------------------------------------------------------------------|
| 1  | Cideng                 | The Health Facilities (PUSKESMAS) is in contract status and does not have land allocation |
| 2  | Cipete Utara           |                                                                                           |
| 3  | Gedong                 |                                                                                           |
| 4  | Gondangdia / Pinangsia |                                                                                           |
| 5  | Gunung Sahari Utara    |                                                                                           |
| 6  | Jati Padang            |                                                                                           |
| 7  | Semper Timur           |                                                                                           |

Based on the results of the analysis between population density and land status of the puskesmas in the village, the urgency classification of land requirements for the construction of the puskesmas is obtained as follows:

**Table 3.** Classification of Population Density Areas in DKI Jakarta Province

| No | City            | Districts   | Village             | Population | Area (Ha) | Density (People/Ha) | Classification |
|----|-----------------|-------------|---------------------|------------|-----------|---------------------|----------------|
| 1  | Central Jakarta | Cilincing   | Semper Timur        | 3028       | 442.61    | 6.84                | Low            |
| 2  | Central Jakarta | Menteng     | Gondangdia          | 4799       | 146.53    | 32.75               | Low            |
| 3  | Central Jakarta | Sawah Besar | Gunung Sahari Utara | 20190      | 207.8     | 97.16               | Low            |

|   |                 |                |              |       |        |        |           |
|---|-----------------|----------------|--------------|-------|--------|--------|-----------|
| 4 | Central Jakarta | Gambir         | Cideng       | 18639 | 126.56 | 147.27 | Low       |
| 5 | East Jakarta    | Pasar Rebo     | Gedong       | 45195 | 245.53 | 184.07 | Average   |
| 6 | South Jakarta   | Pasar Minggu   | Jati Padang  | 46881 | 239.85 | 195.46 | Average   |
| 7 | South Jakarta   | Kebayoran Baru | Cipete Utara | 42237 | 170.88 | 247.17 | High      |
| 8 | West Jakarta    | Taman Sari     | Pinangsia    | 39450 | 98.03  | 402.41 | Very High |

The table above shows that the Pinangsia Village has a Very High classification related to Community Health Centers that have Urgent Needs for Development of Community Health Centers which will then be analyzed regionally.

### 1. Variable Accessibility of Clean Water/Drinking Water Source Networks

Spatial analysis of network accessibility variables for clean water/drinking water sources is carried out by translating variables/indicators of network accessibility for clean water/drinking water sources into a map which is categorized into 3 parameters as follows:

1. Served directly by a network of clean water/drinking water sources (radius <50 M)
2. Not served directly by a network of clean water/drinking water sources (radius 50 - 100 M)
3. Not served by a network of clean water/drinking water sources (radius > 100 M)

**Table 4.** Number of Potential Plots Based on Drinking Water Variables in Pinangsia village at 2022

| Parameter Category                                                                         | Ownership Parcel | HGB Parcel | Right of Use Parcel | Unidentified Parcels | Total |
|--------------------------------------------------------------------------------------------|------------------|------------|---------------------|----------------------|-------|
| Served directly by a network of clean water/drinking water sources (radius <50 M)          | 9                | 11         | 0                   | 3                    | 23    |
| Not served directly by a network of clean water sources/drinking water (radius 50 - 100 M) | 0                | 0          | 0                   | 0                    | 0     |
| Not served by a clean water/drinking water supply network (radius > 100 M)                 | 0                | 0          | 0                   | 0                    | 0     |

### 2. Road Network Accessibility Condition Variables

The location for the construction of the hospital must be near the main road so that it has easy accessibility (Rezayee, 2020). Road accessibility in this variable is assessed from the distance traveled between the potential land location and the nearest main road. The shorter the distance traveled, the easier it will be for various parties, both health workers and the public, to reach puskesmas facilities. the results in the buffering analysis and overlay analysis will get category 3 road network accessibility variable parameters, namely:

1. Proximity to road access  $\leq 50$  M
2. Proximity to road access 50 - 100 M
3. Proximity to road access  $\geq 100$  M

**Table 5.** Number of Potential Plots Based on Road Variables in Pinangsia Village 2022

| Parameter Category                    | Owners<br>hip<br>Parcel | HGB<br>Parcel | Right of<br>Use Parcel | Unidenti-<br>ed Parcels | Total |
|---------------------------------------|-------------------------|---------------|------------------------|-------------------------|-------|
| Proximity to road access $\leq 50$ M  | 7                       | 7             | 0                      | 2                       | 16    |
| Proximity to road access 50 - 100 M   | 2                       | 4             | 0                      | 1                       | 7     |
| Proximity to road access $\geq 100$ M | 0                       | 0             | 0                      | 0                       | 0     |

### 3. Variable Affordability of Public Transport Routes

The level of public transport services is the quality and quantity provided by transportation facilities, including quantifiable characteristics such as safety, travel time, frequency, travel costs, number of transfers and characteristics that are difficult to quantify such as comfort, availability, convenience and mode of image (AASHTO, 1983). Spatial analysis of affordability variables on public transport routes by translating the variables/indicators of accessibility of public transport routes into a map which is divided into 3 parameters, namely:

1. Passed directly by public transport
2. Not passed directly by public transport
3. Not traversed directly by public transportation but can still be continued on foot  $\leq 500$  meters

**Table 6.** Number of Potential Plots Based on Public Transport Route Variables in Pinangsia Village in 2022

| Parameter Category                                                                                         | Ownership<br>Parcel | HGB<br>Parcel | Right of<br>Use Parcel | Unidentified<br>Parcels | Total |
|------------------------------------------------------------------------------------------------------------|---------------------|---------------|------------------------|-------------------------|-------|
| Passed directly by public transport                                                                        | 1                   | 0             | 0                      | 0                       | 1     |
| Not passed directly by public transport                                                                    | 133                 | 124           | 0                      | 15                      | 272   |
| It is not traversed directly by public transportation but can still be continued on foot $\leq 500$ meters | 4                   | 0             | 0                      | 2                       | 6     |

### 4. Flood Event Variable

The flood hazard variable is very important because the location of the health service facility in a flood-free area will make it easier for the health service facility to provide health services to people who need treatment for their health problems or in other words the location of the puskesmas land area which is not on flood land or the location. If the puskesmas land is not on an access road that has a high flood hazard, the health service process will not be disrupted in providing health services to the community. The results in this Reclassify (Grouping) analysis will get category 3 variable parameter flood hazard variables, namely:

1. There have been no incidents of floods in the last 5 years
2. There was an incident of 1x flood in the last 5 years
3. There has been a flood disaster  $>1x$  in the last 5 years



**Table 7.** Number of Potential Plots Based on Flood Variables in Pinangsia Village in 2022

| Parameter Category                                         | Ownership Parcel | HGB Parcel | Right of Use Parcel | Unidentified Parcels | Total |
|------------------------------------------------------------|------------------|------------|---------------------|----------------------|-------|
| There have been no incidents of floods in the last 5 years | 3                | 1          | 0                   | 2                    | 6     |
| There has been a 1x flood disaster in the last 5 years     | 135              | 123        | 0                   | 15                   | 273   |
| There was a flood disaster > 1x in the last 5 years        | 0                | 0          | 0                   | 0                    | 0     |

#### 5. Fire Disaster Vulnerability Variable

According to PU No: 22/PRT/M/2007, the level of vulnerability is a measure that states the high or low or the probability that an area or zone may experience a fire disaster which is measured based on the level of natural physical vulnerability and the level of vulnerability due to human activities. The result of the reclassification analysis is to get the variable parameters of fire disaster vulnerability, namely there are no fire incidents:

1. There was no incident of fire disaster
2. Fire disaster incident

**Table 8.** Number of Potential Plots Based on Fire Variables in Pinangsia Village in 2022

| Parameter Category           | Ownership Parcel | HGB Parcel | Right of Use Parcel | Unidentified Parcels | Total |
|------------------------------|------------------|------------|---------------------|----------------------|-------|
| There were no fire incidents | 9                | 11         | 0                   | 3                    | 23    |

#### 6. Capacity Development Intensity

The intensity development capability variable is very important because knowing the intensity development ability in the Building Floor Coefficient (KLB) will serve as a guideline in the utilization of space in health facility buildings in providing health services to the community by considering space requirements along with space utilization efficiency in buildings. The result in this overlay analysis is to get 3 variable parameters the ability to develop intensity, namely:

1. High expandability (Allowed  $\geq 5$  Floors)
2. Moderate Development Ability (3-4 Floors Allowed)
3. Low Developability (Allowed  $\leq 2$  Floors)

**Table 9.** Number of Potential Plots Based on Intensity Development Variables in Pinangsia Village in 2022

| Parameter Category                              | Ownership Parcel | HGB Parcel | Right of Use Parcel | Unidentified Parcels | Total |
|-------------------------------------------------|------------------|------------|---------------------|----------------------|-------|
| Development Capability High (Allowed $\geq 5$ ) | 9                | 11         | 0                   | 3                    | 23    |
| Development Capability Medium (Allowed 3-4)     | 0                | 0          | 0                   | 0                    | 0     |
| Development Capability Low (Allowed $\leq 2$ )  | 0                | 0          | 0                   | 0                    | 0     |

#### 7. Detailed Spatial Plan

The variable of the zoning development plan is very important because the location of the health service facility must be in accordance with the designation of the spatial

pattern in the Detailed Spatial Plan (RDTR) so that it complies with the zoning regulations so that it can provide health services in an appropriate and directed manner to people who need health services. The result in this overlay analysis will get 3 variable parameters of the zoning development plan, namely:

1. Enter the cultivation area and SPU zone
2. Enter the cultivation area but not the SPU zone
3. Enter the protected area.

**Table 10.** Number of Potential Plots Based on Zoning Development Ability Variables in Pinangsia Village in 2022

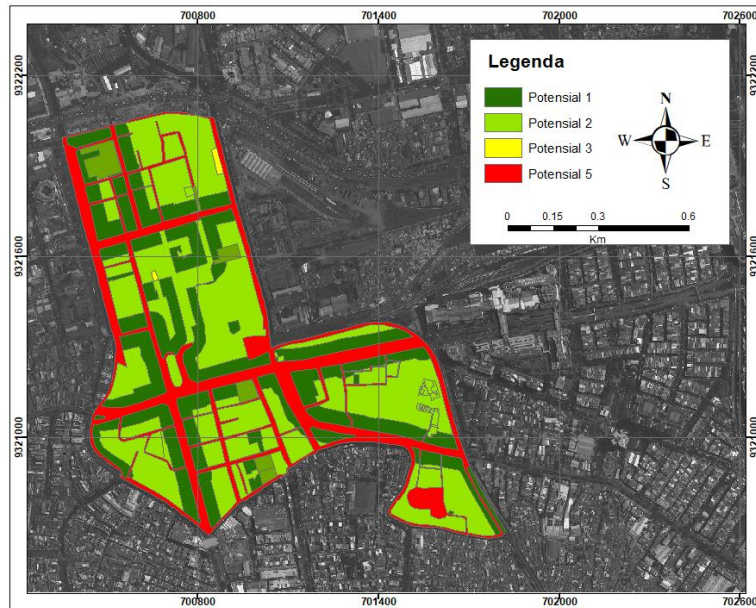
| Parameter Category                              | Ownership Parcel | HGB Parcel | Right of Use Parcel | Unidentified Parcels | Total |
|-------------------------------------------------|------------------|------------|---------------------|----------------------|-------|
| Enter the cultivation area and SPU zone         | 3                | 0          | 0                   | 0                    | 3     |
| Enter the cultivation area but not the SPU zone | 130              | 123        | 0                   | 14                   | 267   |
| Enter the protected area                        | 5                | 1          | 0                   | 3                    | 9     |

#### *D. Priority Land for Community Health Center Health Service Development*

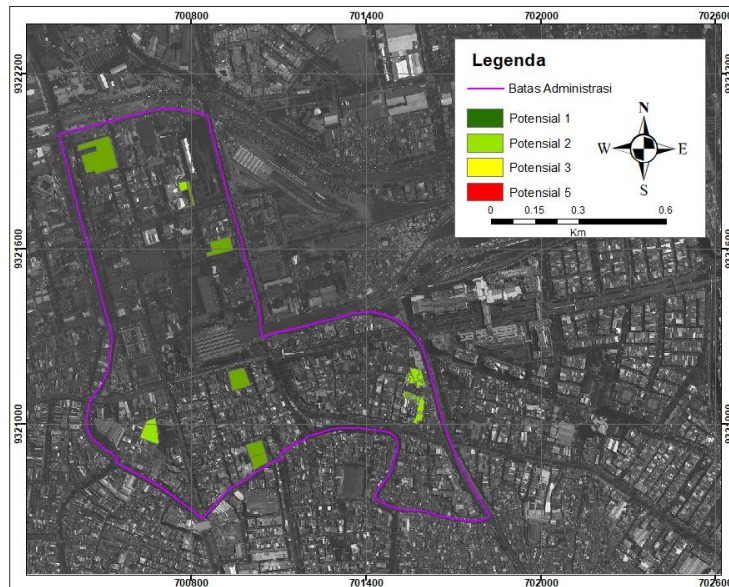
Pinangsia Village has a total of 23 potential parcels which are dominated by potential parcels with priority category 2 with a total of 16 parcels, followed by priority category 1 with a total of 7 plots. If seen from the status of their rights, they are dominated by HGB status, totaling 11 parcels are in priority category 2 entirely. Plots with freehold status occupy the second dominance with a total of 9 parcels, consisting of 6 parcels with category 1 priority, and 3 parcels with priority 2. Then there are 3 parcels with ownership status that have not been identified, with dominance in the priority category 2 totaling 2 plots, and priority 1 totaling 1 parcel. For more details can be seen in the table, diagram and map below.

**Table 11.** Number of Potential Plots Based on Zoning Development Ability Variables in Pinangsia Village in 2022

| Priority Level | Ownership Parcel | HGB Parcel | Right of Use Parcel | Unidentified Parcels | Total     |
|----------------|------------------|------------|---------------------|----------------------|-----------|
| Priority 1     | 6                | 0          | 0                   | 1                    | 7         |
| Priority 2     | 3                | 11         | 0                   | 2                    | 16        |
| Priority 3     | 0                | 0          | 0                   | 0                    | 0         |
| Priority 4     | 0                | 0          | 0                   | 0                    | 0         |
| Priority 5     | 0                | 0          | 0                   | 0                    | 0         |
| <b>Total</b>   | <b>9</b>         | <b>11</b>  | <b>0</b>            | <b>3</b>             | <b>23</b> |



(a)



(b)

**Figure 6.** Land acquisition priority map for health facilities in of Pinangsia Urban Village Plots/Assets. (a) Final Scoring (b) Priority Parcel



**Figure 7.** Non-Potential Assets (Individual)  
(a) Vacant Land (b) Slum Buildings

The limitation of this research is that it does not include and consider the land price factor, so that potential land has the possibility of having a high price.

#### 4. Conclusion

Based on spatial analysis based on geographic information systems, modeling of potential health facility land (PUSKESMAS) in Pinangsia village based on regional analysis can be produced. This analysis looks at the potential of land for health facilities based on data on Accessibility of Clean/Drinking Water Source Networks, Accessibility Conditions of the Road Network, Affordability of Public Transport Routes, Flood Hazard, Fire Hazard, Intensity Development Capacity and Zoning Development Plans. Based on the results of the analysis, the number of potential parcels obtained is 23 potential parcels which are dominated by potential parcels with priority category 2 with a total of 16 parcels, followed by priority category 1 with a total of 7 parcels. Through the results of this research, it is hoped that the DKI Jakarta government will be able to determine the ideal location for land acquisition for PUSKESMAS from a social, economic and territorial perspective.

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