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Threshold Analysis Of Public Cemeteries For Mapping The Suitability Of New Public Cemeteries In The Future Using Remote Sensing And Geographic Information Systems In Tasikmalaya City

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ABSTRAK

Jumlah Penduduk yang bertambah menyebabkan Adanya perubahan penggunaan lahan yang dikhawatirkan tidak terkontrol dan melupakan salah satu fasilitas umum yaitu pemakaman. Kota Tasikmalaya merupakan wilayah yang berfokus pada perdagangan dan jasa, padat penduduk, dan wilayah yang relatif cukup kecil, sehingga penyediaan lahan pemakaman harus diperhatikan. Penelitian ini bertujuan untuk menganalisis sebaran spasial pemakaman, daya tampung, ambang batas, dan wilayah kesesuaian pemakaman di Kota Tasikmalaya. Metode penginderaan jauh dan sistem informasi geografis digunakan untuk analisis. Parameter yang digunakan dalam menganalisis wilayah kesesuaian lahan pemakaman adalah penggunaan lahan, kemiringan lereng, jenis tanah, jarak dari sungai, jarak dari pemukiman, dan jarak dari jalan. Hasil penelitian ini menunjukkan bahwa 1) hasil dari pemetaan sebaran spasial pemakaman terdapat 101 pemakaman dengan luas ±74 Ha dengan 3 TPU yaitu TPU Cieunteung, TPU Cinehel, dan TPU Aisha Rashida. 2) Daya tampung dan ambang batas jika tanpa sistem tumpang susun, pemakaman umum di Kota Tasikmalaya tidak dapat menampung sampai 50 tahun kedepan baik dengan ukuran makam standar maupun ukuran makam hasil survei lapangan sedangkan jika sekali tumpang susun, pemakaman umum di Kota Tasikmalaya tidak dapat menampung sampai 50 tahun ke depan jika dengan ukuran makam hasil survei lapangan dan dapat menampung sampai 50 tahun ke depan jika dengan ukuran makam standar. 3) Hasil dari kesesuaian lahan pemakaman umum menunjukkan Kota Tasikmalaya memiliki wilayah sesuai, cukup sesuai, dan tidak sesuai yang masing-masing memiliki luasan 2231 Ha, 14192 Ha, dan 1999 Ha. Wilayah yang sesuai untuk pemakaman terkonsentrasi di Bagian Utara Kota Tasikmalaya.

Kata Kunci: Sebaran Spasial, Daya Tampung, Ambang Batas, Kesesuaian Lahan Pemakaman, Penginderaan Jauh, Sistem Informasi Geografis

ABSTRACT

The increasing population is causing changes in land use which are feared to be uncontrolled and forgetting one of the public facilities, namely cemeteries. The city of Tasikmalaya is an area that focuses on trade and services, is densely populated, and has a relatively small area so the provision of cemeteries land must be considered. This research aims to analyze the spatial distribution of cemeteries, capacity, thresholds, and suitability areas for cemeteries in Tasikmalaya City using Remote sensing methods and geographic information systems. The parameters used in in this study are; land use, slope, soil type, distance from rivers, distance from settlements, and distance from roads. The results of this research show that 1) Mapping the spatial distribution of cemeteries show that there are 101 cemeteries with an area of ±74 hectares with 3 TPUs, namely TPU Cieunteung, TPU Cinehel, and TPU Aisha Rashida. 2) Capacity and threshold if without an overlapping system, the public cemetery in Tasikmalaya City cannot accommodate the next 50 years, both with standard grave sizes and grave sizes from field surveys,

whereas if once overlapping, the public cemetery in Tasikmalaya City cannot accommodate up to 50 years in the future if you use the size of the grave from a field survey and can accommodate up to 50 years in the future if you use the standard grave size. 3) The suitability of public cemeteries grounds show that Tasikmalaya City has suitable, quite suitable and unsuitable areas, each of which has an area of 2231 Ha, 14192 Ha and 1999 Ha. Suitable areas for cemeteries are concentrated in the northern part of Tasikmalaya City.

Keywords: *Spatial Distribution, Capacity, Threshold, Suitability of Cementary Land, Remote Sensing, Geographyc Information System.*

INTRODUCTION

Currently, Indonesia's population growth rate based on the 2022 population census is at 1.17%. As the population increases, the need for housing, shops, public facilities and so on will also increase, while on the other hand, the available land is fixed and limited. the tendency for population activities to be more focused on providing land for residential areas and economic activities (Wulandari, 2014). On the other hand, the need for land for important public facilities, one of which is for cemeteries.

One of the public facilities that requires its existence and must be arranged in such a way is a cemetery. In fact, cemeteries are public facilities whose existence is often overlooked. These cemeteries must always exist and their existence must be maintained in every area, especially urban areas, considering that the number and population density of urban areas is usually greater and denser than rural areas. Cemeteries grounds are an important component in the human life cycle and therefore must be maintained (Sitio, 2015). Death is a certainty that every living creature will experience without exception (Pradana et al., 2021). The cemeteries place itself is included in the LULU (Locally Unwanted Land Use) category if viewed from the type of use which can be said to be absolute land, but regarding its existence it is undesirable (Aji, et al 2015).

The cemeteries location certainly has parameters so that the cemeteries place can be called ideal. Unfortunately, many cemeteries places are less than ideal, for example in densely populated areas, on the edge of rivers or in the middle of the city, this is not in accordance with regional spatial plans. Public cemeteries places are often associated with things that are mystical, occult, scary, haunted, and so on, making the place itself avoided, its existence less popular, or worse, there can be rejection from our community because its location is close to residential areas (Adriyanto, 2017). So this also becomes an obstacle for the government in fulfilling public cemeteries.

The city of Tasikmalaya is the location and place that is analyzed regarding the availability of public cemeteries grounds, including the threshold for cemeteries grounds. A cemeteries ground is certainly something that is really needed in burying bodies whether they died due to age or disease, including those who died due to a pandemic or epidemic. The problems described above regarding cemeteries grounds, such as their location and availability, are of course the City of Tasikmalaya which has these problems. Apart from that, cemeteries in Tasikmalaya City are still not optimally managed and well organized and this is a very serious problem regarding the availability and need for public cemeteries grounds.

The development of geographic science is relatively rapid with the existence of Remote Sensing and GIS or geographic information systems. Remote sensing and geographic information

systems themselves have many benefits in the geospatial field, including RS and GIS in geography which are very helpful in analyzing geographic data. One of the advances in geospatial technology in geographic information systems is the weighting and scoring method. Making maps with different levels of suitability of cemeteries grounds can be designed using these two technologies. Remote sensing consists of measuring and correcting electromagnetic energy emitted or reflected by the earth's surface and atmosphere from a certain place on the earth's surface (Somantri, 2008). Meanwhile, a geographic information system is defined as a computer-based system that has the ability to handle geographically referenced data, namely data entry, data management including storage and retrieval, data manipulation and analysis, as well as output as the final result. This final result (output) can be used as a reference in making policies or decisions on problems related to geography (Aronoff in Ariana, 2016).

In similar previous research, mapping the distribution of cemeteries mostly used secondary data from related agencies, for example research from Pradana et al., (2021) which examined the availability of burial plots during Covid-19 in the city of Surakarta, the burial data was secondary data, namely taken from data disclosure. or research from Amalia, (2015) which examined the availability of public burial grounds in the city of Surakarta whose source of burial data used secondary data, namely from related agencies there has been no research that has carried out cemeteries mapping with primary data, especially with delineation using satellite imagery. Primary data itself has the advantage of more accurate data, this is what is applied in this research for mapping spatial distribution. Capacity and threshold are based on variables that influence it, namely death rate, total cemeteries area, remaining cemeteries area, used cemeteries area, and grave size. The thing that needs to be emphasized is the size of the graves in previous research, which is different in each region, so adjustments need to be made to field data from the location or population of this research. Regarding the suitability of cemeteries, a summary of suitability parameters has been carried out from different journals. The variables in the journals Fadhil & Oktaviani (2019) and Adriyanto (2017) were combined, modified and made into a new set of parameters in this research.

In accordance with the problems and background previously explained, this research aims to know and analyze the spatial distribution of burial places in Tasikmalaya City based on image interpretation, know and analyze the availability of capacity for public cemeteries and the threshold for public cemeteries in Tasikmalaya City, identifying the suitability of suitable land for new cemeteries in Tasikmalaya City using a geographic information system. From the third objective above, it is hoped that the results of this research, in the form of maps, policies, findings, etc., can help all interested or related parties to further optimize research and be used as a reference for further relevant research.

From what has been described above, this makes the author interested in studying and analyzing a research entitled " Threshold analysis of public cemeteries for mapping the suitability of new public cemeteries in the future using remote sensing and geographic information systems in Tasikmalaya City".

RESEARCH METHODS

Time and Location of Research

The time used for this research was carried out from the beginning of the research, namely selecting the theme. Based on this, the research was carried out

for around 7 months starting from around August 2023 week 1 to February 2024. This time was used starting from preparation or pre-research, implementation of research, and completion or post-research.

Tasikmalaya City is an autonomous city that was legally formed based on Law no. 10 of 2001 concerning the formation of the City of Tasikmalaya. Reporting from the official website, Tasikmalaya City Government (2020). Based on geography, the city of Tasikmalaya is in the southeast of West Java Province. Astronomically, Tasikmalaya City is located at 108º08'83" – 108º24'02"East Longitude and 7º10'00"– 7º26'32"South Latitude (Figure 1). Tasikmalaya City is about 105 km away from Bandung City as the capital of West Java Province. Based on Tasikmalaya City Regional Regulation Number 4 of 2012 concerning Tasikmalaya City Regional Spatial Planning for 2011 – 2031, Tasikmalaya City has an area of 18385.07 Ha. The city of Tasikmalaya is at an altitude of between 201 – 503 meters above sea level and the slope of the land is relatively small when viewed topographically.

Tools And Materials

Tools are objects that are used to do something or that are used to achieve what is intended. The tools used in this research are divided into two, namely tools for collecting in situ data at locations which can be used for values or in formulas or checking the suitability of the coordinates of specified sample points and tools for processing spatial data. The tools used are shown in the Table 1, and the materials used in research show in Table 2.

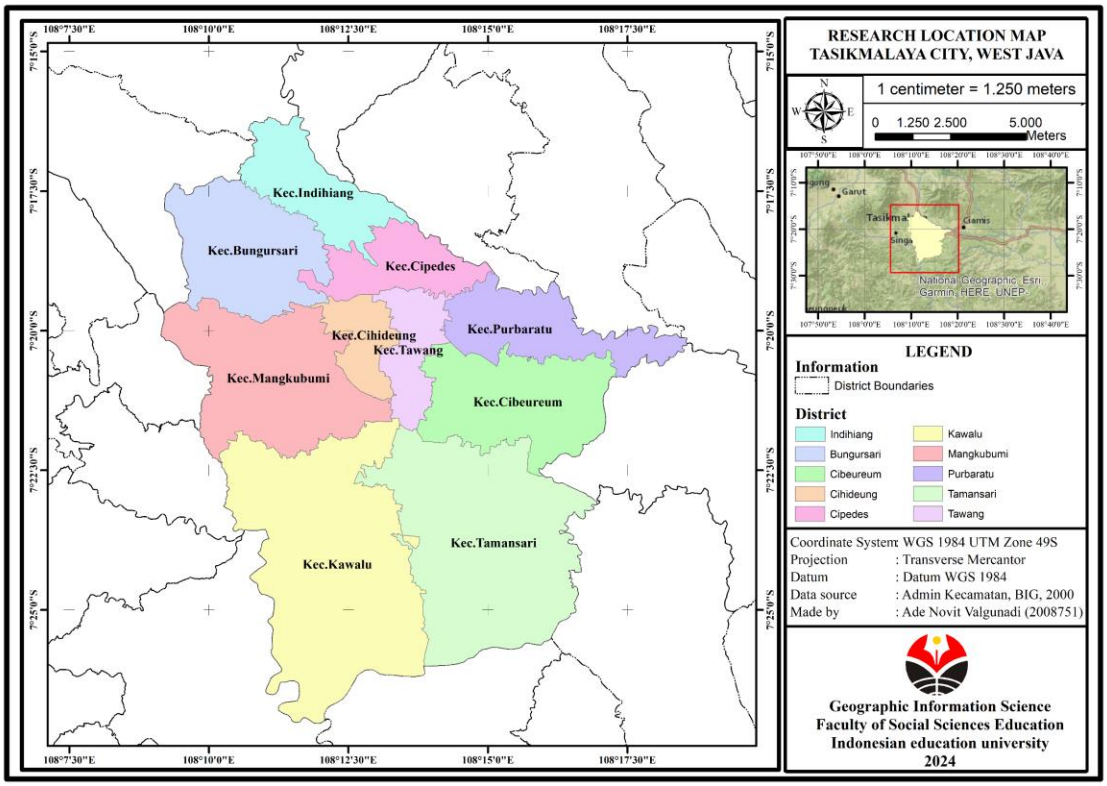

Figure 1. Research Location Map

Table 1. Research Tools

No	Tools	Function
1	Software Google Earth Pro	Determine the sample starting point
2	Software Avenza Maps	Determine the point on the field
3	Software ArcMap 10.8	Data processing and modeling
4	rolling meter	Measuring the distance between graves

Table 2. Research Materials

No	Materials	Source	Function
1	Worldview2 Images, 2021	National Research and Innovation Agency (BRIN)	digitization in determining the spatial distribution of cemeteries
2	Shapefile administrative boundaries	Geospatial Information Agency (BIG)	To find out the administrative boundaries of Tasikmalaya City in spatial processing
3	Research area boundary shapefile	Geospatial Information Agency (BIG)	To find out the research location
4	Tasikmalaya City Administration Map Scale 1:125,000	researcher	Used to determine the administrative boundaries of Tasikmalaya City during field surveys
5	Road Network Shapefile	Geospatial Information Agency (BIG)	Parameters for determining new cemeteries areas
6	River Network Shapefile	Geospatial Information Agency (BIG)	Parameters for determining new cemeteries areas
7	Soil Type Shapefile	Bappeda West Java Province	Parameters for determining new cemeteries areas
8	Land Use Shapefile	Bappeda West java Province and DPUPR Tasikmalaya City	Parameters for determining new cemeteries areas
9	Slope Shapefile	DPUPR Tasikmalaya City	Parameters for determining new cemeteries areas
10	Residential Land Shapefile	Bappeda West java Province and DPUPR Tasikmalaya City	Parameters for determining new cemeteries areas
9	Cemetery data such as distance between graves and grave size	field surveys	To find out the capacity and threshold
10	Population and number of deaths in Tasikmalaya City	Department of Population and Civil Registration, Tasikmalaya City	To find out the capacity and threshold

Types Of Research

The method used in this research is a quantitative description approach using remote sensing and geographic information systems. Quantitative description is describing, researching and explaining what is being studied as it is, and concluding the reality that can be observed using numbers (Yulianingsih et al, 2020 in Sulistyawati et al., 2022). Quantitative descriptive analysis in this research was used to calculate the capacity of public cemeteries regarding whether or not the cemeteries are sufficient as well as calculating the threshold for public cemeteries in Tasikmalaya City.

Remote sensing analysis was carried out to determine the spatial distribution of public cemeteries in Tasikmalaya City by utilizing high resolution satellite imagery. Geographic information system analysis was carried out to obtain suitable areas for new public cemeteries in Tasikmalaya City by utilizing tools in geospatial software.

A geographic analysis system is a computer-based information system that can process spatial data with new spaces or

locations in order to obtain information on patterns or changes in events in an area. The method used in GIS based on Prahasta (2009) is buffering analysis, namely analysis with the output in the form of a new area with boundaries surrounding the object, overlay analysis is the overlapping of several spatial data, for example there is a union combination of several data so that all data is visible and can show intersecting areas. finally there is classification/grouping of data according to parameters or criteria.

Data Collection, Processing, And Analysis Methods

Data collection use method literature study, indirect observation, direct observation and documentation study. Indirect observation in this research is the Worldview-2 image of the sheet containing the City of Tasikmalaya. Direct observation in this research was for ground checking and measuring the distance between graves on existing public cemeteries grounds. Apart from that, observations are carried out to see the location being observed including the characteristics of the location, recording coordinates, location of sample points, and direct observation as well as to document researchers going directly into the field during research activities in order to answer the problems that have been formulated. Documentation was obtained in documenting the field, in the form of a work program at a cemetery such as the person in charge, service system, guard system and others and also other documentation in the form of pictures or writing that the researcher obtained during the research.

The technique used to determine samples from cemetery delineation results which also serve as samples for accuracy testing is Purposive Sampling. Purposive sampling in this research is based on the results of digitizing cemeteries so that accurate and precise results are found. Furthermore, the sampling technique used to determine the sample size of graves at the Tasikmalaya City TPU is cluster random sampling (random sampling by area). This cluster sampling is used to determine the size of the grave plot for calculating capacity and threshold. Lastly, the sampling technique used to produce suitability results for new public cemeteries grounds is Stratified Random Sampling. The sample points are based on the suitability category of the cemeteries ground, namely suitable, quite suitable, and not suitable for each of the 3 sample points so that there is a total of 9 sample points for field checking.

Data processing in this research is specifically for the suitability of cemeteries grounds using a geographic information system with arcmap 10.8 software. The processing process is carried out on the cemeteries land suitability parameters needed for scoring and classifying the suitability of the cemeteries land. determining the score for each parameter refers to (Fadhil & Oktaviani, 2019) and (Adriyanto, 2017) research with modifications. Modifications were made to adapt to the conditions of the research area. The following is for processing data from 6 parameters referring to (Fadhil & Oktaviani, 2019) and (Adriyanto, 2017).

a) Land Use

Land use parameters are related to absorption capacity which greatly influences the management of urban clean water, of course avoiding the seepage of toxic fluids and polluting ground water.

b) Slope

The use of slope is very important in determining the location of public cemeteries. This is because the cemetery must be located in an area that has a flat or maximally gentle slope

c) Distance from Road

The use of distance parameters from the road is important because it has the function of ensuring that traffic flow does not disturb or disturb other road users

d) Type of Soil

The type of soil can influence the construction of a tomb. Apart from that, it has become a rule that cemeteries are advised not to be on fertile land.

e) Distance from River

The use of river parameters is based on the consideration that cemeteries can cause pollution, one of which is in the form of liquid or poison, so they must be far enough from the river to avoid polluting the river water.

f) Distance from Settlement

Use of these parameters is intended to prevent the community from negative impacts or pollution from cemeteries

The use of these 6 parameters refers to the Feasibility Criteria for Determining Public Cemetery Locations and Infrastructure. According to Gondang Riyadi, (2008) the eligibility criteria for urban public cemeteries are as follows: 1) Land slope of 2 – 12% so that the new cemetery does not have a high potential for landslides. 2) Distance of 50 meters from the road for comfortable traffic flow and road aesthetics. 3) A minimum distance of 500 meters from residential areas so that the environment is protected from the threat of disease. 4) The cemetery is 300 meters from the water catchment area to avoid groundwater pollution and/or toxins. 5) The cemetery is 150 meters from the river so as not to pollute river water or other flowing water. 6) One hectare of minimum burial area or 10 Ha in other references. 7) Cemeteries are not developed in potential areas so as not to have an impact on the surrounding area because it can cause land prices to fall. 8) Cemeteries should not be placed in densely populated areas to avoid the threat of pollution from cemeteries

The data analysis technique in this research uses quantitative descriptive analysis with the help of a geographic information system, also in this research there is remote sensing analysis, namely analysis using tools found in Arcmap 10.8 such as *image analysis, raster mosaic dataset, convertion tools,* qualitative descriptive analysis is also used as an explanation of everything such as maps.

For cemeteries delineation, the image used is a high-resolution image, namely Worldview-2. Image delineation here includes the previous processes, namely doing a mosaic on the image considering that the Worldview 2 image has a very high resolution so that the City of Tasikmalaya is within a few pixels or image data. Apart from that, band composites were also carried out with actual or natural colors to make delineation easier. The Composite band has the arrangement Red: 3, Green: 2, Blue: 1 or RGB 321. After that, Deliniation is carried out as previously mentioned.

Determining the threshold itself uses a formula that takes into account the average death rate, overall cemetery area, remaining cemeteries area, used cemeteries area, grave size and projected deaths. Death projections are calculated using the extrapolation method (Formula 1).

$$Pt = Po + b\ (t - o) \qquad (1)$$

Information:

PT : Population in year t

Po : Population in the base year

(t – o) : The difference between the base year and the forecast year (n)

b : average additional population per year from the past to the present (projected base year)

Data analysis for the new public cemeteries ground area using a geographic information system using arcmap 10.8 software with overlay techniques with the

help of open attribute tools, geoprocessing, and field calculator.

The level of suitability of public cemeteries in an area can be determined using the Geographic Information System method, namely weighting and scoring overlay analysis of several variables or parameters. These parameters are land use, slope, distance from roads, distance from rivers, distance from settlements, and soil type. Each parameter has the same influence in determining the suitability of cemeteries land. The land that has the highest final value is the area that is suitable to be used as a new cemeteries ground. The final result is a land suitability map in Tasikmalaya City (Table 3). To clarify the research, the following is a flow chart in this research (Figure 2).

Table 3. Parameters of suitability of cemeteries land

Parameter	Information	Skor	Class	Weight	Data Source
Land Use	Open Land, Shrubs	2	Suitable		Bappeda West Java Province, DPUTR Tasikmalaya City
	Agriculture and Gardens	1	Suitable Enough		
	In addition to previous land use	0	Not Suitable		
Slope	0 – 2%	2	Suitable		DPUTR Tasikmalaya City
	2 – 15%	1	Suitable Enough		
	>15%	0	Not Suitable		
Distance from Road	50 – 100 meters	2	Suitable		Geospatial Information Agency
	100 – 300 meters	1	Suitable Enough		
	<50 meters & >300 meters	0	Not Suitable	1	
Type of soil	Alluvial, Latosol	2	Suitable		Bappeda West Java Province
	Regosol	1	Suitable Enough		
	Glei and other	0	Not Suitable		
Distance from the river	>150 meters	2	Suitable		Geospatial Information Agency
	100 – 150 meters	1	Suitable Enough		
	<100 meters	0	Not Suitable		
Distance from Settlements	>300 meters	2	Suitable		DPUTR Tasikmalaya City
	< 300 meters	1	Suitable Enough		
	Radius 0 Meters	0	Not Suitable		

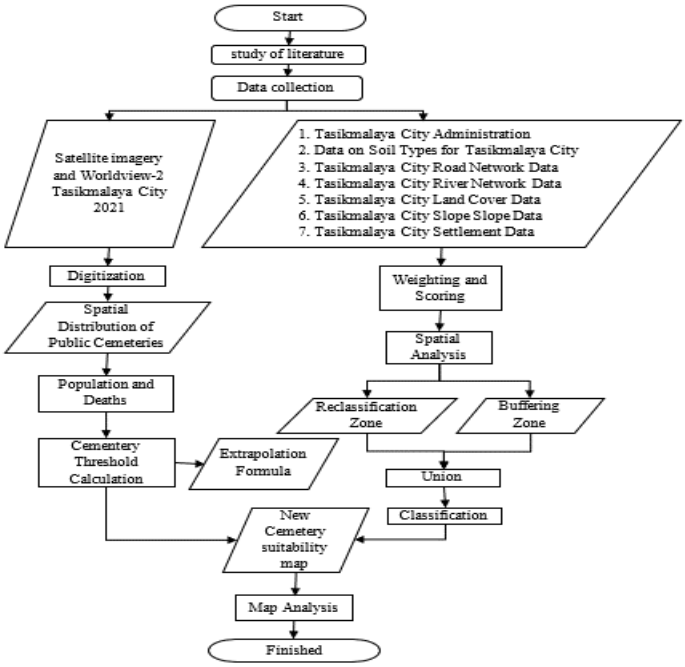

Figure 2. Research Procedure flow diagram

RESULT AND DISCUSSION

Spatial Distribution Of Cemeteries Places In Tasikmalaya City

Mapping the cemeteries in Tasikmalaya City, there are 101 cemeteries, including government-owned cemeteries, non-government-owned cemeteries and special cemeteries. All cemeteries in Tasikmalaya City have a total area of ±74,194 Ha or 741933.8121 m2. The most cemeteries are in Kawalu sub-district with 38 cemeteries and the fewest in Mangkubumi sub-district, namely only 2 cemeteries, however based on area, Tamansari sub-district has cemeteries with a total area of 262908,745 m2 or ±26 hectares, while the sub-district has a small total cemetery area. is in Mangkubumi District.

The results of cemetery delineation show that the distribution of cemeteries in Tasikmalaya City is always close to residential areas. This is also in accordance with the research of Januarman et al (2019) which stated that cemeteries in Jambi City were formed because the distribution of settlements was the main thing in providing public funeral services. It was also explained that the increase in cemeteries increased along with population growth where cemeteries places were located based on housing and even based on sub-districts. Based on data, there are 3 public cemeteries belonging to the Tasikmalaya City government which are managed and owned by the Tasikmalaya City Government, namely the Cinehel public cemetery located in Indihiang District, the Cieunteung public cemetery located in Bungursari District, and the Aisha Rashida Public Cemetery located in Tamansari District. The following is a map of the spatial distribution of Tasikmalaya City government public cemeteries and maps for each TPU belonging to the Tasikmalaya City regional government, namely Cieunteung TPU, Cinehel TPU, and Aisha Rashida TPU (Figure 3).

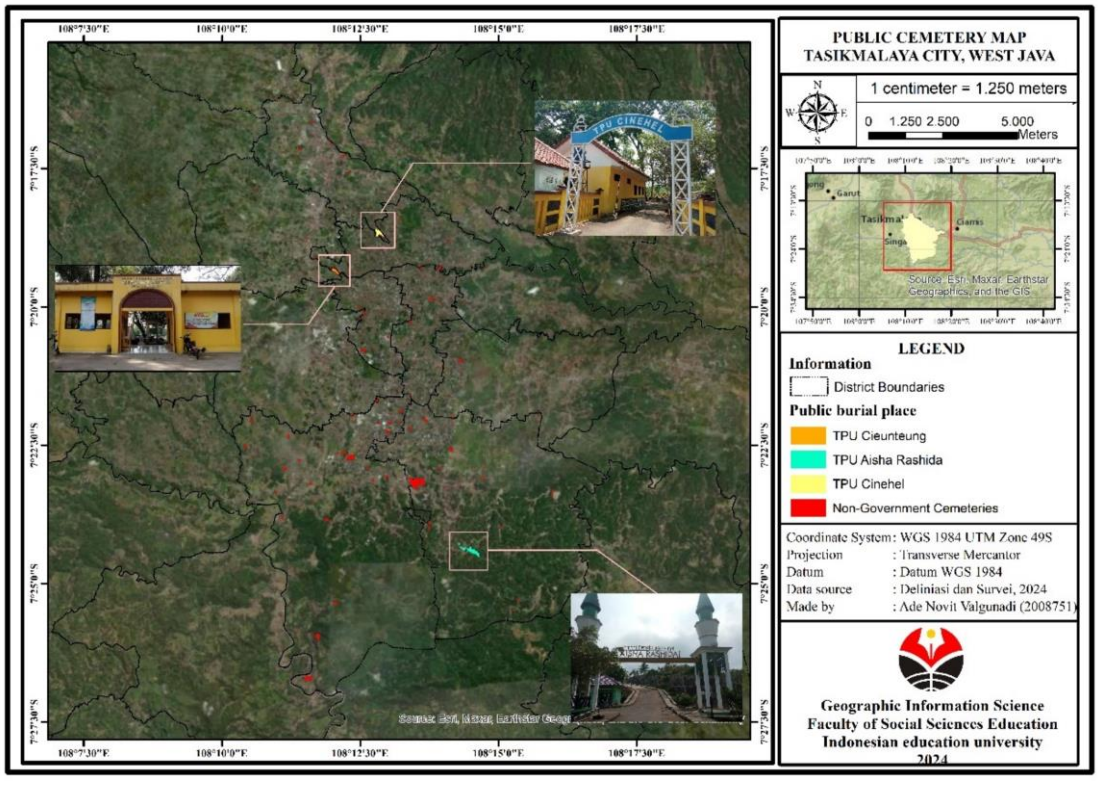

Figure 3. Spatial Distribution Map of Public Cemeteries

Based on the mapping results above, it can be seen the area of each TPU belonging to the Tasikmalaya City Government. The Cieunteung Public Cemetery has an area of around 1,517 Ha or 15172,173 m^2 (Table 4), the Cinehel Public Cemetery has an area of around 3,508 Ha or 35082,345 m^2 (Table 5), and the Aisha Rashida Public Cemetery has an area of around 7,322 Ha or 73219,797 m^2 (Table 6). In particular, the author found facts in the field that the existence of the Cieunteung TPU is on the main road which makes the atmosphere a little quiet and damp, this is in line with research by Alam & Warlina (2019) which states that TPUs located in transitional cities are still declared suitable with the caveat that they must has a clear function, especially for city lungs as green open space. The TPU in the city center is basically already congested, so prevention efforts must be taken.

Table 4. The Size Of The Cieunteung Public Cemetery

Object Name	Area (Ha)	Area (m^2)
Public Services and Facilities	0.015	146.302
Disused Cemeteries	1.500	14998.900
Remnant Cemetery	0.003	26.951
Total	**1.517**	**15172.153**

Table 5. The Size Of The Cinehel Public Cemetery

Object Name	Area (Ha)	Area (m^2)
Remnant Cemetery	0.581	5810.240
Disused Cemeteries	2.820	28204.800
Mosque Road (Grant)	0.003	25.654
TPS3R	0.064	644.015
Public Services and Facilities	0.040	396.955
Total	**3.508**	**35081.664**

Table 6. The Size Of The Aisha Rashida Public Cemetery

Object Name	Area (Ha)	Area (m^2)
Road	0.208	2076.320
Public Services and Facilities	0.221	2211.560
Disused Cemeteries	0.159	1592.842
Remnant Cemetery	6.584	65835.200
Border Park	0.073	732.707
Parking lot	0.077	771.168
Total	**7.322**	**73219.797**

Capacity and Threshold of Existing Public Cemeteries Owned by the Tasikmalaya City Government

Death is a natural part of things for humans and the size of cemeteries grounds is inversely proportional to the availability of cemeteries plots. The population growth of Tasikmalaya City shows an increasing percentage growth from 2016 - 2022, namely around 1.43%, namely around 10,420 people (Table 7 and Figure 4), while the death growth percentage in Tasikmalaya City has increased, namely 123 deaths or a percentage of around -2.57% (Figure 5). From the second thing above, every year, out of a population of 10,420 people, there are 123 deaths. Below are tables and graphs for the population and number of deaths.

Table 7. Percentage Growth in Population and Number of Deaths in Tasikmalaya City

Years	Total Population			Number of Deaths		
	Population	Increase	%	Total	Increase	%
2017	694,610	-	-	5,019	-	-
2018	713,537	18,927	2.65	2,998	-2,021	-67.41
2019	719,882	6,345	0.88	3,813	815	21.37
2020	725,561	5,679	0.78	4,364	551	12.63
2021	731,606	6,045	0.83	6,039	1,675	27.74
2022	746,710	15,104	2.02	5,634	-405	-7.19

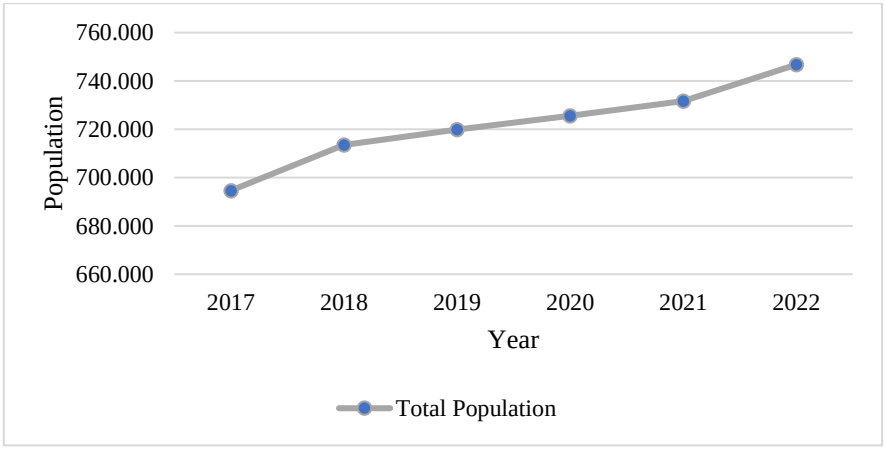

Figure 4. Graph of Population Development in Tasikmalaya City 2016-2022

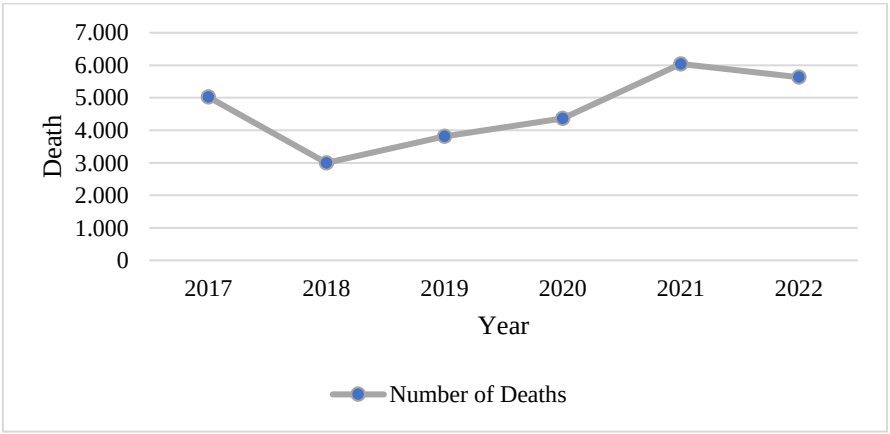

Figure 5. Graph of Development of the Number of Deaths in Tasikmalaya City 2016-2022

The estimated number of deaths can be calculated using extrapolation with a population projection formula to determine future death rates. As explained in table 7 regarding data on population and number of deaths, the burial threshold uses the base year 2022. The threshold for public cemeteries in Tasikmalaya City is projected for the next 25 years, broken down into 5 years. This is based on the 25-year medium-term national spatial plan which is evaluated every 5 years. From this, the threshold will be calculated until 2047. So with a base year of 2022 and detailed calculations every 5 years, 2027 is the first projected year. The year 2027

contains the years 2023, 2024, 2025, 2026, and 2027 itself and the same goes for the next 5 years. This result analysis of death projections for the next 25 years detailed by 5 years (Table 8).

Table 8. Death projections for the next 25 years are broken down by 5 years

No	Projection Year	Prediction of Number of Deaths
1	2027	6249
2	2032	6864
3	2037	7479
4	2042	8094
5	2047	8709

Source: Research Results, 2024

The results of the calculation of death projections for the next 25 years show that the death rate is increasing, from this it can be calculated to estimate the total land that will be used by the population of Tasikmalaya City using a grave size of 1.6m x 0.6m as the standard size of grave plots in Tasikmalaya City without distance between graves and a size of 2.5m x 1.5m based on ideal conditions, this size includes the distance between graves. The estimated amount of cemeteries land needed is calculated and known based on the Table 9 and Figure 6.

Table 9. Estimated Need For Cemeteries Land For Tasikmalaya City For The Next 25 Years

Projection Year	Prediction of Number of Deaths	The amount of land that will be needed for the cemeteries plot 1,6 m x 0,6 m (m^2)	The amount of land that will be needed for the cemeteries plot 2,5 m x 1,5 m (m^2)
2027	6249	5999.04	23433.75
2032	6864	6589.44	25740
2037	7479	7179.84	28046.25
2042	8094	7770.24	30352.5
2047	8709	8360.64	32658.75
Total		**35899,2**	**140231.25**

Based on the table above, it can be seen that the need for cemeteries is increasing as the death rate. Meanwhile, the area of the cemetery decreases every year without increasing the area. As of 2023, the remaining land from the 3 TPUs owned by the government will be approximately ± 71676.5 m^2 (Tbale 10). Of the three public cemeteries, TPU Aisha Rashida has the largest remaining cemeteries area.

Table 10. Tasikmalaya City Cemetery Land Requirement Threshold Without Overlapping

Projection Year	Prediction of Number of Deaths	Availability of Cemeteries Ground in Tasikmalaya City (m^2)	Grave Land Requirements Size 1,6m x 0,6m (m^2)	Grave Land Requirements Size 2,5m x 1,5m (m^2)
2027	6249		65677.52	48242.81
2032	6864		59088.08	22502.81
2037	7479	71676.56	51908.24	-5543.44*
2042	8094		44138.00	-35895.94*
2047	8709		35777.36	-68554.69*

*Condition is no longer suitable for storage

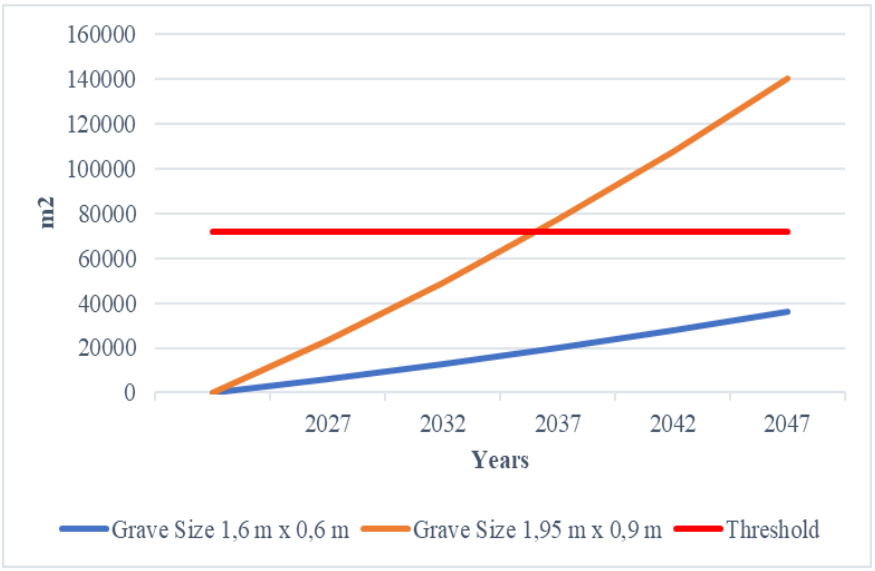

Figure 6. Graphic of Threshold for Cemeteries Land Needs in Tasikmalaya City

Table 11. Tasikmalaya City Cemeteries Land Requirement Threshold with One Overlapping

Projection Year	Prediction of Number of Deaths	Availability of Cemeteries Ground in Tasikmalaya City (m^2)	Grave Land Requirements Size 1,6m x 0,6m (m^2)	Grave Land Requirements Size 2,5m x 1,5m (m^2)
2027	6249		110470.557	93036.3
2032	6864		103881.117	67296.3
2037	7479	116470	96701.277	39250
2042	8094		88931.037	6591.25
2047	8709		80570.397	-28374*

*Condition is no longer suitable for storage

Figure 7. Graph of the Threshold for Cemeteries Land Needs in Tasikmalaya City with One Overlapping

If the grave size scheme is (1.6 m x 0.6 m) then the public cemetery in Tasikmalaya City can accommodate up to 25 years. If we continue to calculate it then the threshold will be around 2062, whereas if the grave size scheme is (2.5 m x 1.5 m) then the threshold is below 2037. If you use a single overlapping grave size scheme (1.6 m x 0.6 m) then the threshold is estimated to be >25 years, even if you calculate further this scheme can accommodate up to 50 years in the future, whereas if the scheme the size of the grave (2.5m x 1.5m) then the threshold is around 2043. Apart from that, it can also be calculated regarding the capacity and capacity threshold for cemeteries grounds in Tasikmalaya City, both without overlap and overlay. The following tables and graphs are presented Table 12,13, and 14).

Table 12. Capacity of TPU Land Owned by Tasikmalaya City Government

No.	Cemeteries System	Capacity for Grave Plot Size 1,6 m x 0,6 m (grave)	Capacity for Grave Plot Size 2,5 m x 1,5 m (grave)
1	Normal	74663	19113
2	Overlapping	121322	31058

Table 13. Capacity Limit for Cemeteries Grounds in Tasikmalaya City Without Overlapping

Projection Year	Prediction of Number of Deaths	Normal	
		Threshold For Grave Plot Size 1,6 m x 0,6 m (Grave)	Threshold For Grave Plot Size 2,5 m x 1,5 m (Petak)
2027	6249	68414	12864
2032	6864	61550	6000
2037	7479	54071	-1479*
2042	8094	45977	-9573*
2047	8709	37268	-182828

*Condition is no longer suitable for storage

Table 14. Capacity Limit for Cemeteries Grounds in Tasikmalaya City with One Overlapping

Projection Year	Prediction of Number of Deaths	One Overlapping	
		Threshold For Grave Plot Size 1,6 m x 0,6 m (Grave)	Threshold For Grave Plot Size 2,5 m x 1,5 m (Petak)
2027	6249	115073	24809
2032	6864	108209	17945
2037	7479	100730	10466
2042	8094	92636	2372
2047	8709	83927	-6337*

*Condition is no longer suitable for storage

With the remaining cemeteries land remaining, namely 71676.56 m2, the capacity can fulfill 74663 graves with a size of 1.6m x 0.6m, with this scheme it can accommodate >25 years or to be precise until 2062 and as many as 43440 for graves measuring 2.5m x 1, 5m which is estimated to only be able to accommodate less than 2037. Meanwhile, the capacity if using a single overlapping system with an area of 116469.6m2 can accommodate 121322 graves with a size of 1.6m x 0.6m which is estimated with this scheme to last up to >25 years or even If calculated further, it can accommodate >50 years and as many as 70,588 for a grave size of 2.5m x 1.5m which is estimated to be able to accommodate until 2042 and less in 2047.

In connection with capacity and threshold, Kartini (2018), who researched capacity and threshold, stated in her research that solutions to this include optimizing cemeteries grounds, having an overlapping system, protected forests for cemeteries, relocating graves, standing cemeteries, integrated disposal, ideal cemeteries, and disposal of Corpse ashes. In line with overlapping, Sudiro (2020), who researched the availability of land for public cemeteries in the City of North Jakarta, discussed the results of interviews with cemetery managers who stated that the existence of a tomb stacking system was helpful and effective for the cemeteries problem and in other research related to the availability of cemeteries land. In general, in the city of Surakarta, it is stated that the community's readiness to face funerals using an overlapping system is in a category with a low level of readiness (Amalia, 2011). From the above, of course it is important for the local government to socialize the overlapping system so that the public understands and has a positive impact.

According to Pradana et al (2021), in their research regarding the availability of public cemeteries grounds during Covid-19 in the city of Surakarta, they stated that another alternative to overcome the availability of cemeteries is to look for new land for cemeteries. Even in research by Koswara et al (2021), which examined the availability of cemeteries land in Tuban urban areas, it was stated that the effort that can be made if cemeteries are in deficit is to look for new cemeteries locations that meet the criteria for their designation. These two studies are in line with the author's research which makes searching for land for new cemeteries an alternative in meeting the need for public cemeteries in Tasikmalaya City if it has reached the threshold.

Suitability of Cemeteries Land for New Public Cemeteries in Tasikmalaya City

Determining the suitability of cemeteries grounds in Tasikmalaya City in this study used 6 main parameters, namely distance from the river, distance from the road, land use, and soil type. These four parameters are processed using geographic information system methods with various geoprocessing tools, one of which is overlay. The findings are explained in detail below:

a) Land Use

The results of the analysis show that most of the land use in Tasikmaya City is dominated by rice fields with an area of 6617 Ha or around 35.9%, then there are residential areas and mixed dry land agriculture with each having an area of >5000 Ha. From this, based on land use, the suitability of public cemeteries is in the quite suitable category. The least land use is in the open land class, namely 13.14 Ha or around 0.07%. The use of rice fields is spread and concentrated in the southern part of Tasikmalaya City. Settlements are spread throughout the Tasikmalaya City area, but these settlements are most prominent in the central part of Tasikmalaya City. Mixed Dry Land Agriculture itself is concentrated in the East towards the center. Dry land farming itself is in the West and East. The plantation forest is in the southern part of Tasikmalaya City, there is 1 airport in Cibeureum District. For open land and plantations there are only a few among other land uses, while the land cover in the form of bodies of water is rivers and lakes (Figure 8).

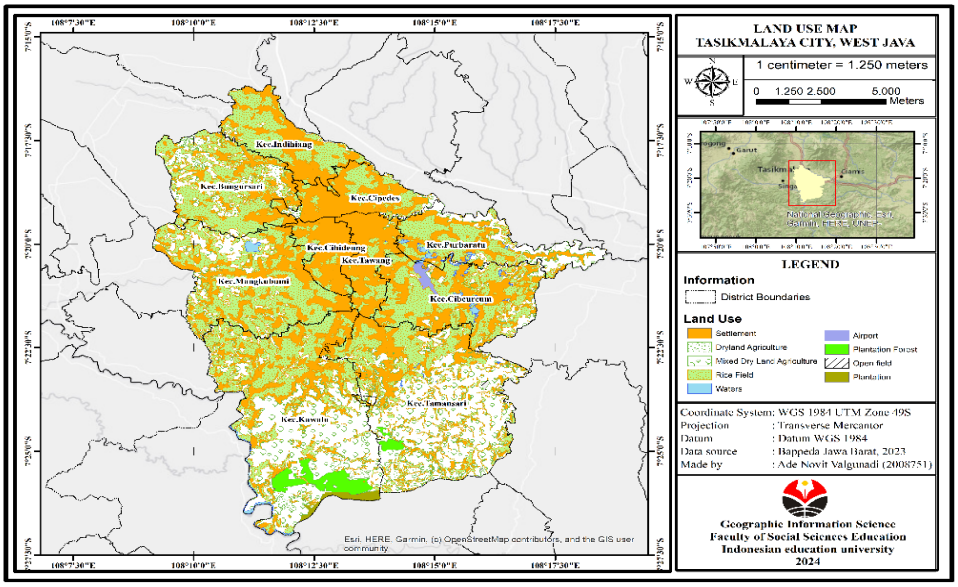

Figure 8. Land Use Map

b) Slope

The slope of the slope is closely related to cemeteries because the steeper the slope, the less suitable it is for cemeteries because it is feared that it could experience landslides. On the other hand, the gentler the slope, the more suitable it is for cemeteries, of course this is to avoid the danger of landslides. The analysis results show that Tasikmalaya City is dominated by land with a total area of 5,372.15 Hectares or 53.7215 Km2, a slope of 0 – 2% is around 29.57% of the entire area of Tasikmalaya City, then 5 – 15% with an area of 4,882.58 Ha or around 26.87%, then 2 – 5% with an area of 4,574.18 Ha or around 25.17%, then 25 – 40% with an area of 1,799.53 Ha or around 9.9%, and the minimum is a slope of 15 – 25% which has an area of 1,543.24 Ha or around 8.49% of the area of Tasikmalaya City(Figure 9).

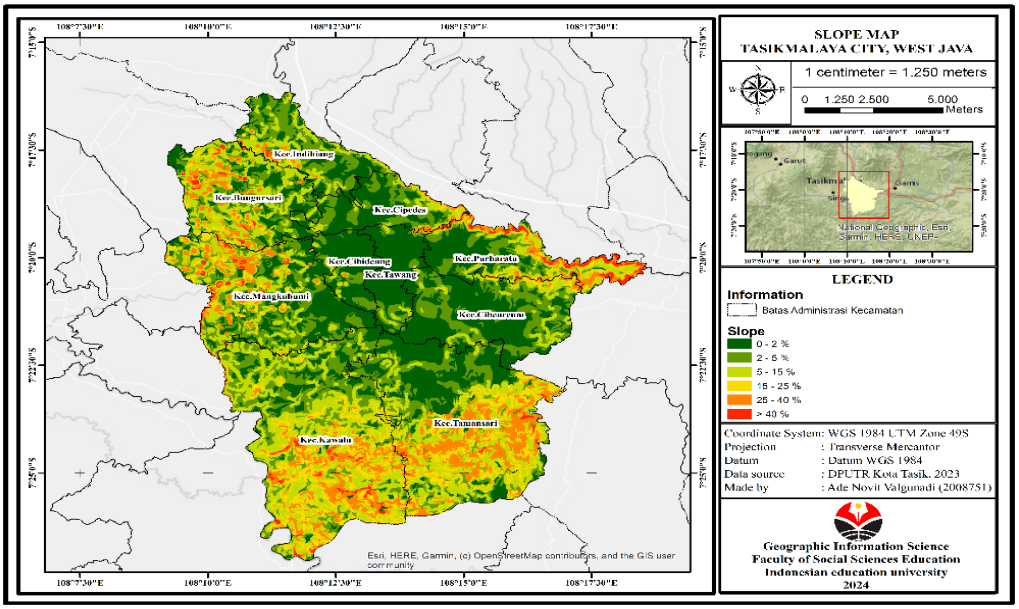

Figure 9. Slope Map

c) Distance from Road

The analysis results show that Tasikmalaya City has areas that are not suitable for cemeteries, although on the other hand there are still many areas that are suitable for cemeteries because the distance is not too close (50 - 100 m) and not too far (100 - 300 m) from the road. Based on the buffer of regional roads, Tasikmalaya City is dominated by a fairly suitable area or 100 – 300 meters or around 42% with an area of 7778.7 Ha. The unsuitable area is around 35.7% or around 6575.2 Ha (Combination of classes <50 and >300 meters), and the suitable area is only 22.1% with an area of 4068.3 Ha (Figure 10).

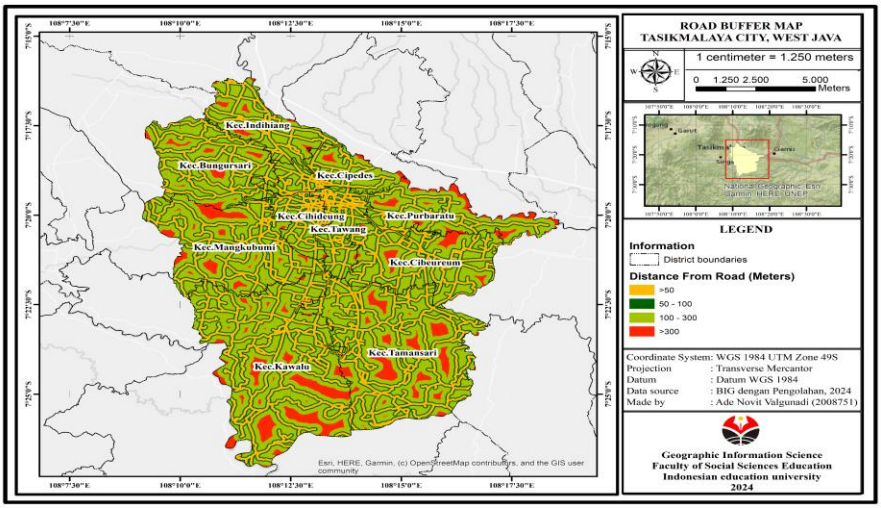

Figure 10. Road Buffer Map

d) Distance From Rivers

Based on the processing results, the existence of 2 main rivers and several of their branches causes Tasikmalaya City to have areas that are not suitable for cemeteries, although on the other hand there are still many areas that are far from the river or have a radius of >150 meters. Based on the river buffer, the Tasikmalaya City area is dominated by the appropriate area or >150 meters or around 58% with an area of 10739 Ha (Figure 11).

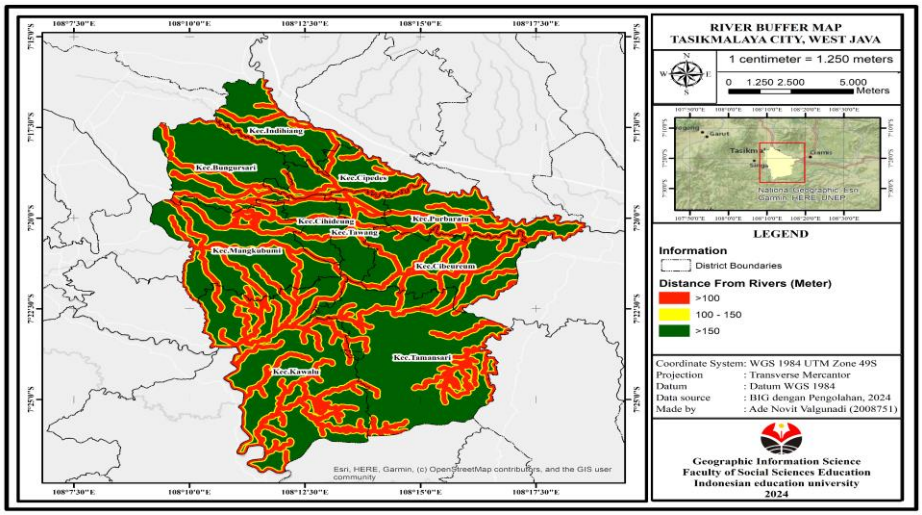

Figure 11. Rivers Buffer Map

e) Distance From Settlements

The large number of settlements in Tasikmalaya City means that the distance to the settlement results in a suitable area having a small area, namely 1611.88 Ha or around 8.75% of the total, while the quite suitable category dominates with an area of 11308.94 Ha or around 61.39%(Figure 12).

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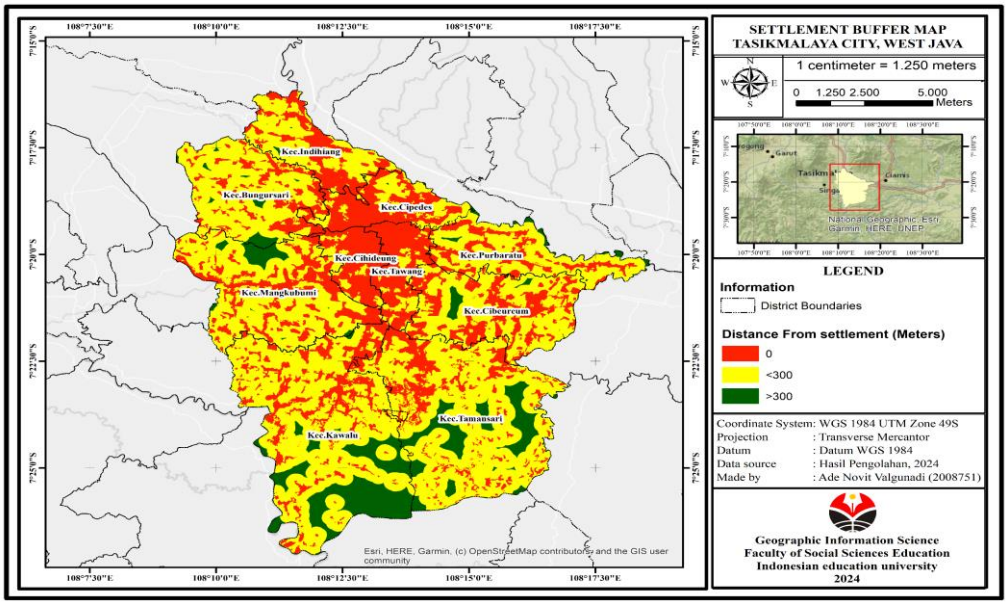

Figure 12. Settlement Buffer Map

f) Type of soil

More than 60% of the entire Tasikmalaya consists of regosol soil with an area of around 11613.7 Ha. Based on this, the suitability area for cemeteries in Tasikmalaya City is dominated by the Fairly Suitable category. Then there is brown forest with an area of 3359.7 Ha or around 18%, next there is latosol land with an area of around 10% or 2014.2 Ha, and finally there is red and yellow podsol with an area of 1434.6 Ha or around 7.8% (Figure 13).

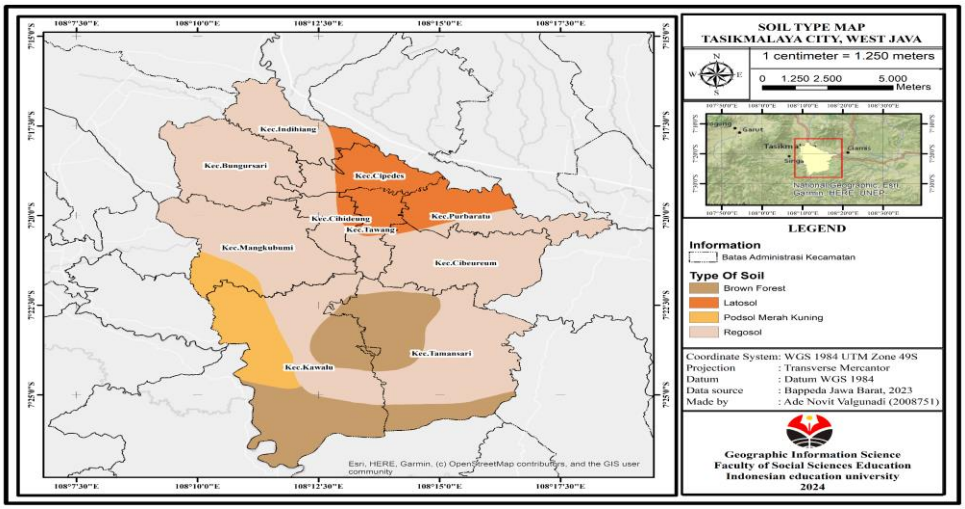

Figure 13. Type Of Soil Map

g) Suitability of public cemeteries grounds

These three suitability categories are spread throughout the Tasikmalaya City area. Funeral suitability is dominated by quite appropriate class. Meanwhile, the unsuitable class has the smallest area. The appropriate category is found most often in latosol type soils and agricultural land use. Based on the results of field checks, it was found that suitable cemeteries have a slope of 0 - 5%, which is flat and sloping, while those that are not suitable for cemeteries have slopes that is steep. Far from roads and rivers.

The results of the overlay analysis of weighting and scoring of the six parameters for the New Public Cemetery in Tasikmalaya City resulted in the classes suitable, quite suitable and not suitable. The dominance of the cemeteries land suitability category in Tasikmalaya City is Fairly Suitable with an area of 14,192 Ha or around 76.88% which is spread throughout the Tasikmalaya City area. Meanwhile, the suitable area is only 12.09% or 2231 Ha, the distribution is in the North and few areas. in the eastern part of Tasikmalaya City (Figure 14).

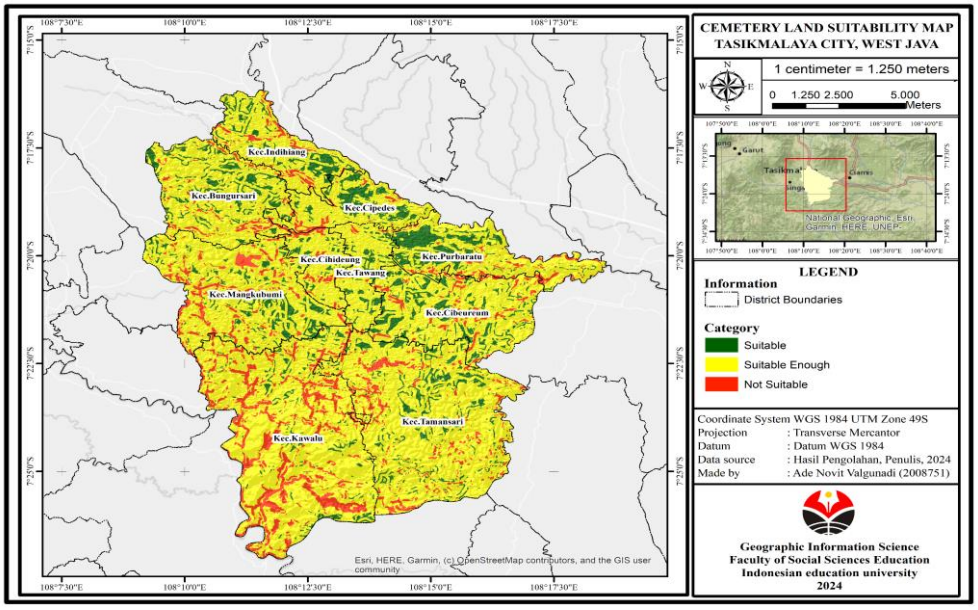

Figure 14. Map of Suitability of Public Cemeteries Grounds

Table 15. Extent of Cemeteries Suitability Categories Based on District in Tasikmalaya City

No	District	Area by Category (Hektar)		
		Suitable	Suitable Enough	Not Suitable
1	Bungursari	267,434	1382,717	111,604
2	Cibeureum	326,402	1368,359	144,535
3	Cihideung	50,414	434,253	60,003
4	Cipedes	212,334	638,965	52,697
5	Indihiang	183,898	807,620	94,954
6	Kawalu	168,398	3219,843	845,349
7	Mangkubumi	254,287	1892,562	252,588
8	Purbaratu	307,640	856,037	99,286
9	Kawalu	352,653	3027,083	319,610
10	Tawang	107,770	564,201	18,739
	Total	**2231**	**14192**	**1999**

The results of the analysis show that areas in the appropriate category for public cemeteries in Tasikmalaya City are only 12.11% of the total area of the area. The area in the category suitable for public cemeteries is 2231 Ha and is spread throughout all sub-districts, but is quite dominant in 4 sub-districts. Areas categorized as quite suitable for public cemeteries in Tasikmalaya City are only 77.04% of the total area. The area categorized as quite suitable for public cemeteries is 14,192 hectares. This area is owned by all sub-districts in Tasikmalaya City. Areas categorized as unsuitable for public cemeteries in Tasikmalaya City are 10.85% of the total area. The area categorized as unsuitable for public cemeteries is 1999 Ha.

Based on the results of field checks, it was found that suitable cemeteries have a slope of 0 - 5%, which is flat and sloping, while those that are not suitable for cemeteries have slopes that are quite steep to steep. Far from roads and far from rivers. This is in line with research by Aji et al, (2015) who studied the suitability analysis of cemeteries using GIS in the city of Semarang. In their discussion it was stated that suitable locations for cemeteries are those that are far from the road, the further from the road a cemetery is, the better it is, as well as The slope that is suitable for cemeteries is a slope that is not steep.

According to Anshori (2018), in his research regarding determining the location of public cemeteries in Kediri City, he stated that alternative locations that can be used for cemeteries are empty land, grass and gardens. In accordance with this research, which is based on the results of field surveys, suitable locations are around gardens and agriculture. The results of processing and field surveys in this research show that the area around the Railway Station in Tasikmalaya City has a fairly suitable category, in line with research conducted by Adriyanto, (2017) in his research regarding the suitability analysis of TPU in East Jakarta City, it was stated in his discussion that it is a good place public cemetery adjacent to the railroad tracks. Apart from that, on average the suitable areas in this study have latosol type soil, the same thing that was found in other research that the suitable areas for cemeteries in DKI Jakarta are on alluvial and latosol soil (Fadhil & Oktaviani, 2019). On average, the land suitable for cemeteries, especially those concentrated in the northern part, meets the cemeteries suitability requirements in Gondang Riyadi's (2008) research which states that the minimum area of a TPU is 10 Ha.

The suitable area of cemeteries land in the appropriate category is 2231 Ha. This is of course a recommendation if existing public cemeteries have reached their threshold and no longer accommodate bodies. If the entire area resulting from processing that is suitable for a public cemetery is assumed to be a public cemeteries place starting from 2052 or the base year 2047 as the threshold for the existing TPU belonging to the Tasikmalaya City government which has been calculated above with the ideal cemetery size being 2.5m x 1 .5m, of course, assuming deaths continue from a constant threshold or death rate calculation, then the 2231 Ha land can meet the need for cemeteries land until 2707 and there will already be a deficit in 2712 or approximately ±660 years.

This area of 2231 hectares, with conditions without an overlapping or normal system, can accommodate around 5949333 corpses or grave plots, whereas with conditions with a single overlapping

system it can accommodate around 11898667 corpses or grave plots. Capacity under conditions without an overlapping system will reach the threshold in 2672 and will already be in deficit in 2677 or approximately ±625 years. Meanwhile, the capacity with a single overlapping system will reach the threshold in 2957 and will already be in deficit in 2962 or approximately ± 910 years, almost a century.

CONCLUSION.

The spatial distribution of cemeteries in Tasikmalaya City based on delineation shows 101 cemeteries with an area of ±74,194 hectares. 3 of the 101 cemeteries are TPUs belonging to the Tasikmalaya City government, namely Cieunteung TPU which is located in Bungursari District, has an area of 15172.153 m^2 and the remaining land is 26.951 m^2, Cinehel TPU which is located in Indihiang District, has an area of 35082.3451 m^2 and the remaining land amounting to 5810,921 m^2. Aisha Rashida TPU, located in Tamansari District, has an area of 73219,797 m^2 and the remaining land is 65835.2 m^2.

The total area of TPU land in Tasikmalaya City is 123,474.32 m2 with the remaining land area being around 71,673 m2. The area required for cemeteries land for a grave size of 1.6 m x 0.6 m without overlapping can accommodate for the next 25 years, likewise with one overlapping can accommodate until 2047. For a grave size of 2.5 m x 1.5 m, if without overlapping will reach the threshold in less than 2037 and will require 68554.7 m2 to reach 2047. Meanwhile, with one overlapping will reach the threshold in less than 2047 and will require 28374 m2 to meet needs until 2047. The threshold is based on grave plots that is, for a grave size of 1.6 m x 0.6 m without overlapping it can accommodate up to the next 25 years or until 2047. Likewise, with overlapping it can accommodate up to 2047. For a tomb size of 2.5 m x 1.5 m without overlapping it only reaches less than 2037 and requires 18,282 grave plots to reach 2047. Meanwhile, with one overlap it only reaches less than 2047 and requires 6,337 grave plots to reach 2042.

The suitability area for public cemeteries in Tasikmalaya City consists of three categories, namely suitable, quite suitable and not suitable. The area suitable for cemeteries has an area of 2231.23 Ha or around 12.11%. Areas suitable for cemeteries are found in all sub-districts with only 3 sub-districts being dominant. This category is most concentrated in the northern part of Tasikmalaya. Areas that are quite suitable for cemeteries have a total area of 14192 Ha or around 77.04% of the total. These areas that are quite suitable are located throughout Tasikmalaya City in 10 Districts. This category is most concentrated in the West, Central and East parts of Tasikmalaya City. Areas that are not suitable for cemeteries have a total area of 1999 Ha or around 10.85% of the total. These areas that are not suitable are located throughout Tasikmalaya City in 10 Districts. This category is most concentrated in the southern part of Tasikmalaya City.

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