DETERMINATION OF THE HIGHEST CRIME AREAS IN THE CITY OF BANDUNG USING GEOGRAPHIC INFORMATION SYSTEM

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ABSTRACT

Crime is one issue that is already familiar to the people in the city of Bandung. Crime is a serious problem to be tackled for the police Polrestabes Bandung. In accordance with the basic tasks of law enforcement to provide protection, shelter and service to the community. Crimes that occur in today's society is very diverse, one of which is like a conventional crime. Based on the interview with Mr. Bambang SI as Head of the Administrative Affairs, Administration and stated that reports of crimes received from people who reported in 2014 that approximately 1566 report crime. These data are not stored and archived by his district, so that frequent delays in data processing crimes to determine the highest crime areas in the city of Bandung Therefore, it can be concluded that the Head of the Criminal difficulties in setting The highest crime areas in the city of Bandung in order to improve the public service that is conduct socialization crime

In this study, a decision support system will menggun Simple Additive Weighting (SAW). M etode is used in the construction of decision-making system in Unit Criminal Polrestabes Bandung to determine the highest crime areas in the city of Bandung.

Based on black box testing and beta testing has been done, it could be concluded that the geographic information system is able to assist the Head of the Criminal Investigation Unit to determine the highest crime areas in the city of Bandung in order to improve services to the community is to conduct socialization activities crime.

Keywords: Crime, Geographic Information Systems, Decision Support Systems, Methods SAW

1. INTRODUCTION

Crime is one issue that is already familiar to the people in the city of Bandung. Crime is a serious problem for the tackle on the part of police officers Polrestabes Bandung. In accordance with the basic tasks of law enforcement to provide protection, shelter and service to the community. Crimes that occur in today's society is very diverse. One of them is like a conventional crime who become a nuisance in public order and safety, among others, murder, theft with violence, theft by weighting, motor vehicle theft, rape, extortion, fighting, drug abuse, juvenile delinquency and gambling. There are several problems in organizing the activities of inquiry and investigation that the case handler mengefisienka n performance. [1]

Based on the interview with Mr. Bambang SI as Head of the Administrative Affairs, Administration and stated that reports of crimes received from people who reported in 2014 that approximately 1566 report crime. These data are not stored and archived by his district, so that frequent delays in data processing crimes to determine which areas have the highest crime. Therefore, it can be concluded that the Chief of the Criminal Investigation Unit have difficulty in determining the highest crime areas in the city of Bandung in order to improve service to the community by holding socialization crime.

Mapping crimes committed by law enforcement become the most important part in analyzing a crime. Before using the computer, crime mapping is done manually by providing a pin or pins on a wall map at every crime scene. Once there is a computer mapping is done by creating an image map with a dot at each crime scene, but just display the data alone are not the decision makers.

Geographic Information Systems (GIS) is a tool and a means of spatial analysis to derive information useful berdasark's new set of thematic information. [2] Geographic Information System can tell you about crime in every district in the city of Bandung, from the information we conclude any area with a high crime rate and provide convenience for policy makers in managing the prevention and suppression. Decision-making methods one of which can be used is the Simple Additive weighting method (SAW).

From the above problems, it would require an application that can assist in Criminal Polrestabes Bandung in solving the problem, in this case the authors build the application, entitled "Determining Regions Highest Crime in Bandung with a Geographic Information System"

1.1 Geographic Information Sistem

Geographic Information Systems or Geographic Information System (GIS) have the sense of always changing according to the development. It is evident from the many definitions of GIS which has been circulating in various literature sources. Geographic Information Systems (GIS) is a computer-based system that has the ability to handle a geographic referenced data including data entry, data management (storage and redial), manipulation and analysis of data, as well as the output sebaga i the final result (output). [4] The final result (output) can be used as reference in making decisions on issues relating to geography. This system can integrate spatial data (vector maps and digital imagery), attribute (table database system) as well as other important properties. The ability is exactly what distinguishes a geographic information system with other information systems and create a geographic information system more helpful in providing information that is closer to real world conditions, to predict an outcome and strategic planning. Geographic information system designed to collect, store and analyze the objects to which geographic location is an important characteristic. The data in a geographic information system itself is divided into two spatial data and non-spatial data. Here's the explanation:

1.1.1 Spatial Data

Is one of the information system, in which there is information on the earth including the surface of the earth, under the earth's surface, aquatic, marine and lower atmosphere. Spatial data and information used to determine posisis derivatives of identifying an element in the earth's surface. Model spatial data used in geographic information systems can be divided into two, namely:

1. Vector Data Model

In the vector data of the earth is represented as a mosaic of lines (arcline), polygon (area bounded by a line which starts and ends at the same point), point / point (node label), and the nodes (a point of intersection between two lines) Vector data model is a data model that is most widely used, the model is based on the point (points) with the coordinates (x, y) to construct spatial objects. The object is built is divided into sections ttiga again that: [3]

1. Point (*point*)
   The point is garfis simplest representation on an object. Dimensionless point but can be displayed in symbolic form either on the map or on the monitor screen.
2. Line (*line*)
   Line is a *linear* form that connects two or more points, and represent objects in a dimension.
3. Area (*polygon*)
   Polygon is a representation of objects in two dimensions.

2. Raster Data Model

Raster data (also called grid cells) is the data generated from remote sensing systems. In raster data, geographic objects represented as a grid cell structure called a pixel (Picture Element). In raster data, the resolution depends on the size of its pixels.

1.1.2 Non Spatial Data

Non-spatial data / attribute data is data that represent aspects of the description of the phenomenon being modeled that covers the items and properties, so that the information submitted will be more diverse, non-spatial data also stores attributes of the appearance of the surface of the earth such as soil that has the attributes of texture, depth and so forth. Non-spatial data / attributes stored in the form of lines and columns, an example of non-spatial data are: District Name, Address government offices, website address, name of the mountain.

1.2 Decision Support System

Decision Support System (Decision Support System) is defined as a computer system that is capable of providing a good ability problem solving skills as well as the ability of communicating to semi-structured problems. Specifically, DSS is defined as a system that supports the work of a manager or group of managers in solving the problem of semi-structured in a way to provide information or proposals leading to certain decisions. [5]

1.2.1 SAW Method

Simple Additive weighting method (SAW) also known as the term is often a weighted summation method. The basic concept SAW method is to find the sum of the weighted performance rating for each alternative on all attributes. SAW method requires a process of normalizing the decision matrix (X) to a scale that can be compared with all the ratings of existing alternatives. This method is the method most famous and most widely used in dealing with situations of Multiple Attribute Decision Making (MADM). MADM itself is a method used to find the optimal alternative of a number of alternatives to certain criteria.

SAW method requires decision makers determining the weights for each attribute. The total score for alternatives is obtained by adding up all the multiplication of rating (which can be compared cross-attribute) and the weight of each attribute. The rating for each attribute dimension must be free in the sense that has gone through the process of normalization previous matrix The decision process is to choose a alternatife.

SAW method commonly known term weighted summation method. The basic concept Merode SAW is seeking the sum of the weighted performance rating for each alternative on all

attributes. SAW method requires a process of normalizing the decision matrix (X) to a scale that can be compared with all the ratings of existing alternatives.

The advantages of the method SAW

1. Determining the weight value for each attribute, followed by the ranking process that will select the best alternative from a number of alternatives.
2. Assessment would be more appropriate because it is based on the value of the weight criteria specified preferences.
3. Calculation of normalization of the matrix in accordance with attribute values (between the benefit and cost).

Disadvantages of the method SAW

1. Used on a local weighting.
   Calculations were performed using crisp or fuzzy numbers

1.2.1.1 Step for SAW method

1. Specify the criteria that will be used as a reference in the decision, namely Ci.
2. Make decisions based on criteria matrix (Ci).
3. Doing normalization matrix based on the equations adjusted for the type attribute (attribute or attributes benefit costs) in order to obtain the normalized matrix R.

   In the SAW method, criteria are divided into two types of criteria that are benefit (benefits) and criteria that are cost (detrimental). That is, the greater the weight values for the benefit of criteria it will be better, on the contrary, if the value of the weights to the criteria the greater cost it will be worse. Calculations for the benefit and cost is of course different. Here's the explanation:

   1. Cost Criteria

   The formula used for the process of normalization on the criteria that are cost can be seen in the formula 1:

   $R_{ij}=(Min\{X_{ij}\}/X_{ij})$.....(2.1)

   Where :

   rij = normalized performance rating
   Minij = minimum value of each row and column
   Xij = rows and column of a matrix

   2. Benefit Criteria

   The formula used for the process of normalization on the criteria that are benefit can be seen in formula 2.

   $R_{ij}=(X_{ij}/Max\{X_{ij}\})$ .....(2.2)

   Where :

   Rij = normalized performance rating
   Maxij = minumum value of each row and column
   Xij = rows and column a matrix
4. Doing perangkingan against criteria (Wh) on Ranking process done by giving more weight to the criterion (W j). This perangkingan visible from where the most important criteria and which are less important criteria.

5. The final results obtained from the ranking process is the summation of the matrix multiplication R normalized with the weight vector in order to obtain the greatest value is selected as the best alternative (Ai) as a solution.

The process of calculating each of these alternatives is the final step of the calculation method of SAW, in which the calculation is done by looking for alternative values that have the highest weight. This process is done by summing of the multiplication of the matrix (R ij) with W j

The formula used can be seen in the formula 3

$A_i=(R_{ij}*w_1)+(R_{ij}*w_2)+...(R_{ij}*w_n)$.....(2.3)

Dimana :

Ai = final value of the alternative
wj = weight criteria
rij = normalization matrix

2. CONTENTS OF RESEARCH

2.1 Determination of the highest crime areas

Process Analysis of this information system using Simple Additive weighting method (SAW) to assist the Head of the Criminal Investigation Unit Polrestabes Bandung in determining the highest crime areas in the city of Bandung.

Based on the interview with Mr. Bambang SI as the Head of Administration, Administration, in determining the area of the highest crime have used the criteria and sub-criteria that have been set where the criteria and sub-criteria is used as an input to the SAW method, criteria and sub-criteria can be seen in table 1.

Table 3.1 Criteria for determining the highest crime areas

Criteria Name	Sub kriteria	Information
Population (C1)	0-20000	Population between 0 and 20000 souls
	20001-40000	Population between 20001 to 40000 inhabitants
	40001-60000	Population between 40001 to 60000 inhabitants
	60001-80000	Population between 60001 to 80000 inhabitants
	>80000	Population of more than 80000

		inhabitants
Jumlah Kejahatan (C2)	0-20	The number of crimes of 0 to 20 events
	21-40	The number of crimes 21 to 40 events
	41-60	The number of crimes 41 to 60 events
	61-80	The number of crimes 61 to 80 events
	>80	The number of crimes more than 80 events
Rencana Tata Ruang Wilayah (C3)	A	The majority of Protected Areas
	B	Protected Areas with Little Settlements
	C	slightly Settlement
	D	Most Settlement Region, national Trade and Industry
	E	The majority of Settlement of Trade and Industr

Based on interviews and discussions with Mr. Bambang SI as Head of Administration, Administration on the proposed criteria for determining the area of the highest crime gained weight calculations to determine the area of the highest crime can be seen in Table 3.5 and for the weight of the sub criteria for determining the area of the highest crime can be seen in table 3.6, 3.7 and 3.8.

Table 3.2 Criteria Weights

Criteria Name	Weight Value Criteria
Population (C1)	0,16
Number of Crimes (C2)	0,54
Spatial Planning Bandung (C3)	0,30

Table 3.3 Weighting of sub-criteria C1

Sub Kriteria	Weight Value Sub Criteria
0-20000	0,10
20001-40000	0,15
40001-60000	0,20
60001-80000	0,25
>80000	0.30

Table 3.4 Weighting subcriteria C2

Sub Kriteria	Weight Value Sub Criteria
0-20	0,10
21-40	0,15
41-60	0,20
61-80	0,10
>80	0.30

Table 3.5 Weighting subcriteria C3

Sub Kriteria	Weight Value Sub Criteria
A	0.10
B	0,15
C	0,20
D	0,25
E	0,30

To initialize each criterion 30 alternative is a district in the city of Bandung. So yes hasiln can be seen in table 3.6 initialization Criteria.

Table 3.6 Initialization Criteria

Territory	Criteria		
	C1	C2	C3
Bandung Kulon	>80000	21-40	E
Babakan Ciparay	>80000	21-40	D
Bojongloa Kaler	>80000	21-40	D
Bojongloa Kidul	>80000	41-60	D
Astana Anyar	60001-80000	21-40	E
Regol	>80000	>80	E
Lengkong	60001-80000	61-80	E
Bandung Kidul	40001-60000	0-20	D
Buah Batu	>80000	41-60	D
Rancasari	60001-80000	0-20	D
Gedebage	20001-40000	0-20	D
Cibiru	60001-80000	21-40	D
Panyileukan	20001-40000	41-60	C
Ujung Berung	60001-80000	21-40	D
Cinambo	20001-40000	0-20	D
Arcamanik	60001-80000	21-40	D
Antapani	60001-80000	0-20	E
Mandalajati	60001-80000	21-40	B
Kiaracondong	>80000	61-80	D
Batununggal	>80000	21-40	E
Sumur Bandung	20001-40000	41-60	E
Andir	>80000	41-60	D
Cicendo	>80000	61-80	D

Bandung Wetan	20001-40000	21-40	D
Cibeunying Kidul	>80000	41-60	B
Cibeunying Kaler	60001-80000	21-40	B
Coblong	>80000	41-60	E
Sukajadi	>80000	>80	D
Sukasari	>80000	0-20	D
Cidadap	40001-60000	21-40	B

In order to dila Kukan calculations in Table 3.6 Initialization criteria is then converted into a value based on the value of the weight that has previously been set. So yes hasiln can be seen in table 3.7 the decision matrix.

Table 3.7 Decision Matrixs

Territory	**Criteria**		
	C1	**C2**	**C3**
Bandung Kulon	0,30	0,15	0,30
Babakan Ciparay	0,30	0,15	0,25
Bojongloa Kaler	0,30	0,15	0,25
Bojongloa Kidul	0,30	0,20	0,25
Astana Anyar	0,25	0,15	0,30
Regol	0.30	0,30	0,30
Lengkong	0,25	0,25	0,30
Bandung Kidul	0,20	0,10	0,25
Buah Batu	0,30	0,20	0,25
Rancasari	0,25	0,10	0,25
Gedebage	0,15	0,10	0,25
Cibiru	0,25	0,15	0,25
Panyileukan	0,15	0,20	0,20
Ujung Berung	0,25	0,15	0,25
Cinambo	0,15	0,10	0,25
Arcamanik	0,25	0,15	0,25
Antapani	0,25	0,10	0,30
Mandalajati	0,25	0,15	0,15
Kiaracondong	0.30	0,25	0,25
Batununggal	0.30	0,15	0,30
Sumur Bandung	0,15	0,20	0,30
Andir	0,30	0,20	0,25
Cicendo	0,30	0,25	0,25
Bandung Wetan	0,15	0,15	0,25
Cibeunying Kidul	0.30	0,20	0,15
Cibeunying Kaler	0,25	0,10	0,15
Coblong	0,30	0,20	0,30
Sukajadi	0,30	0,30	0,25
Sukasari	0,30	0,10	0,25
Cidadap	0,20	0,15	0,15

The process of determining the highest crime area in Bandung are simple additive weighting method. Step cu ma is normalized decision matrix table.

After calculating the normalization of the entire value on el tab 3.7, then obtained a value of crime pad all the criteria in Table 3.8 Normalized.

Table 3.8 Normalized

Territory	**Criteria**		
	C1	**C2**	**C3**
Bandung Kulon	1	0,50	1
Babakan Ciparay	1	0,50	0,83
Bojongloa Kaler	1	0,50	0,83
Bojongloa Kidul	1	0,66	0,83
Astana Anyar	0,83	0,50	1
Regol	1	1	1
Lengkong	0,83	0,83	1
Bandung Kidul	0,66	0,33	0,83
Buah Batu	1	0,66	0,83
Rancasari	0,83	0,33	0,83
Gedebage	0,50	0,33	0,83
Cibiru	0,83	0,50	0,83
Panyileukan	0,50	0,66	0,66
Ujung Berung	0,83	0,50	0,83
Cinambo	0,50	0,33	0,83
Arcamanik	0,83	0,50	0,83
Antapani	0,83	0,33	1
Mandalajati	0,83	0,50	0,50
Kiaracondong	1	0,83	0,83
Batununggal	1	0,50	1
Sumur Bandung	0,50	0,66	1
Andir	1	0,66	0,83

Cicendo	1	0,83	0,83
Bandung Wetan	0,50	0,50	0,83
Cibeunying Kidul	1	0,66	0,50
Cibeunying Kaler	0,83	0,33	0,50
Coblong	1	0,66	1
Sukajadi	1	1	0,83
Sukasari	1	0,33	0,83
Cidadap	0,66	0,50	0,50

The next step is to calculate the value of the preferences of each sub-district at 3.11 table that aims to rank districts.

After calculating the preference value of each alternative districts, namely by multiplying nila i in Table 3.8 to nil ai weighting criteria in Table 3. 2, then the value obtained preferences district that is already sorted from the largest to the smallest in Table 3.9.

Table 3.9 on the calculation of each alternative

No.	Territory	The result of the calculation preferences
1	Regol	1
2	Sukajadi	0.949
3	Lengkong	0.881
4	Kiaracondong	0.857
5	Cicendo	0.857
6	Coblong	0.765
7	Buah Batu	0.765
8	Andir	0.736
9	Sumur Bandung	0.730
10	Bandung Kulon	0.730
11	Batununggal	0.702
12	Astana Anyar	0.679
13	Bojongloa Kidul	0.679
14	Babakan Cuparay	0.679
15	Bojongloa Kaler	0.666
16	Cibiru	0.651
17	Ujung Berung	0.651
18	Arcamanik	0.651
19	Cibeunying Kidul	0.634
20	Panyileukan	0.599
21	Antapani	0.587
22	Bandung Wetan	0.560
23	Sukasari	0.552
24	Rancasari	0.532
25	Bandung Kidul	0.525
26	Mandalajati	0.507
27	Gedebage	0.507
28	Cinambo	0.488
29	Cidadap	0.461
30	Cibeunying Kaler	0.341

Based on calculations of each alternative on the table 3.9, the 30 alternative districts in Bandung, district Regol has a value alternative to the highest, which means districts Regol is an area of the highest crime, so it was concluded that 1 (one) of the 30 (thirty) alternatives selected for the socialization of crime is Regol districts.

1.2 Determination Analysis Socialization

Determination of socialization conducted by the Head of Criminal Unit to report on data from the determination of the highest crime area received from the Head of Administration, Administration. Furthermore, to determine the socialization of what will be done in the district Regol Head of Criminal determining of the amount of crime that often occurs in the district Regol, kejahat an amount of data can be seen in Table 3.10

Table 3.10 Regol districts Crime Data in January 2014

Group / Type of Crime	Total Crime
Crimes Against Deadly	
Murder	0
Crimes Against Physical (Agency)	
Severe persecution	4
Light maltreatment	1
Domestic violence	2
Crimes Against Decency	
Rape	0
Of Abuse	0
Crimes Against Freedom People	
Kidnapping	1
mploying minors	0
Crimes Against Property Rights	
Theft with Violence	4

Theft with violence using firearms	2
Theft with violence using weapons	3
Theft	5
Theft by weighting	3
Motor vehicle theft	6
Destruction	0
Arson	1
Fencing	2
Narcotics Related Crime	
Narcotics and Psychotropic	6
Related Crime Fraud	
Fraud	8
Embezzlement	1
Public Order Related Crimes	
Crimes against public order	2
Total	51

In districts regol happened 51 the number of events k ejahatan follow. According to the table 3:10 crimes the most frequent scams by the number of crime scene 8 (dela pan) and seen from table 3.9 on the calculation of each alternative, the value of the highest preference is 1 (one), ie districts Regol then of these two tables, the crime Fraud been as socialization activities to be conducted in the district Regol.

1.3 Analysis of Geographic Information System

Stages Spatial data is the data manifold spatial object spatial data here Data required by the Geographic Information System, there are two kinds, among other spatial data and non-spatial data (attributes). Spatial data is a simple overview of the real world, spatial data can be data regarding the location of a particular object, while the non-spatial data (attribute) is the data in the form of information that describes the contents of the spatial data.
Here is the data needed by the system to be built:

Spatial data objects here using the form of point and area. Map data for GIS major who describes the location of each sub-district in the city of Bandung. The following explanations and ura ian spatial data used:

a. The first layer displaying area every district in the city of Bandung, the spatial data in the form of an area (polygon). Can be seen in Figure 3.1

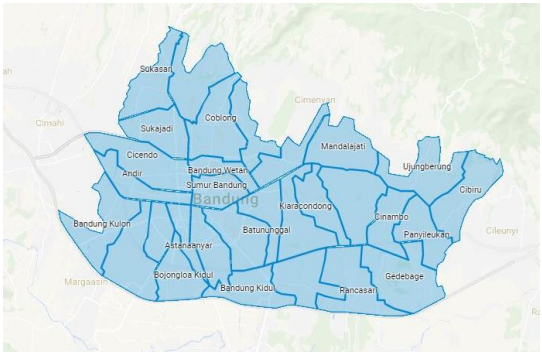


Figure 3.1 spatial data every district in Bandung

b. The second layer is a point the coordinates of the local police station in the city of Bandung.



Figure 3.2 The office coordinates of spatial data point

Bandung is composed of 30 districts where there is a police station in each sub-district sector.
To view the coordinates of the point that was criss an can be seen in Figure 3.3.

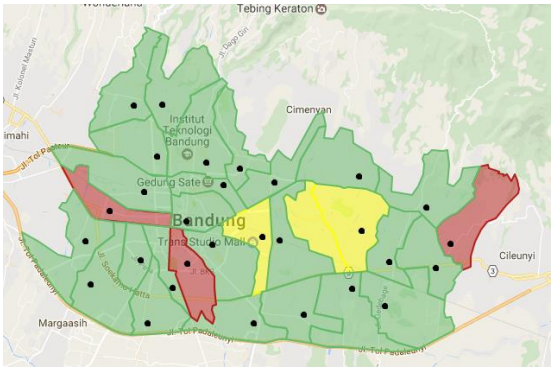


Figure 3.3 point coordinates to office

Staining was made to distinguish each of the districts of the results perhit Ungan preferences in table 3.9 on the calculation of each alternative, the coloring of the districts created by the deal with Mr. Bambang SI as Head of the Administrative Affairs, Administration and due to staining of the highest crime areas has not been there before. Spatial data used to build the system clearer ya can be seen in Table 3:10 staining crime area.

Table 3.10 staining the area crime

No	Description	Spatial Data	Example
1.	Office	Coordinate point	●

2.	Areas with crime area value 0	Polygon	
3.	Areas with crime area value <= 0.20	Polygon	
4.	Areas with the value of the area crime 0.20 <value area of crime <= 0.40	Polygon	
5.	Areas with crimes of regional value of 0.40 <value area of crime <= 0.60	Polygon	
6.	Areas with crimes of regional value of 0.60 <value area of crime <= 0.80	Polygon	
7.	Areas with crime area value> 0.80	Polygon	

Non-spatial data (attribute) the individual information of each data vector digital maps, non-spatial data is needed in GIS, which which will contain information about spatial data. Analysis of non-spatial data used to build the system i ni can be seen in Table 3.11 staining crime area. Here's an explanation and description of non-spatial data were used.

Table 3.11 The naming of a Non-Spatial Data

No	Name	Description	Attribute
1.	Name of the District	Contains information about the name of districts in Bandung	Name districts
2.	Office name	Contains information on the office name, office address and office telephone number	Office name, address, phone number
3.	Criminality	Contains information on the number of crimes	Criminality
4.	Socialization	Contains information on socialization	Socialization

1.4 Mapping Analysis Into Map

Based on the results of the determination of the highest ahatan Gen. areas in table 3.9 on the calculation of each alternative that districts host penen Regol and results dissemination in the table 3.10 Regol districts Crime Data in January 2014 are socializing on the next Fraud mapping into folders.

Because the results of the calculation preference Regol districts have a high preference value then to districts of Regol will change color to Dark Red ie areas with crime area values> 0.80, for staining yes kejahatann level can be seen in Table 3.10 staining crime area.

Based on the value prefe Rensi in table 3.9 on the calculation of each alternative, then the mapping for each wilay ah can be seen in Table 3.12.

Tabel 3.12 Mapping Region

No	Mapping the region	Spatial Data	Color spatial data
1.	-	Polygon	
2.	-	Polygon	
3.	Cobeunying Kaler	Polygon	

4.	Panyileukan, Antapani, Bandung wetan, Sukasari, Bandung Kidul, Mandalajati, Gedebage, Cinambo, Cidadap	Polygon	
5.	Coblong, Buah Batu, Andir, Sumur Bandung, Bandung Kulon, Batununggal, Astanaanyar, Bojongloa Kidul, Babakan ciparay, Bojongloa kaler, cibiru, Ujungberung, arcamanik, cibeunying kidul	Polygon	
6.	Regol, Sukajadi, Lengkong, Kiaracondong, Cicendo	Polygon	

3. CLOSING

3.1 Conclusions

Based on the results obtained then obtained the conclusion that a system that is built can make the head Unit in defining crimes Reskrim highest in Bandung in order to improve services to the community i.e. conduct socialization crimes.

3.2 Suggestion

Suggestions for the development of the applications of geographic information systems this future, among them are able to figure out the distance between the nearest occurrences crimes with the nearest police station to quick response police in dealing with any crimes.

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