

**USING OF N-DIMENSIONAL EUCLIDEAN DISTANCE
TO DETERMINE LOCATION WITH LACK OF HOSPITAL WITH
HEALTH SOCIAL SECURITY AGENCY SERVICE**

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ABSTRACT

Health Social Security Agency or Badan Penyelenggara Jaminan Sosial Kesehatan (BPJSK) is a health to make people pays inexpensive price to get medical treatment. One of the shortcomings of BPJSK is regency of BPJSK card owner must be identical with the regency of target hospital. Lampung Province has varying location and uneven distribution of hospitals especially in regencies. This study aims to determine location with lack of hospital with BPJSK by using of n-dimensional Euclidean distance. The three-dimensional coordinate of 2098 sample points (SP) and 77 hospitals are the quantitative parameter used to calculate the distance. Every hospital and SP are assigned an identity number depending on the regency of each hospital and SP. Each SP pairs with its closest hospital. The SP with different identity is grouped. 32.1% of area of Lampung Province is the location with lack of hospital with BPJSK. The most prioritized regencies is Pringsewu Regency based on the distance and the population. Further research about spatial analyzing the exact location to build hospital with BPJSK service should be conducted.

Keywords: *Minimum Distance; BPJS; Health Service; Closest Hospita; Population.*

A. INTRODUCTION

Health Social Security Agency or Badan Penyelenggara Jaminan Sosial Kesehatan (BPJSK) is a health service provided by Indonesian government. BPJSK is established in 2014 based on Peraturan BPJS Number 1 of 2014 (Republic of Indonesia, 2014). It collaborates with not all hospitals, but with only some hospitals (BPJS Kesehatan, 2014). People seeking medical treatment in the hospital with BPJSK service pays inexpensive price by showing BPJSK card. People get charged every month to keep the BPJSK card active.

BPJSK system have some shortcomings such as regency of BPJSK

card owner must be identical with the regency of target hospital. The other problems are related to procedure and human resources and the information socialization (Widiastuti, 2017; Widada et al., 2017). People from different regency can get treatment from the hospital by preparing referral letter from the written regency in their BPJSK card in the capital of the regency (Mariyam, 2018). It will be a big problem for the people that located closer to the hospital in the different regency than the hospital in the same regency. Moreover, it is also much closer than the capital of regency so that people is more likely to choose closer hospital

with expensive cost than far hospital with inexpensive cost. This problem is as important to solved as reliability, responsiveness, and assurance of BPJSK (Lahdji et al., 2017).

Distribution of hospitals in Lampung Province are not evenly distributed so that it needs more hospitals. The mentioned location is the area where the closest hospital with BPJSK is in the different regency. Hypothetically, it is located in outskirts of regency which people often spend their time in the different regency (Sukirno, 2017). Distance from residential area to the hospital is the key parameters to determine the location (Feikin et al., 2009; Goodman et al., 1997). However, Lampung Province is located in various elevations from 0 to 2262 meters from means sea level so it is necessary to consider elevation using N-dimensional Euclidean distance (Surya and Astuti, 2017; Shih and Wu, 2004). This study aims to determine location with lack of hospital with BPJSK by using of n-dimensional Euclidean distance.

B. MATERIALS AND METHODS

The research is conducted in Lampung Province. It is shown on Figure 1 and the explanation of regency abbreviation in Figure 1 is shown on Table 1. There are total 15 regencies and 9,626,107 people in Lampung Province (BPS, 2020). Data used in the research are the hospital with BPJSK which is obtained from Health Human Resources Information Agency. The two-dimensional coordinate of hospitals is obtained from Google Maps (Google, 2021). The other data are the elevation as well as the regency border which are obtained from National Geospatial Information Agency of Indonesia. The sample of research area are sample points (SP) which are evenly distributed in Lampung Province. The two-dimensional coordinate of SP, the two-dimensional coordinate of hospitals, elevation of both SP and hospitals, and the total population of each districts and regencies in Lampung Province are the quantitative parameter used in this research.

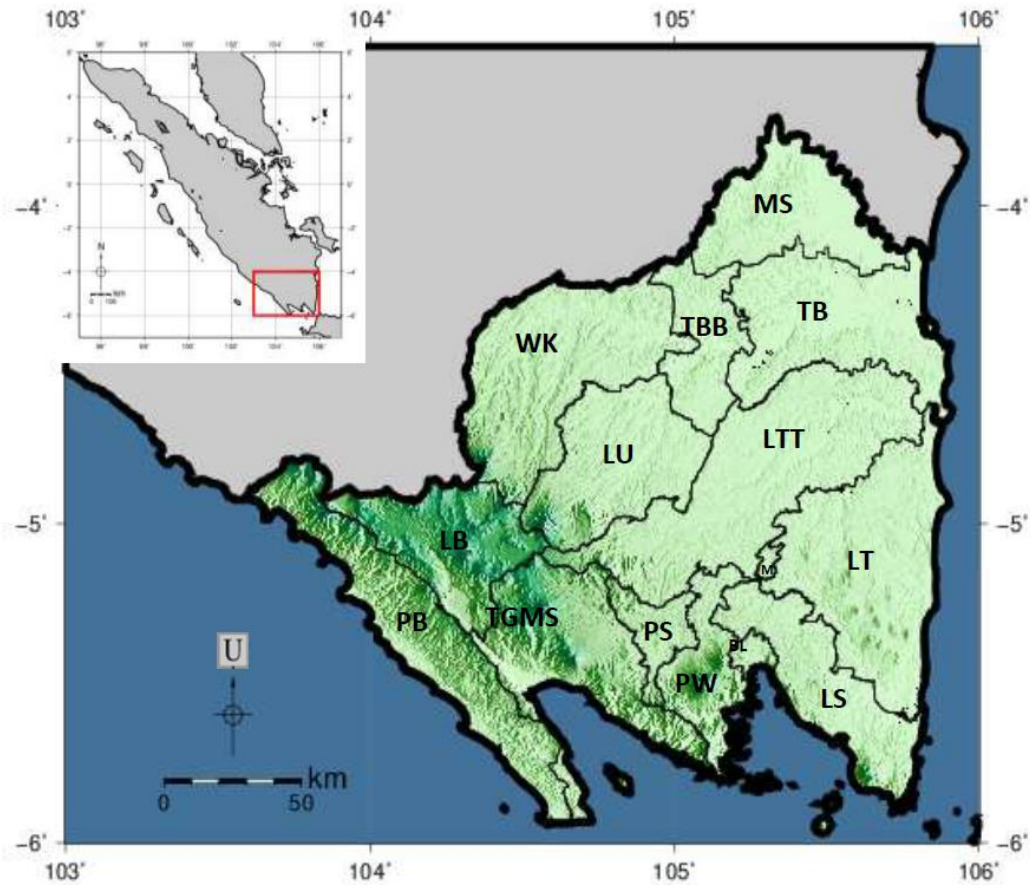


Figure 1. Research Area

Table 1. Expalanation of Abbreviation of Regency

Regency Code	Regency Name
LT	Lampung Tengah
LU	Lampung Utara
PB	Pesisir Barat
LB	Lampung Barat
WK	Way Kanan
TGMS	Tanggamus
TBB	Tulang Bawang Barat
PS	Pringsewu
TB	Tulang Barat
PW	Pesawaran
MS	Mesuji
LS	Lampung Selatan
M	Metro
LT	Lampung Timur
BL	Bandar Lampung

Every hospital and SP are assigned an identity number depending on the regency of each hospital and SP before conducting distance calculation. The SP are distributed in all regencies except Bandar Lampung City and Metro City since the distribution and the number of hospitals of BPJS there are relatively high compared to other regencies as shown on Figure 2. The SP are the intersection of grid with certain interval (Ceccato et al.,

2019) which cover all of the research area. The distance of SP is made as minimal as possible to make the number of SP as many as possible. However, in order to make the calculation faster, the optimal number of SP are obtained after each district in research area has at least one SP. The mentioned districts are all districts in Lampung Province outside Bandar Lampung City and Metro City. The calculated distance between SP are 4 km.

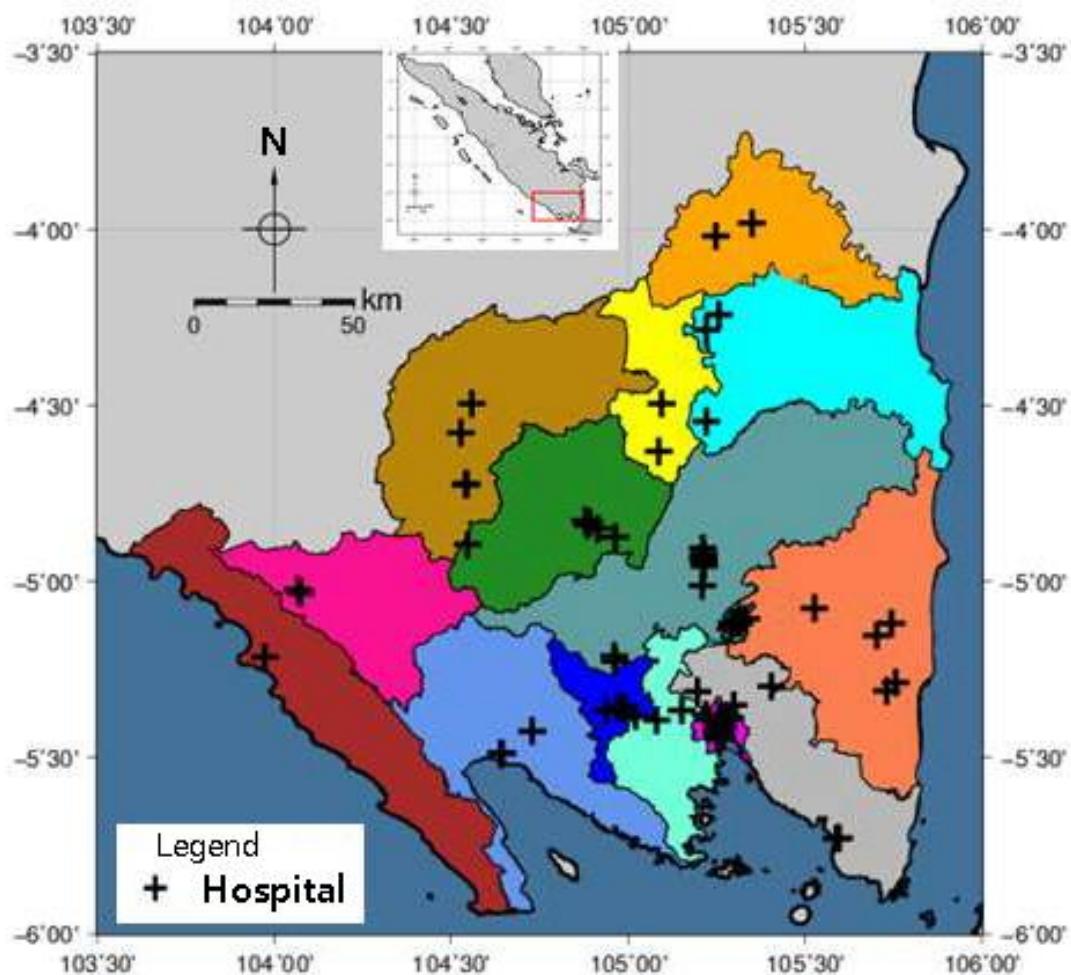


Figure 2. Distribution of Hospitals

The n-dimensional Euclidean distance is calculated from each SP with three-dimensional coordinate to each hospital with three-dimensional coordinate. The three-dimensional coordinate is obtained by combining two-dimensional coordinate point with its elevation. The number of calculations is 161546 calculations since there are 2098 SP and 77 hospitals. The calculation of three-dimensional distance using N-dimensional Euclidean Distance as shown in Equation 1 (Johnson and Wichern, 2002; Alif et al., 2020a).

$$D_{PH} = \sqrt{(X_P - X_H)^2 + (Y_P - Y_H)^2 + (Z_P - Z_H)^2} \quad (1)$$

where X_P is the x-coordinate of SP, Y_P is the y-coordinate of SP, Z_P is the z-coordinate of SP, X_H is the x-coordinate of hospital, Y_H is the y-coordinate of hospital, Z_H is the z-coordinate of hospital, and D_{PH} is the distance between SP and hospital.

Location determination with lack of hospital with BPJSK (X area) is based only from distance calculation. It does not consider other factors that determine the feasibility of hospital construction such as land use, land slope, road class, air pollution level, and noise level which are outside the scope research. This research is preliminary research to determine the location with lack of hospital with BPJSK and the research using those parameters

should be conducted after this research (Purnomo et al., 2017). The process of this research is shown in Figure 3. Closest hospital from each SP is calculated from minimal value of calculated distance to all 77 hospitals so that each SP pairs with its closest hospital. Regency identity numbers which is assigned before distance calculation are key factors to determine the location. The identity pairing will lead two different result: same identity numbers and different identity numbers. The pairings with different identity numbers leads to difference regency so that people from the such SP must go to hospital from the other regency which is their closest hospital. All of SP with different identity numbers with its closest hospital are grouped and classified together.

The SP with different identity numbers or regency are transformed into X area and the population of the involved district are used to determine priority district to build hospital with BPJSK. The X area is generated by drawing polygon covering all of the SP. It also covers the area between the SP and regency boundaries. The number of districts and which districts that is part of the X area are determined. The percentage of districts covered by the X area is also determined to obtain the population of the X area. The illustration of the district that covered by

the area with its SP are shown in Figure 4. It shows one district with the yellow color show the covered X area with different identity numbers and gray color show the area with same identity numbers. The percentage of district covered by the X

area is assumed similar to the percentage of population reside in the X area. It assumes the people reside in the districts are distributed equally. The district is ranked based on the number of populations resides in the covered X area.

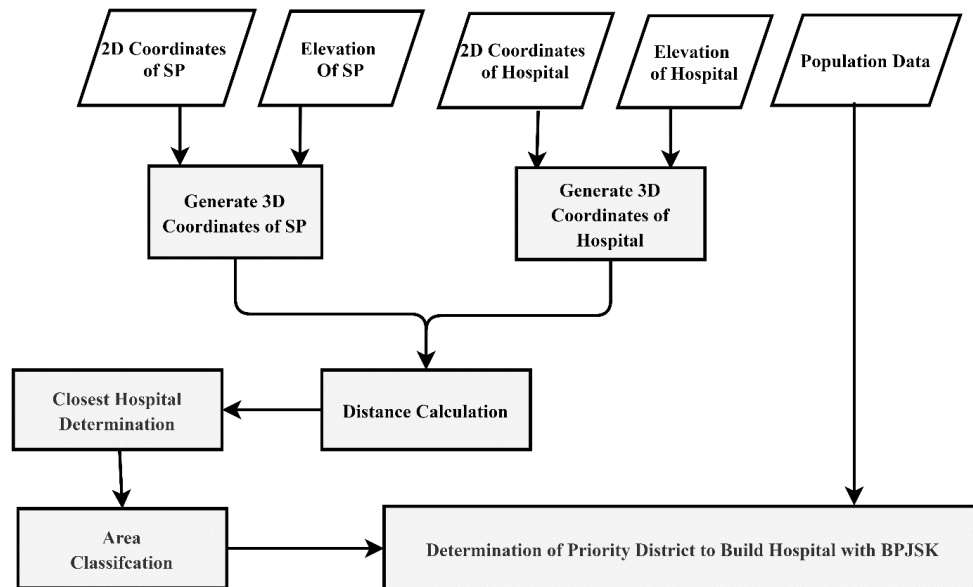


Figure 3. Research Flowchart

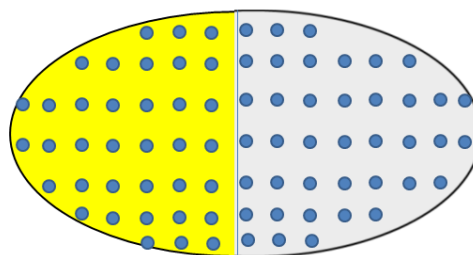


Figure 4. The illustration of district with its SP covered by the X area.

C. RESULTS AND DISCUSSION

32.1% of area of Lampung Province is the location with lack of hospital with BPJSK. The distribution of SP and the result of classification is shown Figure 5. The dark gray dots are SP pairing with the closest hospital from different regency.

The people from those SP is more likely to choose closer hospital with expensive cost in different regency than far hospital with inexpensive cost in the same regency. The different regency hospital is expensive since BPJSK is not applied for people

from different regency. The light gray dots are SP pairing with the closest hospital from same regency which is not further discussed in this research. The percentage of area of dark gray dots over area of Lampung Province is 32.1%.

The most prioritized district to build hospital with BPJSK is Negeri Besar District, in Way Kanan Regency. The X area are drawn to cover all of the SP classified as dark grey dots in Figure 5. The X area are shown as various colors in Figure 6. The darker colors show the district that is most prioritized district to build hospital with BPJSK while the lighter colors show the district that is least prioritized district to build hospital with BPJSK. There is no polygon drawn to

cover light gray dots in Figure 5 since the closest hospital from those area is still located in the same regency with most of them located far from regency boundaries. In the contrary, the X area are located close to regency boundaries. It shows that hospital in Lampung Province is not distributed equally especially in the boundaries area. This makes people in the boundaries area cannot get medical treatment which is both inexpensive and near. Pesisir Barat Regency and Lampung Barat Regency are regency having X area far from boundaries. It shows the lack of hospital with BPJSK in those two regencies. It is crucial since those two regencies are prone to landslides which can cause injuries (Iqbal et al., 2017).

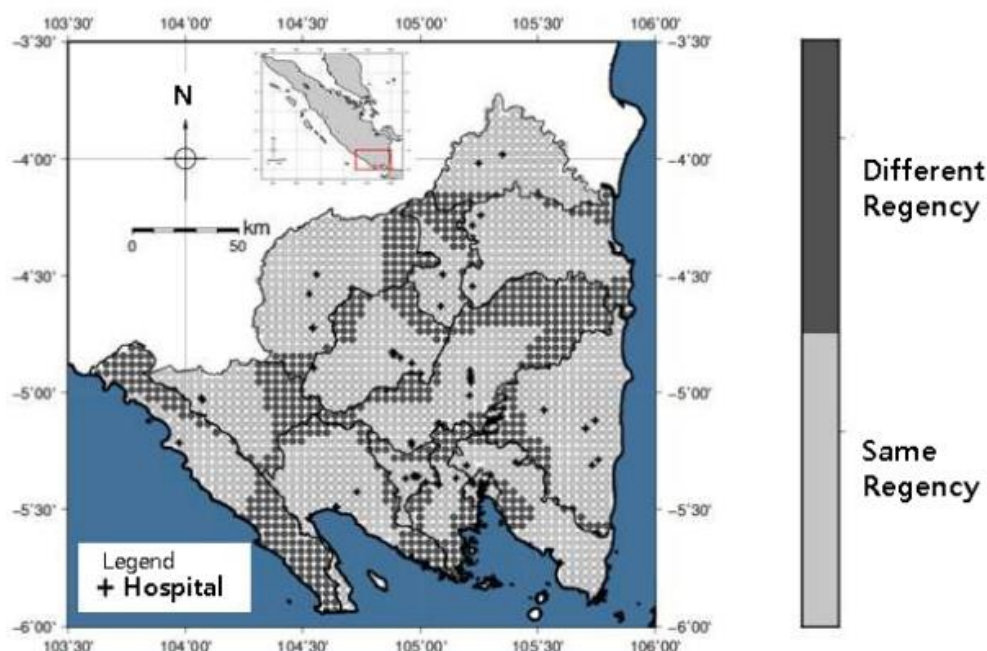


Figure 5. Classification of SP

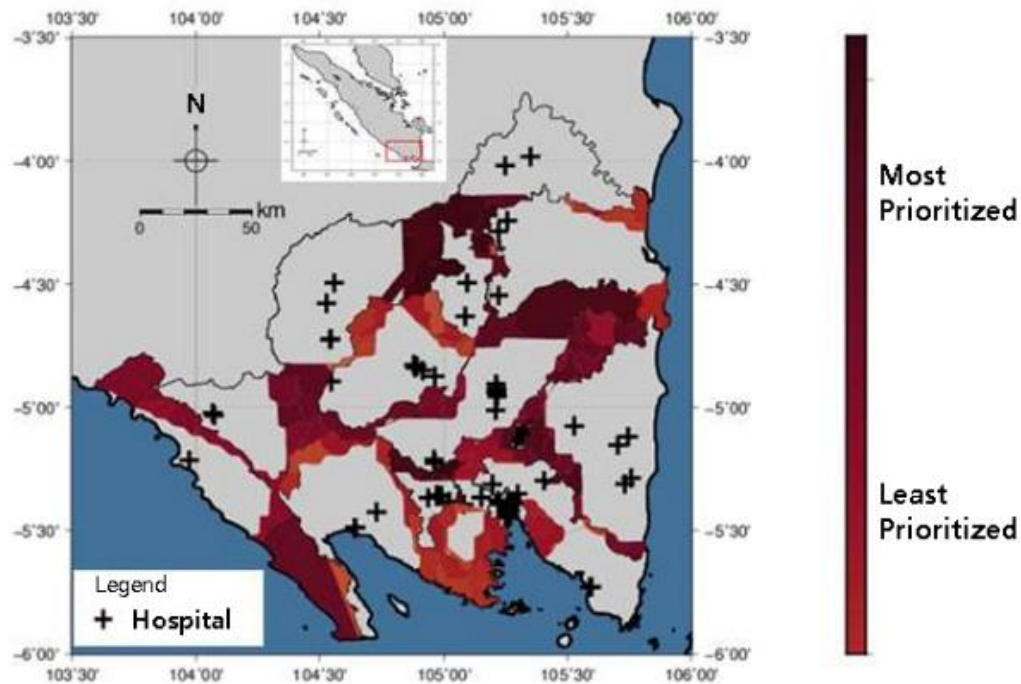


Figure 6. Classification of the X area

The X area are covering 119 districts in 13 regencies in Lampung Province. The Pringsewu regency is the regency which have most district that is categorized as the most prioritized districts. It is shown on Figure 7. The main factors that most prioritized district are Pringsewu Regency is the high population of Pringsewu Regency (Nurjannah et al., 2018). The X area in Lampung Province with the most population is shown on Table 2. The Adiluwih is the second most prioritized district to build hospital with BPJSK. The other districts in Pringsewu Regency are Sukoharjo, Gadingrejo, Banyumas, and Pagelaran Utara. The total population of X area int those districts are 898676 people and most of them must get medical treatment from the closest hospital on

other regency which is Lampung Tengah Regency. The number of hospitals in Pringsewu is a lot but it concentrated on the central districts.

The Tanggamus Regency is the regency after Bandar Lampung City and Metro City which hospital is distributed more equally. It is shown on Figure 8. It is not well distributed but it is better than the other regencies. The well-distributed hospital is good since there is potential of fault-generated earthquakes in the Tanggamus Regency (Alif et al., 2020b). The most prioritized district in Tanggamus Regency is Pugung District which is only in 81th rank from 119 districts. The factors that makes there is many least prioritized districts are the population of district in regency

boundaries and the lack of hospital with BPJSK in the regency bordering Tanggamus Regency. It is shown in Figure 8 that people in west regency boundaries of Tanggamus still get medical treatment from the closest hospital in the same regency. The number of hospitals in

Tanggamus Regency is low so that Tanggamus Regency and the regency bordering Tanggamus Regency: Pesisir Barat Regency and Lampung Barat are still needing more hospitals. The X area in Lampung Province with the least population is shown on Table 3.

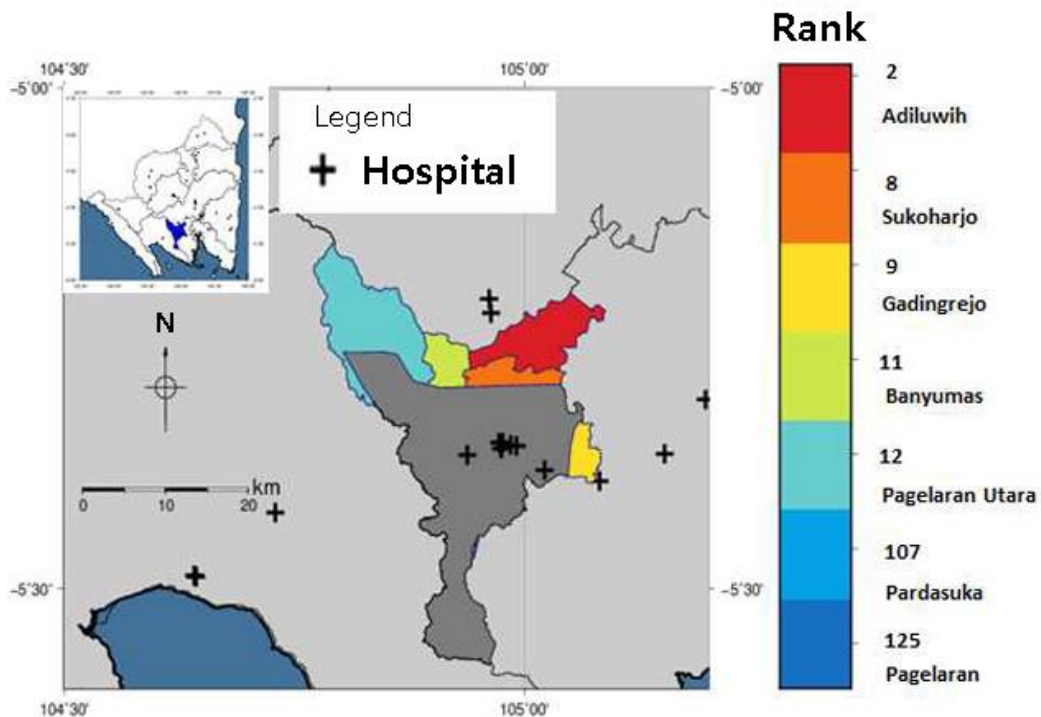


Figure 7. The most prioritized districts in Pringsewu Regency

Table 2. Population on the Most Prioritized Districts

Rank	District	Regency	Area of X Area (ha)	Population of X Area
1	Negeribesar	Way Kanan	22692.5	437858
2	Adiluwih	Pringsewu	6502.2	357721
3	Gunungagung	Tulang Bawang Barat	22316.8	330791
4	Negarabatin	Way Kanan	22204.4	288937
5	Lambukibang	Tulang Bawang Barat	7722.2	227489
6	Waykenanga	Tulang Bawang Barat	6647.5	226570
7	Wayserdang	Mesuji	9824.5	177008
8	Sukoharjo	Pringsewu	2312.1	175619
9	Gadingrejo	Pringsewu	1557.6	169546
10	Pakuanratu	Way Kanan	22306.5	137040
11	Banyumas	Pringsewu	2459.5	119088
12	Pagelaran Utara	Pringsewu	10288.3	103632

Table 3. Population on the Least Prioritized Districts

Rank	District	Regency	Area of X Area (ha)	Population of X Area
110	Ulubelu	Tanggamus	13462.6	60
111	Gedongtataan	Pesawaran	843.4	60
112	Waysulan	Lampung Selatan	873.4	51
113	Semaka	Tanggamus	1038.4	40
114	Sekincau	Lampung Barat	22.4	37
115	Sidomulyo	Lampung Selatan	549.7	30
116	Penawartama	Tulang Bawang	1244.9	27
117	Banjarbaru	Tulang Bawang	913.5	26
118	Limau	Tanggamus	526.9	9
119	Pematangsawa	Tanggamus	736.6	6

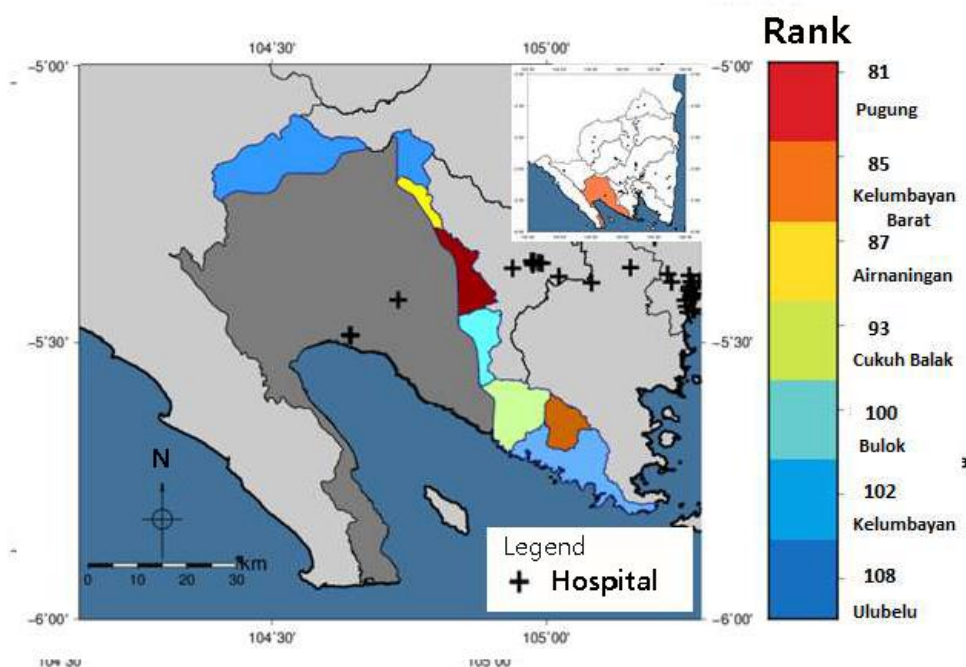


Figure 8. The least prioritized districts in Tanggamus Regency

D. CONCLUSIONS

The location with lack of hospital with BPJSK in Lampung Province is distributed in 13 regencies with the most prioritized regencies is Pringsewu Regency. The area is located close to regency boundaries showing that hospital is not distributed equally. This makes people in the boundaries area cannot get

medical treatment which is both inexpensive and near. N-dimensional Euclidean distance is properly used to calculate distance in the location with varying elevation. The more populated area in the districts in Pringsewu Regency and Way Kanan Regency are more priority regencies to build hospital with BPJSK.

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