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Research Paper

Formulation of Set Covering Problem Using Myopic Algorithm and Greedy Reduction Algorithm in Determining the Location of Temporary Landfills in Semambu Island Village, Ogan Ilir Regency, South Sumatra

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Abstract
This study discusses Set Covering Problem (SCP) in designing the optimal temporary waste disposal site (TWDS) in Semambu Island Village using the Myopic Algorithm (MA) and Greedy Reduction Algorithm (GRA). The analysis was carried out and compared using a maximum distance of 500m and 1000m to get the best solution from two methods. The results of the p-Median Problem by LINGO 13.0 software and MA with a maximum distance of 500m show the same TWDS location, namely Working Area (WA) 1, 2, 3, 4, 5, and 6 with the location of the candidate TWDS being at TWDS 2 WA 1, TWDS 1 WA 2, TWDS 2 WA 3, and TWDS 2 WA 5. For 1000m, it will be the location of the candidate's TWDS being at TWDS 2 WA 1, TWDS WA 2, and TWDS 2 WA 3. Using GRA, results were obtained will be 4 TWDS, namely TWDS 2 Hamlet 1, TWDS 1 Hamlet 2, TWDS 2 Hamlet 3, TWDS 2, Hamlet 5. Then using GRA, 2 solutions are obtained, namely columns 2 and 5 which dominate. Column 2 nomination are Hamlets 1, 2, 3, and 6. Column 5 which dominates will be Hamlets 1, 3, 5, and 6.

Keywords
Set Covering Problem, Greedy Reduction Algorithm, Myopic Algorithm, Semambu Island Village, Optimal TPS Location

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1. INTRODUCTION

Semambu Island Village has an area of 1200 ha/m^2. The distance of Semambu Island from the capital of South Sumatra Province is about 26 Km while from Ogan Ilir Regency it is about 14 Km and only 7 Km from North Indralaya District makes the location of Semambu Island Village can be said to be quite strategic. The number of people in Semambu Island Village is 1,603 people, which includes 427 families with 828 male and 775 female populations (Arba, 2021). This research was conducted in Semambu Island Village because there exist problems regarding the improper management of waste. The observation results stated that the distance between residents' houses ranged from 5-20 m and the people of Semambu Island Village had a habit of burning garbage in their respective houses by digging the soil 1m×2m wide which might build up at one point and caused environmental pollution. The lack of temporary and final dumps in the village triggered a wild buildup of garbage.

The Set Covering model is part of linear programming (Medrano-Gómez et al., 2020; Zhang and Zhang, 2015) formed to minimize the number of facility locations (Bangun et al., 2022; Bendík, 2015; Segall et al., 2017; Sitepu et al., 2019a) while still serving all requests (Akhter, 2015; Binev et al., 2018). Some of the Set Covering models include the Location Set Covering Problem (LSCP) (Machado et al., 2021) and p-Median Problem (Doungpan, 2020; Sitepu et al., 2022). LSCP is a problem in the distribution system that aims to find the optimal number of facility locations (Yang et al., 2020; Zhang and Zhang, 2015) so that it can serve all points of demand(Alizadeh and Nishi, 2019; Kocaoglu et al., 2014; Mohri and Haghshenas, 2021). The p-Median problem aims to find the location of the facility so that the p-total cost between each request and the nearest facility is minimized (Özceylan et al., 2017). P-Median Problem also aims to minimize the distance between the points of demand (Dzator and Dzator, 2015; Özceylan et al., 2017). Those problems can be solved using an exact method such as branch and bound algorithm to get the optimal location (Bendík, 2015; Sitepu et al., 2019b).

There exist the heuristics methods (Gajda et al., 2022; Kordalewski, 2013) to solve the SCP problems such as myopic algorithm and Greedy Reduction Algorithm (GRA). Myopic

Algorithm is an algorithm that is carried out in an effort to find the best solution in random conditions (Chen et al., 2020; Kawi and Rusdiansyah, 2009). GRA is one of the methods used to solve optimization problems, namely finding the most optimal solution of all possibilities (Binev et al., 2018; Puspita et al., 2019).

Recently, there is no optimal locations for Temporary Waste Disposal Sites (TWDS) (Octarina, 2022). in each Working Area (WA) Pulau Semambu Village, then the necessity to design that is critical. It deals with the society and environment if the TWDS are not in a suitable location. Then, it is necessary to formulate the LSCP model and the -PMedian Problem and apply GRA and Myopic Algorithm in determining the optimal number and location of waste TPS in Semambu Ogan Ilir Island Village, South Sumatra so that it can serve all request locations (Basciftci et al., 2021; Bendík, 2015; Chen and Yu, 2016).

2. EXPERIMENTAL SECTION

2.1 Methods

Steps taken in this research are as follows.

1. Collect Data
   The data taken is from Semambu Island Village which has 6 hamlets and each hamlet has 2 TWDS. Data collection is carried out directly from January 2022 to February 2022.
2. Describe The Data
   The number of TWDS from all WA in Semambu Island Village is explained in detail.
3. Measure the mileage from each request location to the location of the facility in Semambu Island Village in a unit of meter with the help of the GPS Speedometer application.
4. Define and specify variables and parameters for the LSCP and p-Median Problem models.
5. Formulate the LSCP model and p-Median Problem and solve it with LINGO 13.0 software application.
6. Analyze the results of the LSCP and p-Median Problem models.
7. Solve the solution to the p-Median Problem using the Myopic Algorithm
8. Analyze the calculation results of the Myopic Algorithm.

3. RESULT AND DISCUSSION

Pulau Semambu Village consists of 6 (six) hamlets with 12 TWDS. Table 1 describes the names of TWDS in each hamlet, each consisting of 2 TWDS.

Table 2 describes the location of TWDS using Google Maps in each hamlet in Pulau Semambu Village.

WA 1 is defined by variable y_1, WA 2 is defined by variable y_2, and so on. Table 3 explained about the definition of the TWDS variable in Pulau Semambu Village in Ogan Ilir Regency. Based on Table 3, x_1 is a variable that states TWDS 1 WA 1, x_2 is a variable that states TWDS 2 WA 2, and so on

Table 1. List of TWDS Names in Each Dusun in Pulau Semambu Village

Hamlet	TWDS Name List
Hamlet I	- TWDS 1
	- TWDS 2
Hamlet II	- TWDS 1
	- TWDS 2
Hamlet III	- TWDS 1
	- TWDS 2
Hamlet IV	- TWDS 1
	- TWDS 2
Hamlet V	- TWDS 1
	- TWDS 2
Hamlet VI	- TWDS 1
	- TWDS 2

Table 2. Definition of Variables and Parameters for Each Model

Variable	Variable Description
y_1	WA 1
y_2	WA 2
y_3	WA 3
y_4	WA 4
y_5	WA 5
y_6	WA 6

until x_{12} is a variable that states TWDS 2 WA 6.

Distance data between TWDS is obtained by using the GPS Speedometer and measured on 10 February 2022. By provisions of the Palembang City Environment and Hygiene Service, the maximum distance between TWDS used is 500 m. For comparison, this study will use a maximum distance of 500 m and 1000 m. Table 4 explained the distance between polling stations in Pulau Semambu Village.

3.1 Determination of the Number and Location of TWDS with the Location Set Covering Problem (LSCP) Model

The next step is to determine the location of TWDS with the optimal number. The location determination model used is LSCP which aims to optimize the number of TWDS in Pulau Semambu Village and can serve all demand points.

3.2 The Equation Model Used to Optimize the Number of TWDS with a Maximum Distance of 500 m

The LSCP model is obtained as follows: Minimize:

$$Z_{LSCP} = x_1+x_2+x_3+x_4+x_5+x_6+x_7+x_8+x_9+x_{10}+x_{11}+x_{12} \quad (1)$$

with constraints:

Figure 1. Comparison of Calculation Results of the p-Median Problem a) Using LINGO 13.0 and b) Myopic Algorithm with Maximum Distance of 500m

Table 3. Definition of TWDS Variables in Pulau Semambu Village

Variable	Variable Description
x_1	TWDS 1 of 1
x_2	TWDS 2 of 1
x_3	TWDS 1 of 2
x_4	TWDS 2 of 2
x_5	TWDS 1 of 3
x_6	TWDS 2 of 3
x_6	TWDS 1 of 4
x_7	TWDS 2 of 4
x_9	TWDS 1 of 5
x_{10}	TWDS 2 of 5
x_{11}	TWDS 1 of 6
x_{12}	TWDS 2 of 6

$$x_1 + x_2 \geq 1 \quad (2)$$
$$x_3 + x_4 + x_7 \geq 1 \quad (3)$$
$$x_3 + x_4 \geq 1 \quad (4)$$
$$x_5 + x_6 + x_{11} + x_{12} \geq 1 \quad (5)$$
$$x_3 + x_7 + x_8 \geq 1 \quad (6)$$
$$x_7 + x_8 \geq 1 \quad (7)$$
$$x_9 + x_{10} \geq 1 \quad (8)$$
$$x_5 + x_6 + x_{11} + x_{12} \geq 1 \quad (9)$$
$$x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8, x_9, x_{10}, x_{11}, x_{12} \in 0, 1 \quad (10)$$

The optimal solution is shown in Table 5.

The optimal solution is 5, where the value of the variable is as in Table 6 as follows.

From Table 6 it is obtained that Z = 5 with the optimal solution. This means that the TWDS candidate locations are in 5 locations, namely: $x_2 = x_3 = x_6 = x_8 = x_{10} = 1$

Figure 2. Comparison of Calculation Results of the p-Median Problem a) Using LINGO 13.0 and b) Myopic Algorithm with Maximum Distance of 500m

1. TWDS 2 of 1
2. TWDS 1 of 2
3. TWDS 2 of 3
4. TWDS 2 of 4
5. TWDS 2 of 5

3.3 The Equation Model Used to Optimize the Number of TWDS with a Maximum Distance of 1000 m

The LSCP model is obtained as follows: Minimize Equation (1) subject to Equation (2),

$$x_3 + x_4 + x_7 + x_8 + x_9 + x_{10} \geq 1 \quad (11)$$
$$x_3 + x_4 + x_7 + x_8 + x_9 \geq 1 \quad (12)$$
$$x_5 + x_6 + x_{11} + x_{12} \geq 1 \quad (13)$$
$$x_3 + x_4 + x_7 + x_8 \geq 1 \quad (14)$$
$$x_3 + x_4 + x_{10} \geq 1 \quad (15)$$
$$x_3 + x_9 + x_{10} \geq 1 \quad (16)$$
$$x_5 + x_6 + x_{11} + x_{12} \geq 1 \quad (17)$$

and Equation (12)

Then, the solution using LINGO 13.0, is stated in Table 7 and variable values are stated in Table 8.

From Table 6 it is obtained that Z = 3 with the optimal solution. This means that the TWDS candidate locations are in 3 locations, namely $x_2 = x_3 = x_6 = 1$.

1. TWDS 2 of 1
2. TWDS 1 of 2
3. TWDS 2 of 3

3.4 Model of p-Median Problem Pulau Semambu Village

Model completion p-Median Problem uses facility location data (selected TWDS) and demand locations (every Dusun in Pulau Semambu Village) obtained from the LSCP model.

Table 4. Distance between TWDS in Pulau Semambu Village(in meters)

d_{xy}	1	2	3	4	5	6	7	8	9	10	11	12
1	0	390	1390	1540	2990	3350	1650	1950	2030	2300	2870	3190
2	390	0	1580	1730	3180	3540	1840	2140	2220	2490	3060	3380
3	1390	1580	0	230	1680	2040	440	740	720	990	1560	1880
4	1540	1730	230	0	1830	2190	590	890	870	1140	1710	2030
5	2990	3180	1680	1830	0	360	2040	2340	1260	1530	120	200
6	3350	3540	2040	2190	360	0	2400	2700	1620	1890	480	160
7	1650	1840	440	590	2040	2400	0	300	1080	1350	1920	2240
8	1950	2140	740	890	2340	2700	300	0	1380	1650	2220	2540
9	2030	2220	720	870	1260	1620	1080	1380	0	270	1140	1460
10	2300	2490	990	1140	1530	1890	1350	1650	270	0	1410	1730
11	2870	3060	1560	1710	120	480	1920	2220	1140	1410	0	320
12	3190	3380	1880	2030	200	160	2240	2540	1460	1730	320	0

Table 5. Optimal Solutions for Pulau Semambu Village LSCP Model

Solver Status	
Model Class	PILP
State	Global Optimal
Objective	5
Infeasibility	0
Iterations	0
Extended Solver Status	
Solver Type	Branch and Bound
Best Objective	5
Objective bound	5
Steps	0
Active	0
Update Interval	2
GMU (K)	2
ER (sec)	21

Table 6. Variable Values for LSCP Solution

Variable	Variable Value	Variable	Variable Value
x_1	0	x_7	0
x_2	1	x_8	1
x_3	1	x_9	0
x_4	0	x_{10}	1
x_5	0	x_{11}	0
x_6	1	x_{12}	0

Table 7. Optimal Solutions for the Pulau Semambu Village LSCP Model

Solver Status	
Model Class	PILP
state	Global Optimal
Objective	3
Infeasibility	0
Iterations	0
Extended Solver Status	
Solver Type	Branch and Bound
Best Objective	3
Objective bound	3
Steps	0
Active	0
Update Interval	2
GMU (K)	21
ER (sec)	0

Table 8. Variable Values for LSCP Solution

Variable	Variable Value	Variable	Variable Value
x_1	0	x_7	0
x_2	1	x_8	0
x_3	1	x_9	0
x_4	0	x_{10}	0
x_5	0	x_{11}	0
x_6	1	x_{12}	0

3.5 P-Median Problem Model with a Maximum Distance of 500 m in Pulau Semambu Village

Table 9 describes the distance between each of the optimal TWDS obtained in LSCP model (1)-(10)

Table 9. p-Median Problem Model in Pulau Semambu Village

d_{xy}	2	3	6	8	10
1	290	1290	3250	1850	2200
2	1540	40	2000	700	950
3	2750	1240	800	1900	1090
4	1490	90	2050	650	1000
5	2070	570	1470	1230	420
6	2740	1240	800	1900	1090

Then the p-median model will be as follows.

$$Z_{P-Median} = 290y_{1,2} + 1290y_{1,3} + 3250y_{1,6} + 1850y_{1,8} + 2200y_{1,10} + 1540y_{2,2} + 40y_{2,3} + 2000y_{2,6} + 700y_{2,8} + 950y_{2,10} + 2750y_{3,2} + 1240y_{3,3} + 800y_{3,6} + 1900y_{3,8} + 1090y_{3,10} + 1490y_{4,2} + 90y_{4,3} + 2050y_{4,6} + 650y_{4,8} + 1000y_{4,10} + 2070y_{5,2} + 570y_{5,3} + 1470y_{5,6} + 1230 y_{5,8} + 420y_{5,10} + 2740y_{6,2} + 1240y_{6,3} + 800y_{6,6} + 1900 y_{6,8} + 1090y_{6,10} \tag{18}$$

Subject to

$$y_{1,2} + y_{1,3} + y_{1,6} + y_{1,8} + y_{1,10} = 1 \tag{19}$$
$$y_{2,2} + y_{2,3} + y_{2,6} + y_{2,8} + y_{2,10} = 1 \tag{20}$$
$$y_{3,2} + y_{3,3} + y_{3,6} + y_{3,8} + y_{3,10} = 1 \tag{21}$$
$$y_{4,2} + y_{4,3} + y_{4,6} + y_{4,8} + y_{4,10} = 1 \tag{22}$$
$$y_{5,2} + y_{5,3} + y_{5,6} + y_{5,8} + y_{5,10} = 1 \tag{23}$$
$$y_{6,2} + y_{6,3} + y_{6,6} + y_{6,8} + y_{6,10} = 1 \tag{24}$$
$$x_2 + x_3 + x_6 + x_8 + x_{10} = 5 \tag{25}$$

$$y_{1,2} + y_{3,2} + y_{4,2} + y_{5,2} + y_{6,2} \le x_2 \tag{26}$$
$$y_{1,3} + y_{2,3} + y_{3,3} + y_{4,3} + y_{5,3} + y_{6,3} \le x_3 \tag{27}$$
$$y_{1,6} + y_{2,6} + y_{3,6} + y_{4,6} + y_{5,6} + y_{6,6} \le x_6 \tag{28}$$
$$y_{1,8} + y_{2,8} + y_{3,8} + y_{4,8} + y_{5,8} + y_{6,8} \le x_8 \tag{29}$$
$$y_{1,10} + y_{2,10} + y_{3,10} + y_{4,10} + y_{5,10} + y_{6,10} \le x_{10} \tag{30}$$
$$y_{1,2}, y_{2,2}, y_{3,2}, y_{4,2}, y_{5,2}, y_{6,2}, y_{1,3}, y_{2,3}, y_{3,3}, y_{4,3}, y_{5,3}, y_{6,3}, y_{1,6}, y_{2,6}, y_{3,6}, y_{4,6}, y_{5,6}, y_{6,6}, y_{1,8}, y_{2,8}, y_{3,8}, y_{4,8}, y_{5,8}, y_{6,8}, y_{1,10}, y_{2,10}, y_{3,10}, y_{4,10}, y_{5,10}, y_{6,10} \in 0, 1 \tag{31}$$
$$x_2, x_3, x_6, x_8, x_{10} \in 0, 1 \tag{32}$$

Solutions and variable values are presented in Table 10 and Table 11, respectively. The optimal solution is 2440, so the optimal solution is obtained as in Table 11. $Z_{(P-Median)} = 2440, y_{1,2} = y_{2,3} = y_{3,6} = y_{4,3} = y_{5,10} = y_{6,6} = 1$

Table 10. Optimal Solutions for the p-Median Problem in Pulau Semambu Village

Solver Status	
Model Class	PILP
State	Global Optimal
Objective	2440
Infeasibility	0
Iterations	0
Extended Solver Status	
Solver Type	Branch and Bound
Best Objective	2440
Objective bound	2440
Steps	0
Active	0
Update Interval	2
GMU (K)	34
ER (sec)	0

3.6 P-Median Problem Model with a Maximum Distance of 1000 m in Pulau Semambu Village

Table 12 displays the distance between WA and TWDS in distance of 1000 m.

The p-median problem will be as follows. Minimize:

$$Z_{(P-Median)} = 290y_{1,2} + 1290y_{1,3} + 3250y_{1,6} + 1540y_{2,2} + 40y_{2,3} + 2000y_{2,6} + 2750y_{3,2} + 1240y_{3,3} + 800y_{3,6} + 1490y_{4,2} + 90y_{4,3} + 2050y_{4,6} + 2070y_{5,2} + 570y_{5,3} + 1470y_{5,6} + 2740y_{6,2} + 1240y_{6,3} + 800y_{6,6} \tag{33}$$
$$y_{1,2} + y_{1,3} + y_{1,6} = 1 \tag{34}$$
$$y_{3,2} + y_{3,3} + y_{3,6} = 1 \tag{35}$$
$$y_{4,2} + y_{4,3} + y_{4,6} = 1 \tag{36}$$
$$y_{5,2} + y_{5,3} + y_{5,6} = 1 \tag{37}$$
$$y_{6,2} + y_{6,3} + y_{6,6} = 1 \tag{38}$$
$$x_2 + x_3 + x_6 = 3 \tag{39}$$
$$y_{1,2} + y_{2,2} + y_{3,2} + y_{4,2} + y_{5,2} + y_{6,2} \le x_2 \tag{40}$$
$$y_{1,3} + y_{2,3} + y_{3,3} + y_{4,3} + y_{5,3} + y_{6,3} \le x_3 \tag{41}$$
$$y_{1,6} + y_{2,6} + y_{3,6} + y_{4,6} + y_{5,6} + y_{6,6} \le x_6 \tag{42}$$
$$y_{1,2}, y_{2,2}, y_{3,2}, y_{4,2}, y_{5,2}, y_{6,2}, y_{1,3}, y_{2,3}, y_{3,3}, y_{4,3}, y_{5,3}, y_{6,3}, y_{1,6}, y_{2,6}, y_{3,6}, y_{4,6}, y_{5,6}, y_{6,6} \in 0, 1 \tag{43}$$
$$x_2, x_3, x_6 \in 0, 1 \tag{44}$$

Then the optimal solutions are presented in Table 13 as follows. The optimal solution is 2590 as in Table 13. Table 14 explains the variable values for p-median problem of 1000 m maximum distance.

Based on Table 14, it is obtained with the optimal solution of $Z_{(P-Median)} = 2590, y_{1,2} = y_{2,3} = y_{3,6} = y_{4,3} = y_{5,3} = y_{6,6} = 1$.

Table 11. Values for Solution to p-Median Problem Using LINGO 13.0 Software

Variable	Variable Value	Variable	Variable Value	Variable	Variable Value
$y_{1,2}$	1	$y_{3,2}$	0	$y_{5,2}$	0
$y_{1,3}$	0	$y_{3,3}$	0	$y_{5,3}$	0
$y_{1,6}$	0	$y_{3,6}$	1	$y_{5,6}$	0
$y_{1,8}$	0	$y_{3,8}$	0	$y_{5,8}$	0
$y_{1,10}$	0	$y_{3,10}$	0	$y_{5,10}$	1
$y_{2,2}$	0	$y_{4,2}$	0	$y_{6,2}$	0
$y_{2,3}$	1	$y_{4,3}$	1	$y_{6,3}$	0
$y_{2,6}$	0	$y_{4,6}$	0	$y_{6,6}$	1
$y_{2,8}$	0	$y_{4,8}$	0	$y_{6,8}$	0
$y_{2,10}$	0	$y_{6,8}$	0	$y_{6,10}$	0

Table 12. Distance Between WA and TWDS Candidates with a Maximum Distance of 1000 m

d_{xy}	2	3	6
1	290	1290	3250
2	1540	40	2000
3	2750	1240	800
4	1490	90	2050
5	2070	570	1470
6	2740	1240	800

3.7 Determination of the Number and Location of TWDS in Pulau Semambu Village Using the p-Median Problem Model and Solved with Myopic Algorithm

Model completion The p-Median Problem using Myopic Algorithm aims to obtain an optimal solution in determining the location of TWDS so that it can fulfill all demand points in each WA. In solving the Myopic Algorithm, the first step is to determine the distance between the WA and TWDS as shown in Table 4. The second step is to add up all the columns in Table 4 then select the minimum number from Table 4 and mark it in yellow indicating that the column has the minimum number of each column. The next step is to replace the value in each entry with the value of the entry in the column that has the minimum number provided that the value of the replaced entry has value above the value of the entry in the column that has the minimum number then the column that has the minimum number of each column is marked in blue. The last step is to check the sum of all the columns to see if the sum of all the columns is the same or not. If the total number of columns is the same, the Myopic Algorithm solution is terminated and if the total number of columns is not the same, then repeat the second step until the total number of columns is the same. Table 15-Table 19 show the p-Median Problem with a Maximum Distance of 500m using the Myopic Algorithm.

Table 13. Optimal Solutions for the p-Median Problem in Pulau Semambu Village of Maximum Distance of 1000 m

Solver Status	
Model Class	PILP
state	Global Optimal
Objective	2590
Infeasibility	0
Iterations	0
Extended Solver Status	
Solver Type	Branch and Bound
Best Objective	2590
Objective bound	2590
Steps	0
Active	0
Update Interval	2
GMU (K)	26
ER (sec)	0

3.8 Solving p-Median Problem with a Maximum Distance of 500 meters using the Myopic Algorithm

The final Myopic Algorithm solution for TWDS in Pulau Semambu Village is the optimal distance of 2440 meters with a total of 6 demand point locations and 4 TWDS locations spread across Pulau Semambu Village.

3.9 Solving the p-Median Problem Model with a Maximum Distance of 1000 meters using the Myopic Algorithm

Table 20-Table 23 show that Solving the p-Median Problem Model with a Maximum Distance of 1000 meters using the Myopic Algorithm.

In Table 23, it can be seen that the total distance in each column is the same, so the Myopic Algorithm work is stopped. The final Myopic Algorithm solution for TWDS in Pulau Semambu Village is the optimal distance of 2590 meters with a total of 6 demand point locations and 3 TWDS locations spread across Pulau Semambu Village.

Table 14. Values for Solutions to the p-Median Problem Using LINGO 13.0 Software Software

Variable	Variable Value	Variable	Variable Value	Variable	Variable Value
$y_{1,2}$	1	$y_{3,2}$	0	$y_{5,2}$	0
$y_{1,3}$	0	$y_{3,3}$	0	$y_{5,3}$	1
$y_{1,6}$	0	$y_{3,6}$	1	$y_{5,6}$	0
$y_{2,2}$	0	$y_{4,2}$	0	$y_{6,2}$	0
$y_{2,3}$	1	$y_{4,3}$	0	$y_{6,3}$	0
$y_{2,6}$	0	$y_{4,6}$	0	$y_{6,6}$	1

Table 15. Solving Myopic Algorithm (Part 1)

d_{xy}	2	3	6	8	10
1	290	1290	3250	1850	2200
2	1540	40	2000	700	950
3	2750	1240	800	1900	1090
4	1490	90	2050	650	1000
5	2070	570	1470	1230	420
6	2740	1240	800	1900	1090
Total	10880	4470	10370	8230	6750

Table 16. Solving Myopic Algorithm (Part 2)

d_{xy}	2	3	6	8	10
1	290	1290	1290	1290	1290
2	40	40	40	40	40
3	1240	1240	800	1900	1090
4	90	90	90	90	90
5	570	570	570	570	420
6	1240	1240	800	1240	1090
Total	3470	4470	3590	4470	4020

Table 17. Solving Myopic Algorithm (Part 3)

d_{xy}	2	3	6	8	10
1	290	290	290	290	290
2	40	40	40	40	40
3	1240	1240	800	1240	1090
4	90	90	90	90	90
5	570	570	570	570	420
6	1240	1240	800	1240	1090
Total	3470	3470	2590	3470	3020

Table 18. Solving Myopic Algorithm (Part 4)

d_{xy}	2	3	6	8	10
1	290	290	290	290	290
2	40	40	40	40	40
3	800	800	800	800	800
4	90	90	90	90	90
5	570	570	570	570	420
6	800	800	800	800	800
Total	2590	2590	2590	2590	2440

3.10 Solving p-Median Problem with a Maximum Distance of 500 meters using the Greedy Reduction Algorithm

GRA is a common algorithm. GRA is a type of algorithm that produces an optimum solution through a step-by-step solution using a problem-solving approach by finding the maximum temporary value at each step of the process. Mathematically GRA can be written as follows.

Minimize

$$\sum_a \sum_b d_{ab} y_{ab} \tag{45}$$

subject to

$$\sum_{b \in b} y_{ab} = 1, \forall a \in A \tag{46}$$

$$\sum_{b \in b} x_b = p \tag{47}$$

$$y_{ab} \leq x_b, \forall a \in A, b \in B \tag{48}$$

$$y_{ab} \in \{0, 1\}, \forall a \in A, b \in B \tag{49}$$

$$x_b \in \{0, 1\}, \forall b \in B \tag{50}$$

Based on Equation (45)-(50), the dominant column is sought among all the existing columns, in creating the Table. A column is said to dominate if the value is less than the others.

3.11 Column 2 as the Dominating Column

Table 24 explains the dominant value of comparison results with column 3

Based on the results from Table 24, it is found that columns 3 and 6 have the smallest value. So it can be said that columns

Table 19. Solving Myopic Algorithm (Part 5)

d_{xy}	2	3	6	8	10
1	290	290	290	290	290
2	40	40	40	40	40
3	800	800	800	800	800
4	90	90	90	90	90
5	420	420	420	420	420
6	800	800	800	800	800
Total	2440	2440	2440	2440	2440

Table 20. Myopic Algorithm Solution (Part 1)

d_{xy}	2	3	6
1	290	1290	3250
2	1540	40	2000
3	2750	1240	800
4	1490	90	2050
5	2070	570	1470
6	2740	1240	800
Total	10880	4470	10370

Table 21. Solving Myopic Algorithm (Part 2)

d_{xy}	2	3	6
1	290	1290	1290
2	40	40	40
3	1240	1240	800
4	90	90	90
5	570	570	1470
6	1240	1240	800
Total	3470	4470	3590

Table 22. Solving Myopic Algorithm (Part 3)

d_{xy}	2	3	6
1	290	290	290
2	40	40	40
3	1240	1240	800
4	90	90	90
5	570	570	570
6	1240	1240	800
Total	3470	3470	2590

3 and 6 are solutions for 3 locations facilities, namely (2,3) and (2,6) with a total of 1830. After getting 2 and 6, then the next is the same as before by finding the dominant value by comparing the values between columns, which is stated in Table 25.

Based on Table 25, it can be seen that the smallest value is in column 1. So it can be seen that the dominating columns are 2, 3, 6, and 1. Next, in Table 26, calculation results using p-Median GRA (Column 2 Dominant) is conducted. Column 2 nomination are Hamlets 1, 2, 3, and 6.

3.12 Column 5 as the Dominant Column

Table 27 shows that the dominant value of comparison results with column 5. Based on the results from Table 27, it is found that column 1 is the column that has the smallest value. So it can be said that column 1. Then the value is 2450. So, the solutions for the dominating column are 5 and 1, like stated in Table 28-Table 29.

Based on Table 28-Table 29, it can be seen that the smallest values are in columns 3 and 1. So it can be seen that the dominating columns are 5, 1, 3, and 6. Column 5 dominates, namely Hamlets 1, 3, 5, and 6.

3.13 Calculation Result Analysis

The results of the calculation of the LSCP model with a maximum distance of 500m in Pulau Semambu Village are conducted by using the LINGO 13.0 software, as stated in Table 30.

So that it can serve 6 hamlets in Semambu Island Village totaling 4 TWDS, namely TWDS 2 Hamlet 1, TWDS 1 Hamlet 2, TWDS 2 Hamlet 3, TWDS 2, and Hamlet 5. The results of the calculation of the LSCP model with a maximum distance of 1000 meters in Pulau Semambu Village using the LINGO 13.0 software as stated in Table 31.

Calculation results with LINGO 13.0 software and Myopic Algorithm show the same TWDS location. Table 32-Table 33 show the comparison results for 500 m and 1000 m distances between LINGO 13.0 and Myopic Algorithm. The results show the same distance.

Figure 1 and Figure 2 summarize the optimal location of TWDS using myopic algorithms and using LINGO 13.0. In Figure 1 a) the calculation is for 500m and Figure 1 b) is for 1000m by using LINGO 13.0 and myopic algorithm.

The analysis summarizes some results as follows.

1. The location of the TWDS location obtained from the results of the LSCP calculation so that it can serve 6 hamlets in Pulau Semambu Village with a maximum distance of 500 meters are 5 TWDS candidates, namely TWDS 2 WA 1, TWDS 1 WA 2, TWDS 2 WA 3, TWDS 2 WA 4, and TWDS 2 WA 5, while with a maximum distance of 1000 meters, 3 TWDS candidates were obtained, namely TWDS 2 WA 1, TWDS 1 WA 2, and TWDS 2 WA 3.
2. The solution to the p-Median Problem is to obtain the location of the request and the facility with the minimum distance. The data for each location of demand is grouped with the location of the nearest facility so that the average distance traveled is minimum with all requests in 6 hamlets in Pulau Semambu Village.
3. Calculation results of p-Median Problem Software LINGO 13.0 and Myopic Algorithm with a maximum distance

Table 23. Solving Myopic Algorithm (Part 4)

d_{xy}	2	3	6
1	290	290	290
2	40	40	40
3	800	800	800
4	90	90	90
5	570	570	570
6	800	800	800
Total	2590	2590	2590

Table 24. Dominant Value of Comparison Results with Column 3

Column	1	3	4	5	6
2	2980	830	4130	2640	1830

of 500 meters indicate the location of the same TWDS, namely WA 1, WA 2, WA 3, WA 4, WA 5, and WA 6 with candidate TWDS locations located at TWDS 2 WA 1, TWDS 1 WA 2, TWDS 2 WA 3, and TWDS 2 WA 5 and with a maximum distance of 1000m indicate the same TWDS location, namely WA 1, WA 2, WA 3, WA 4, WA 5, and WA 6 with candidate TWDS locations are TWDS 2 WA 1, TWDS 1 WA 2, TWDS 2 WA 3.

4. Based on the completion of the model using a covering-based model and assisted using Lingo software, the results obtained are the number of TPS to be built so that it can serve 6 Hamlets in Pulau Semambu Village, totaling 4 TPS, namely TPS 2 Hamlet 1, TPS 1 Hamlet 2, TPS 2 Hamlet 3, TPS 2 and Hamlet 5. Then using GRA, 2 solutions were obtained, namely columns 2 and 5 which dominated. Column 2 nominations are Hamlet 1, 2, 3, and 6. Column 5 which dominates will be Hamlet 1, 3, 5, and 6.

4. CONCLUSION

Based on the results of the analysis of calculations and discussions that have been carried out, it can be concluded that the recommended TWDS location for each demand point in each hamlet in Pulau Semambu Village is the TWDS with the closest distance to the point of request location, as stated in Tabel 31, Table 32 and clearly display in Figure 1 and Figure 2. For further research, it is better to also include some considerations from the population which locations can be set as the TWDS

Table 25. Dominant Value of Comparison Results with Columns 2 and 6

Column 1	Column 4	Column 5
580	1730	1300

Table 26. Calculation Results Using P-Median GRA (Column 2 Dominant)

Number of Facilities	GRA
1	2
2	2 and 3
3	2, 3, and 6
4	2,3,6, and 1

Table 27. Dominant Value of Comparison Results with Column 5

Column	1	2	3	4	6
5	2450	2640	2890	2590	2890

Table 28. Dominant Value of Comparison Results with Columns 5 and 1

Column 2	Column 3	Column 4	Column 6
1390	1110	1390	1110

Table 29. Calculation Results Using P-Median GRA (Column 5 Dominant)

Number	GRA
1	5
2	5 and 1
3	5, 1, and 3
4	5,1,3, and 6

Table 30. LSCP Calculation Results with a Maximum Distance of 500m in Pulau Semambu Village

Number	TWDS Candidate Name
1	TWDS 2 OF 1
2	TWDS 1 OF 2
3	TWDS 2 OF 3
4	TWDS 2 OF 4
5	TWDS 2 OF 5

Table 31. LSCP Calculation Results with a Maximum Distance of 1000m in Pulau Semambu Village

Number	TWDS Candidate Name
1	TWDS 2 OF 1
2	TWDS 1 OF 2
3	TWDS 2 OF 3

Table 32. Comparison of Calculation Results of the p-Median Problem Software LINGO 13.0 with a Maximum Distance of 500m and Myopic Algorithm

Number	LINGO 13.0	Software Results	Myopic	Algorithm Results
1	WA 1	TWDS 2 OF 1	WA 1	TWDS 2 OF 1
2	WA 2	TWDS 1 OF 2	WA 2	TWDS 1 OF 2
3	WA 3	TWDS 2 OF 3	WA 3	TWDS 2 OF 3
4	WA 4	TWDS 1 OF 2	WA 4	TWDS 1 OF 2
5	WA 5	TWDS 2 OF 5	WA 5	TWDS 2 OF 5
6	WA 6	TWDS 2 OF 3	WA 6	TWDS 2 OF 3
Total		2440		2440

Table 33. Calculation Results of the p-Median Problem Software LINGO 13.0 with a Maximum Distance of 1000m and Myopic Algorithm

Number	LINGO 13.0	Software Results	Myopic	Algorithm Results
1	WA 1	TWDS 2 OF 1	WA 1	TWDS 2 OF 1
2	WA 2	TWDS 1 OF 2	WA 2	TWDS 1 OF 2
3	WA 3	TWDS 2 OF 3	WA 3	TWDS 2 OF 3
4	WA 4	TWDS 1 OF 2	WA 4	TWDS 1 OF 2
5	WA 5	TWDS 1 OF 2	WA 5	TWDS 1 OF 2
6	WA 6	TWDS 2 OF 3	WA 6	TWDS 2 OF 3
Total		2590		2590

location, due to using the private property of the population. Also, to include some criteria in solving the model based on TWDS volume, hamlet having the most crowded populations or other criteria, then the SCP can be extended into fuzzy SCP to also include some new criteria emerge from the population.

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