

# i-RIC 2024

INTERNATIONAL RESEARCH & INNOVATION CONFERENCE

# PROCEEDING

“HARMONY IN DIVERSITY: FOSTERING UNITY  
SUSTAINABLE RESEARCH AND INNOVATION SOCIETY”

24 & 25 JULY  
| 20  
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Organizer



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Published by:

Politeknik Nilai Negeri Sembilan (PNS)  
Kompleks Pendidikan Bandar Enstek,  
71760, Bandar Enstek,  
Negeri Sembilan

2024

eISBN 978-967-2742-35-7

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## PREFACE

It is a great privilege for us to present the proceedings of the International Research and Innovation Conference (i-RIC 2024) to the authors and delegates. We hope that you will find it useful, exciting, and inspiring. The International Research and Innovation Conference (i-RIC 2024) was held online from 24 to 25 July 2024, organized by Politeknik Nilai in collaboration with Universitas Logistik dan Bisnis Internasional (ULBI) with the theme, “Harmony in Diversity: Fostering Unity Sustainable Research and Innovation Society.”

i-RIC 2024 aims to gather more researchers, students, government agencies, and private sectors in an event with a larger international impact. The organization of this program also serves as a platform for sharing research findings, ideas, and knowledge among members of polytechnics, community colleges, higher education institutions, public universities, as well as government and private agencies involved. Researchers, academics, and experts from various sectors will have a global stage at i-RIC 2024 to discuss the latest findings and research that support sustainable development goals. The conference aims to generate knowledge to make our world greener and better for us and our future generations.

There were 4 keynote speeches covering different areas of the conference. The first day started with Associate Professor Dr. Ir. Agus Purnomo (ULBI Indonesia) talk on "How to Boost Green Supply Chain Resilience?" and Professor Dr. Mohamed Kchaou (University of Bisha, Saudi Arabia; University of Sfax, Tunisia) on "Latex Based Membrane for Oily Wastewater Treatment Technology Process and Perspectives". The second day featured Professor Dr. Recai Kus (Selcuk University, Turkey) on "Load Optimization of AISI 1040 and AISI 5140 Joint" and Dr. Umawathy a/p Technamurthy (Universiti Kebangsaan Malaysia) with her talk on "Harnessing the Potential of Maker Education in Enhancing Student Learning Outcomes".

A total of 124 presenters participated in the parallel presentation sessions, which ran smoothly over the two-day event supported by 109 i-RIC 2024 organizing committees. This included 16 online presentation moderators, 42 reviewers, 19 judges, and all participants who took the time to attend the online sessions. A total of 124 research papers and 56 innovations were presented in this program across 7 fields, namely:

- A. Engineering and Technology
- B. Business Management
- C. Education, Teaching, and Learning
- D. Health and Life Sciences
- E. Social Sciences
- F. Information Communication Technology
- G. Logistics and Supply Chain

Information regarding i-RIC 2024 can be accessed through the Program Book at <https://heyzine.com/flip-book/521619ef82.html> and overall results can be found at <http://iric.polinilai.edu.my/.../confe.../results-innovation>.

We would like to express our heartfelt thanks and sincere appreciation to all the authors for their contributions to this publication. We also express our gratitude and appreciation to all of the reviewers for their constructive feedback on the papers. Warmest thanks to the members of the organizing committee for their hard work and dedication in ensuring the success of the event.

Congratulations to everyone involved in making this conference a success.

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# **LOGISTICS AND SUPPLY CHAIN MANAGEMENT**

“HARMONY IN DIVERSITY: FOSTERING UNITY  
SUSTAINABLE RESEARCH AND INNOVATION SOCIETY”

# Proposed Logistics Distribution Pattern for Regional Head Election in Bulukumba Regency (Case Study of the 2024 Regional Head Election)

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## Abstract

The General Election Commission (KPU) of Bulukumba Regency is an institution that organizes general elections as stipulated by law governing the conduct of general elections in Bulukumba Regency. One of the crucial stages for the successful organization of elections is the accurate and efficient distribution of election logistics. The KPU of Bulukumba Regency needs to conduct mapping and understand the characteristics of the area to facilitate the determination of distribution patterns, distribution scheduling, mode of transportation, budget preparation, and collaboration with relevant agencies. PT. Pos Indonesia Bulukumba branch, as a state-owned enterprise engaged in courier and logistics services, can provide solutions for the KPU Bulukumba in selecting transportation modes, scheduling distributions, and determining optimal logistic distribution routes for the 2024 Regional Head Election in Bulukumba Regency using the capacitated vehicle routing problem approach by considering distances from Google Maps and using the nearest neighbor algorithm to determine the shortest distance between points. The proposed distribution pattern provided by PT. Pos Indonesia Bulukumba branch includes using 4 units of CDD box, 3 units of CDD long box, and 1 unit of CDE engkel. The route used is 6 routes with a total of 3 trips, and the distribution schedule is carried out in 1 day starting in the morning with an estimated completion of distribution and all transportation modes returning to the KPU warehouse in the evening.

**Keywords:** Election Logistics Distribution, Distribution Pattern, Capacitated Vehicle Routing Problem, Nearest Neighbor

## 1. Introduction

### Background

Logistics is a series of activities from the initial point, which is the supplier, to the endpoint, which is the consumer. According to Donald J. Bowersox, translated by Hasyim Ali (2002), logistics is the strategic process of managing the movement and storage of goods, spare parts, and finished goods from suppliers, among company facilities, and to customers. The General Election Commission (KPU) is a general election organizing agency as referred to in the law governing general election organizers who are given the duties and authorities in organizing elections based on the provisions stipulated in the law governing elections. In organizing the election, there are logistics distribution activities for election equipment which of course must be managed with proper and effective logistics management in accordance with the Technical Guidelines for Election Logistics Management.

Election logistics is the organizing equipment used in the election of Governors and Deputy Governors, Regents and Deputy Regents and/or Mayors and Deputy Mayors, which consists of voting equipment, other equipment support, as well as socialization and campaign materials. Effective and efficient management of general election logistics is one of the important aspects/keys in realizing the implementation of elections with integrity, professionalism and accountability. The management of election logistics consists of several stages, namely planning

needs and budgets, procurement, distribution, maintenance and inventory, and destruction of ballots. These stages are a cycle whose implementation is carried out continuously as a cycle of Election Logistics Governance.

One of the stages that is an important factor in measuring the success of organizing elections is the distribution of election logistics that is appropriate and effectively efficient. This is the main focus of the Bulukumba Regency KPU to ensure that the distribution of election logistics can be carried out properly so that the election can run smoothly. The year 2024 is a political year because in this year simultaneous elections will be held for the Election of President and Vice President, House of Representatives (DPR), Regional Representative Council (DPD), Provincial and Regency / City People's Representative Council (DPRD) which will be held on February 14, 2024 and the implementation of Regional Head Elections (Pilkada) for the Election of Governors & Deputy Governors and the Election of Regents & Deputy Regents or the Election of Mayors & Deputy Mayors which will be held on November 27, 2024.

There are several studies related to election logistics researched by Zainal Ilham Barkati (2014) on Distribution Management of 2014 Legislative Election Logistics in Malinau Regency, Dewi Safitri & Hawignyo (2024) on Logistics Distribution Planning Strategies for Efficient and Successful 2024 Elections at the General Election Commission Kab. Karawang, Eka Wisnu Wardhana & Oki Anita Candra Dewi (2021) on Optimizing the Number of Vehicles and Distribution Routes for Election Logistics in Kediri Regency during the Pandemic.

Based on historical data for the February 14, 2024 elections in Bulukumba Regency, there are 1241 polling stations (TPS) spread across 10 sub-districts and 147 villages. Logistics distribution for the 2024 elections in Bulukumba Regency is estimated to have 4964 voting booths (4 booths / TPS) and 2482 ballot boxes (2 ballot boxes / TPS) which will be distributed to all polling stations. In the implementation of the distribution of election logistics, the KPU of Bulukumba Regency feels the need to map the farthest areas that are not easy to reach, Bulukumba Regency has several islands but there is only 1 inhabited island, Liukang Loe Island. By paying attention to the existing topology and geography, the Bulukumba Regency KPU also needs to take into account the obstacles that may arise in the process of distributing election logistics such as the distance of the TPS location, the travel time required, geographical and weather conditions, the number of voters, security and vulnerability of the area, and the means of transportation needed to reach all existing TPS. By mapping and knowing the characteristics of the area, it can facilitate the determination of distribution patterns, distribution scheduling, determination of transportation modes, budget preparation and cooperation with related agencies.

Departing from the problems experienced by the Bulukumba Regency KPU during the February 2024 elections reported on the metrotvnews.com news portal website, namely the shortage of ballots due to ballots that were found damaged during the sorting and folding process, causing the election logistics distribution process to be delayed for several days. The distribution of election logistics that must be postponed can affect the distribution scheduling that has been determined. To avoid delays in the distribution process to the polling stations (TPS), it is necessary to plan the right distribution pattern by considering the various risks that may occur. Therefore, it is necessary to carry out careful planning so that logistics distribution can run on time, in the right amount, in the right location, and remain in good condition in accordance with the Technical Guidelines for General Election Logistics Management until it reaches the location of the Polling Station (TPS).



PT Pos Indonesia is one of the companies engaged in the first goods delivery service in Indonesia. PT Pos Indonesia has the task of implementing and supporting government program policies in the economic field as well as development which generally provides delivery services for all Indonesian people. PT Pos Indonesia as a state-owned enterprise engaged in courier and logistics services has collaborated with KPU RI in the context of distributing election logistics in 2024. PT Pos Indonesia has more than 4,800 post offices with networks spread throughout Indonesia even to the 3T (foremost, remote, disadvantaged) areas. For the Bulukumba Regency area, PT Pos Indonesia has 1 Branch Office and 3 Sub-Branch Offices spread across the Bulukumba Regency area. The distribution of Post Offices in Bulukumba Regency by having 4 locations that can cover services to all areas of Bulukumba Regency even to border areas with other districts and areas that are difficult to reach. By having 4 Post Offices spread across the Bulukumba Regency area, PT Pos Indonesia Bulukumba Branch Office in carrying out the distribution of election logistics in collaboration with the KPU Bulukumba Regency, supported by human resources (HR) who already understand the geographical conditions and characteristics of the region in Bulukumba Regency. So that the election logistics distribution process can be carried out effectively and efficiently from the planning process to implementation.

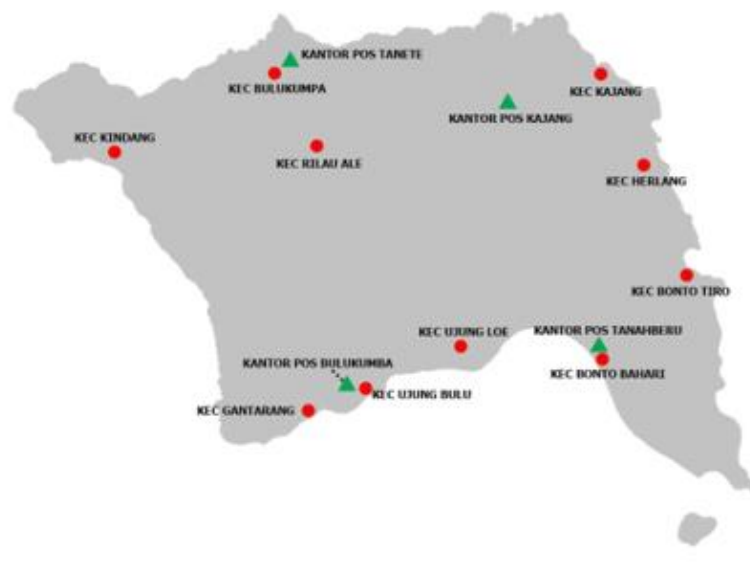


Figure 1: Distribution of Sub-districts and Post Offices in Bulukumba Regency Source: Google Maps June 2024  
Processed by the author

This research focuses on the selection of transportation modes, distribution scheduling, and determination of optimal logistics distribution routes in the 2024 Pilkada in Bulukumba Regency using the capacitated vehicle routing problem approach by taking into account the distance from Google maps and using the nearest neighbor algorithm in determining the closest distance between points. The results of this study are expected to be a template for the Bulukumba Branch Post Office in handling the distribution of election logistics which can be a reference if in the future it handles the distribution of election logistics again.

## 2. Problem Formulation

Based on the background of the problems described above, the problem formulations that will be discussed in this study are as follows:

1. How is the selection of transport mode for logistics distribution of Bulukumba regency election in 2024?
2. How to determine the optimal route for logistics distribution for the Bulukumba regency

election in 2024?

3. How is the scheduling of logistics distribution for the 2024 Bulukumba regency election?

### 3. Research Objectives

The objectives of this research are:

1. Knowing the appropriate mode of transportation for the logistics distribution of the 2024 Bulukumba Regency Pilkada.
2. Determining the optimal route for logistics distribution for the 2024 Bulukumba regency election.
3. Scheduling the distribution of logistics for the 2024 Bulukumba regency election.

## 4. Body of Paper

### Method

#### Capacitated Vehicle Routing Problem

This research uses the capacitated vehicle routing problem (CVRP) method to get the shortest and optimal route by considering the capacity of the transportation mode. The distribution of election logistics is carried out with an origin point from the Bulukumba Regency KPU warehouse to each sub-district office then back to the Bulukumba Regency KPU warehouse. By using the CVRP method, it is possible for trucks to do multi-dropping and more than one route in one day. The basic concept of CVRP is:

- Each vehicle departs from the depot and terminates at the same depot
- The route form starts from the depot (origin) and the customer is the destination to be visited.
- Each customer is visited by exactly one vehicle
- The demand for each customer is equal to  $q_i$  ( $i = 1, 2, \dots, N$ ) and  $Q$  is the maximum capacity of the vehicle
- CPRV is a method that considers the routes formed are customer requests and each route is not allowed to exceed the capacity of the vehicle used  $Q$ .

#### Nearest Neighbor

The Nearest Neighbor algorithm is a simple method that was first introduced in 1983. (Anita et al., 2017). Each iteration, the nearest neighbor algorithm method looks for the closest distance from each customer or from one sub-district to another in this study. A new route will be formed if there is a possible position for the next destination. The nearest neighbor algorithm inserts one sub-district after another that is adjacent to another sub-district that has not met its demand until all capacities are met then returns to the origin point or KPU warehouse. This is done repeatedly until all points are fulfilled.

Based on previous research conducted by Pop (2011), the following is a description of the nearest neighbor algorithm for the logistics distribution of the Bulukumba Regency KPU election.

1. The starting point (origin) is the Bulukumba Regency KPU warehouse as the location of the Bulukumba Regency election logistics storage. Then from the KPU warehouse looking for the location of the nearest sub-district office from the warehouse as the initial route visited.
2. Next, find the location of another sub-district office that is closest to the first sub-district office visited if the capacity of the transportation mode still allows for the delivery of the next sub-district.

- a. If the selected sub-district has a demand that exceeds the remaining capacity, then go back to step (2) to find another sub-district with sufficient demand for the remaining capacity.
  - b. If none of the sub-districts have a demand that matches the remaining capacity of the transportation mode, then return to step (1), namely the route starts again from the origin point of the KPU warehouse and looks for other sub-district destination points that have not been visited.
3. If all sub-districts have been visited and their demand has been met then this algorithm is complete.

Another alternative that can be done is to choose a mode of transportation that is adjusted to the demand of adjacent sub-districts so as to maximize the capacity of the mode of transportation and the delivery route becomes more effective and efficient vehicle.

The Nearest Neighbor algorithm searches for routes by considering the closest distance from one point to another. Table 1 shows the distance matrix from the KPU warehouse located at Jl. Jend Sudirman No.10, Bulukumba to each sub-district location in Bulukumba Regency. Distance data is obtained through Google Maps by collecting the distance of all 10 sub-districts and the KPU warehouse. The closest distance from the KPU warehouse is to Ujung Bulu sub-district as far as 1 km, while the farthest distance is Kajang sub-district with a distance of 39.5 km.

Table 1: Distance Matrix of KPU Warehouse and Sub-districts in Bulukumba Regency (km)

		TUJUAN										
		GUDANG KPU	BONTO BAHARI	BONTOTIRO	BULUKUMPA	GANTARANG	HERLANG	KAJANG	KINDANG	RILAU ALE	UJUNG BULU	UJUNG LOE
ASAL	GUDANG KPU	0	24,3	35,1	30,2	4,4	35,1	39,5	29,1	24,3	1	9,5
	BONTO BAHARI	24,3	0	13,1	45,8	28,7	20,8	27,1	52,5	39,9	24	14,8
	BONTOTIRO	35,1	13,1	0	46,1	39,5	18	25,1	64,2	41,5	34,2	24,5
	BULUKUMPA	30,2	45,8	46,1	0	33,1	35	30,8	47,4	6,8	30,4	31
	GANTARANG	4,4	28,7	39,5	33,1	0	39,5	43,9	30,8	27,2	5,1	13,8
	HERLANG	35,1	20,8	10,5	35	39,5	0	9,2	64,2	41,8	35,3	25,6
	KAJANG	39,5	27,1	25,7	30,8	45,8	9,2	0	61,8	37,8	41,6	32
	KINDANG	29,1	53,4	64,2	47,4	29,8	64,2	61,8	0	41,4	29,8	38,5
	RILAU ALE	24,3	34,9	42,2	7,1	26,4	42,1	37,8	41,4	0	23,7	24,3
	UJUNG BULU	1	24,4	34,8	30,4	5,1	34,8	39,2	23,7	29,8	0	9,6
UJUNG LOE	9,5	14,8	25,6	31	13,8	25,6	30	24,3	37,7	9,6	0	

Source: Google Maps June 2024

The distance matrix data in Table 1 is used to find routes by finding the closest point from the origin to the first destination. Then look for the next destination point by considering the closest distance and demand needs of the next destination point. If the next point demand cannot be met, then look for another destination point that can fulfill the demand.

## 5. Result and Discussion

### Mode of Transportation Selection

Guided by the General Election Commission Decree Number 1395 of 2023 concerning Technical Guidelines for Election Logistics Management. Listed in Chapter II point C regarding the distribution stages. The distribution of Election Logistics is carried out in order to fulfill the needs of Election Logistics in the implementation of voting and recapitulation of vote counting that takes place in the country and abroad. The distribution of Election Logistics by KPU, Provincial KPU, Regency / City KPU, and PPLN must pay attention to the priority scale of the destination area, including:

1. Voter turnout
2. Number of polling stations/TPSLN/KSK/Post

3. Distance
4. Travel time;
5. Geographical location;
6. Climate/weather;
7. Operational schedule of transportation modes;
8. Regulating the licensing of transportation modes;
9. Local licensing regulations; and
10. The degree of insecurity of the destination.

The type of transportation used can be land transportation, water transportation, and/ or air transportation with the following considerations:

1. Situation and conditions;
2. Distribution speed;
3. Availability of transportation and existing infrastructure;
4. Origin and destination conditions;
5. Effectiveness and efficiency; and
6. Security and safety.

The selection of transportation modes for the distribution of election logistics in this case, namely for the election of the Bulukumba Regency KPU, is adjusted to the demand for ballot boxes and voting booths in each sub-district.

*Table 2: Demand for Ballot Booths and Ballot Boxes per Sub-district*

No	Kabupaten	Kecamatan	Jumlah TPS	Bilik Suara	Kotak Suara
1		Bonto Bahari	80	320 pcs	160 pcs
2		Bontotiro	82	328 pcs	164 pcs
3		Bulukumpa	156	624 pcs	312 pcs
4		Gantarang	226	904 pcs	452 pcs
5		Herlang	80	320 pcs	160 pcs
6	Bulukumba	Kajang	143	572 pcs	286 pcs
7		Kindang	97	388 pcs	194 pcs
8		Rilau Ale	123	492 pcs	246 pcs
9		Ujung Bulu	127	508 pcs	254 pcs
10		Ujung Loe	127	508 pcs	254 pcs
	Total		1241	4964 pcs	2482 pcs

*Source: KPU Bulukumba Regency 2023*

The main things that must be considered in choosing the mode of transportation are the load capacity of the mode of transportation, the dimensions of the mode of transportation, the size and dimensions of the KPU ballot box, the size and dimensions of the KPU voting booth. The condition of the voting booths at the time of distribution is in a folded condition and has not been assembled to form a booth. This is because the voting booths themselves will be assembled at each polling station (TPS) so that at the time of distribution the booths are folded so that they are flat. The following is an illustration of the size of ballot boxes and voting booths (Figure 2 and Figure 3) based on General Election Commission Regulation Number 14 of 2023.

### Ballot Box

*Table 3: Ballot Box Size (cm)*

Ukuran Kotak Suara	
P	60
L	40
T	40

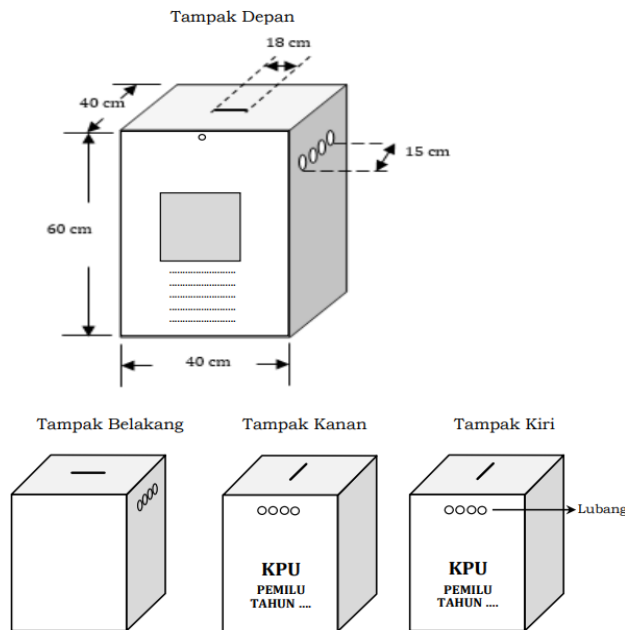


Figure 2: Ballot Box  
Source: KPU Bulukumba Regency 2023

## Folded Voting Booths

Table 4: Size of voting booth (cm)

Ukuran Bilik Suara	
P	160
L	60
T	3

Source: KPU Bulukumba Regency 2023



Figure 3: Folded voting booths  
Source: KPU Bulukumba Regency 2023

The layout of ballot boxes and voting booths in the transportation mode during the distribution process is very important to consider as a reference in choosing the mode of transportation to maximize the available capacity. The provisions in the distribution are that the position of the ballot box must stand upright and must not be tilted or put to sleep. Meanwhile, voting booths can be inserted between ballot boxes by utilizing empty space or placed on top of the ballot box arrangement or on the side of the ballot box where there is still empty space. So, in determining the mode of transportation, the main thing that needs to be calculated is the size and dimensions of the ballot box.



The mode of transportation that can be an alternative that will be used in the distribution of logistics for the Bulukumba regional election by taking into account the road and geographical conditions can use the types of transportation modes *Colt Diesel Engkle (CDE)*, *Colt Diesel Double (CDD) Box*, *Colt Diesel Double Long (CDDL) Box*, *Blind Van*. The following is the capacity of the transportation mode for the distribution of ballot boxes and voting booths for the Bulukumba regional election.

Table 5: Alternative Modes of Transportation and their Capacities (pcs)

No	Moda Angkutan	Kapasitas Max	
		Kotak Suara	Bilik Suara
1	CDD Long Box	168	328
2	CDE Engkel	56	109
3	CDD Box	120	234
4	Blind Van	20	39

Source: KPU Bulukumba Regency 2023

The maximum capacity of the transportation mode is a reference in determining the distribution route using the capacitated vehicle routing problem (CVRP) method nearest neighbor algorithm. Determination of the number of transportation modes to be used is based on the number of routes and trips available.

### Route Determination Using Nearest Neighbor Algorithm

An overview of the nearest neighbor algorithm for the distribution of election logistics of the Bulukumba Regency KPU can be illustrated as Figure 4 below.

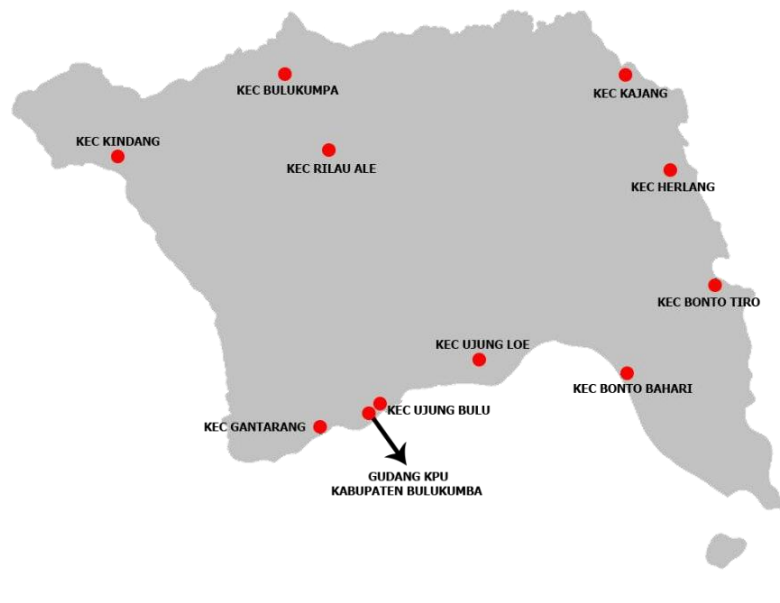


Figure 4: Location Point of Bulukumba KPU Warehouse and Sub-district Source: Google Maps June 2024 processed by the author

Figure 4 is an overview of the location points of 10 sub-districts in Bulukumba Regency and the location of the KPU Warehouse. For route determination from the origin point, namely the KPU warehouse, looking for the location of the closest sub-district of all existing sub-districts the first route is to choose the sub-district closest to the KPU warehouse location as the first destination point (Figure 5).

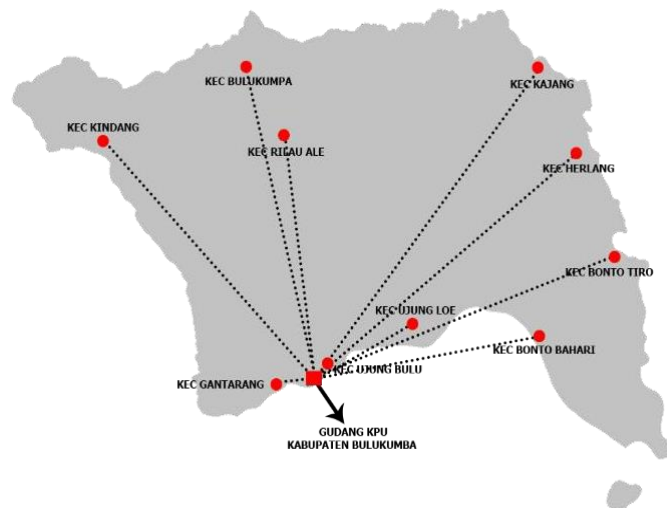


Figure 5: Nearest Neighbor Algorithm Finding the Nearest Point Source: Google Maps June 2024 processed by the author

The distance from the KPU warehouse to the nearest sub-district is Ujung Bulu sub-district with a distance of 1 km (table 1) so that Ujung Bulu sub-district is the first destination point. The nearest neighbor algorithm will pay attention to the capacity of the transportation mode and the demand needed by Ujung Bulu Sub-district, if using the CDD Box transportation mode with a capacity of 120 ballot boxes while the needs in Ujung Bulu Sub-district are 254 ballot boxes and 508 voting booths then to maximize capacity 3 CDD Box units are needed, there is a remaining capacity that will be used to transport the demand needed from other sub-districts or use 2 CDD Box units with a capacity shortage of 14 ballot boxes and 40 voting booths which can later be maximized to be transported by other transportation modes that route to Ujung Bulu Sub-district (Figure 6).

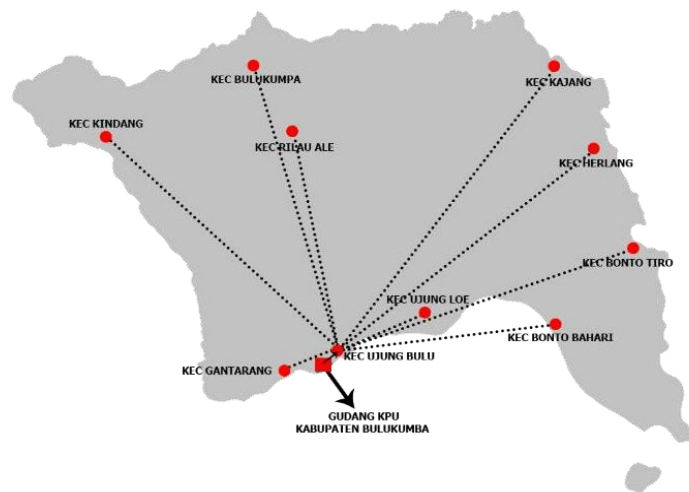


Figure 6: Nearest Neighbor Algorithm First Nearest Point Source: Google Maps June 2024 processed by the Author

After the first sub-district is selected, then look for the next sub-district location point closest to the first sub-district, namely Gantarang Sub-district. Demand needs from Gantarang District are 452 ballot boxes. Taking into account the very high demand and to maximize the capacity of the transportation mode, Gantarang District uses its own route with the transportation mode used as many as 1 unit CDD Box and 2 units CDD Long Box. Gantarang sub-district which

has its own route, then the Ujung Bulu sub-district route needs to find another sub-district location point while still considering demand and the closest distance.

The Ujung Bulu sub-district route then looks for the next sub-district location point with close proximity and by considering demand needs to maximize the capacity of the transport mode. So, for the route from Ujung Bulu Sub-district then to Rilau Ale Sub-district which is also adjacent to Bulukumpa Sub-district (Figure 7). So that the route formed starts from the origin point of the KPU Warehouse to Ujung Bulu Subdistrict then to Rilau Ale Subdistrict and the last point to Bulukumpa Subdistrict with a total distance of 31.8 km. The total demand transported was 812 ballot boxes and 1624 voting booths, the mode of transportation used was 2 units of CDD Long Box and 4 units of CDD Box.

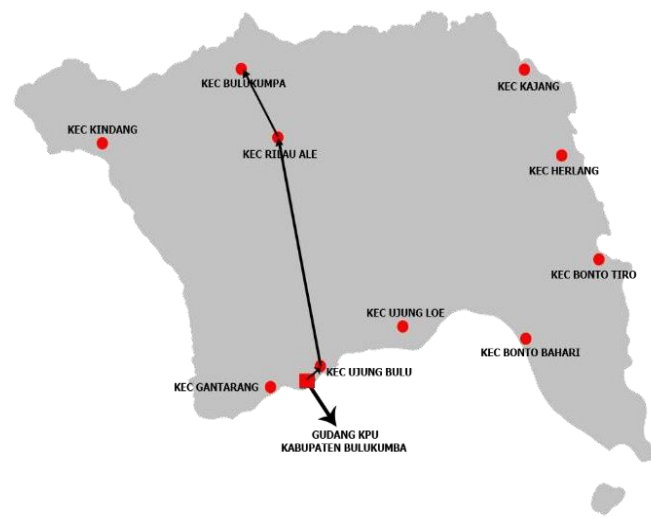


Figure 7: Nearest Neighbor Algorithm Route Determination Based on Demand and Distance Source: Google Maps June 2024 processed by the author

Then the next sub-district is Ujung Loe Sub-district, when viewed from its geographical location which is close to and in the same direction as Bontobahari Sub-district, it can be combined into the same route. The demand from Ujung Loe sub-district is 254 ballot boxes and 508 voting booths, while the demand from Bontobahari sub-district is 160 ballot boxes and 320 voting booths. The transportation modes used for this route are 3 units of CDD Box and 1 unit of CDE Engkel.

The next sub-district is Bontotiro sub-district which is also close and in the same direction with Herlang sub-district so that these two sub-districts can be combined into the same route. Bontotiro sub-district with demand of 164 ballot boxes and 328 voting booths and Herlang sub-district with demand of 160 ballot boxes and 320 voting booths. By considering the total demand needs of the two sub-districts, the transportation mode used is 2 units of CDD Long Box.

Determination of the next route for Kajang and Kandang sub-districts by considering the distance, geographical location, and demand needs, these two sub-districts use separate routes. Kajang sub-district with a demand requirement of 286 ballot boxes and 572 voting booths using the transportation mode of 2 units of CDD Box and 1 unit of CDE Engkel. Meanwhile, Kandang sub-district with a demand requirement of 194 ballot boxes and 388 voting booths uses the transportation mode of 1 unit CDD Long Box and 1 unit CDE Engkel.

Table 6: Results of Determination of Routes and Modes of Transportation

TRIP	ARMADA	ASAL	TUJUAN	RUTE	JARAK	BILIK SUARA	KOTAK SUARA	TOTAL	
								BILIK SUARA	KOTAK SUARA
1	A - CDD Box	GUDANG KPU	KECAMATAN UJUNG BULU	A	1 Km	508 pcs	254 pcs	1624 pcs	812 pcs
	B - CDD Box		KECAMATAN UJUNG BULU						
	C - CDD Box		KECAMATAN RILAU ALE						
	D - CDD Box		KECAMATAN RILAU ALE	B	29,1 Km	388 pcs	194 pcs		
	X - CDD Long Box		KECAMATAN BULUKUMPA						
	Y - CDD Long Box		KECAMATAN BULUKUMPA						
	Z - CDD Long Box		KECAMATAN KINDANG	B	29,1 Km	388 pcs	194 pcs		
	J - CDE Engkel		KECAMATAN KINDANG						
			KECAMATAN KINDANG						
2	A - CDD Box	GUDANG KPU	KECAMATAN UJUNG LOE	A	9,5 Km	508 pcs	254 pcs	828 pcs	414 pcs
	B - CDD Box		KECAMATAN UJUNG LOE						
	C - CDD Box		KECAMATAN BONTO BAHARI						
	J - CDE Engkel		KECAMATAN BONTO BAHARI	B	35,1 Km	328 pcs	164 pcs		
	X - CDD Long Box		KECAMATAN BONTOTIRO						
	Y - CDD Long Box		KECAMATAN HERLANG						
				B	18 Km	320 pcs	160 pcs		
3	A - CDD Box	GUDANG KPU	KECAMATAN KAJANG	A	39,5 Km	572 pcs	286 pcs	572 pcs	286 pcs
	B - CDD Box		KECAMATAN KAJANG						
	J - CDE Engkel		KECAMATAN KAJANG						
	C - CDD Box		KECAMATAN GANTARANG	B	4,4 Km	904 pcs	452 pcs		
	X - CDD Long Box		KECAMATAN GANTARANG						
	Y - CDD Long Box		KECAMATAN GANTARANG						
			KECAMATAN GANTARANG						

Source: Data Processing by the Author

The results of the analysis using the nearest neighbor algorithm method by considering the distance and capacity of the transportation mode, the results obtained 6 routes with a total of 3 trips. The first trip is route A from KPU Warehouse - Ujung Bulu Sub-district - Rilau Ale Sub-district - Bulukumpa Sub-district - KPU Warehouse, route B KPU Warehouse - Kindang- District - KPU Warehouse. The second trip is route A from KPU Warehouse - Ujung Loe sub- district - Bonto Bahari sub-district - KPU warehouse, route B is KPU Warehouse – Bontotiro sub-district - Herlang- KPU warehouse. The third trip is route A from KPU Warehouse - Kajang-District KPU Warehouse, route B is KPU Warehouse - Gantarang District KPU Warehouse.

Determination of the three trips is the result of calculations using the nearest neighbor algorithm by considering the demand needs of each sub-district and the capacity of the transportation mode, then looking for the closest distance between sub-district location points or looking for sub-district location points that can be passed by the same route so that they can be put together into one route with a multidrop system.

### Scheduling Distribution to Sub-districts

In determining the scheduling of the distribution of logistics for the Bulukumba Regency elections, coordination with the KPU regarding the distribution plan to each sub-district and distribution is carried out by following the schedule determined by the Bulukumba Regency KPU. According to General Election Commission Decree Number 1395 of 2023 concerning Technical Guidelines for Election Logistics Management, the distribution of domestic election logistics is carried out using land, water and air transportation facilities with a distribution time schedule in accordance with the provisions set by the KPU.

The distribution of election logistics is carried out in accordance with the provisions of the KPU, distribution can be carried out starting from 4 days before the election by prioritizing the farthest locations. The election logistics needs must have been distributed to the polling stations (TPS) on 1 day before the election. For distribution from the KPU warehouse to the District Election Committee (PPK), it is carried out in 1 day.

Scheduling the distribution of election logistics from the KPU warehouse to the sub-district by considering the number of routes and trips that have been determined. Bulukumba Regency has 10 sub-districts so that the distribution process is carried out starting in the morning and finishing at night. This study designed 3 distribution trips, so the trips and routes became a reference for

making distribution schedules. Trip 1 uses the transportation mode of 4 units of CDD Box, 3 units of CDD Long Box, and 1 unit of CDE Engkel. Trip 2 uses the transportation mode 3 units CDD Box, 2 units CDD Long Box, and 1 unit CDE Engkel. Trip 3 uses transportation modes of 3 CDD Box units, 2 CDD Long Box units, and 1 CDE Engkel unit. The following is the logistics distribution schedule for the Bulukumba Regency election.

*Table 7: Bulukumba Regency Pilkada Logistics Distribution Schedule*

Trip	Armada	Asal	Tujuan	Rute	ETD	ETA
1	A - CDD Box	Gudang KPU	Kecamatan Ujung Bulu	A	06.00 WITA	11.45 WITA
	B - CDD Box		Kecamatan Ujung Bulu			
	C - CDD Box		Kecamatan Rilau Ale			
	D - CDD Box		Kecamatan Rilau Ale			
	X - CDD Long Box		Kecamatan Bulukumpa			
	Y - CDD Long Box		Kecamatan Bulukumpa			
	Z - CDD Long Box		Kecamatan Kindang	B	06.00 WITA	09.15 WITA
	J - CDE Engkel		Kecamatan Kindang			
2	A - CDD Box	Gudang KPU	Kecamatan Ujung Loe	A	12.30 WITA	16.30 WITA
	B - CDD Box		Kecamatan Ujung Loe			
	C - CDD Box		Kecamatan Bonto Bahari			
	J - CDE Engkel		Kecamatan Bonto Bahari			
	X - CDD Long Box		Kecamatan Bontotiro	B	12.30 WITA	17.15 WITA
	Y - CDD Long Box		Kecamatan Herlang			
3	A - CDD Box	Gudang KPU	Kecamatan Kajang	A	18.30 WITA	22.30 WITA
	B - CDD Box		Kecamatan Kajang			
	J - CDE Engkel		Kecamatan Kajang			
	C - CDD Box		Kecamatan Gantarang	B	18.30 WITA	21.15 WITA
	X - CDD Long Box		Kecamatan Gantarang			
	Y - CDD Long Box		Kecamatan Gantarang			

*Source: Data Processing by the author*

Trip 1 departed from the KPU warehouse at 06.00 WITA with route A to Ujung Bulu sub-district, Rilau Ale sub-district, and Bulukumpa sub-district, route B to Kindang sub-district. The estimated transportation mode of trip 1 returned to the KPU warehouse at 09.15 WITA for route B and at 11.45 WITA for route A. The transportation mode departs from the KPU warehouse at 12.30 WITA for the next trip. Trip 2 route A goes to Ujung Loe and Bonto Bahari sub-districts, route B goes to Bontotiro and Herlang sub-districts. The estimated trip 2 transportation mode returns to the KPU warehouse at 17.15 WITA for route B and at 16.30 WITA for route A. For trip 3, the transportation mode is departed again at 18.30 WITA with route A to Kajang sub-district and route B to Gantarang sub-district. The estimated trip 3 transportation mode returns to the KPU warehouse at 21.15 WITA for route B and 22.30 WITA for route A.

## 6. Conclusion

The distribution of election logistics that runs effectively and efficiently is one of the stages as a measure of the success of organizing elections. The distribution of election logistics starts from the Regency / City KPU to the District Organizing Committee (PPK), then to the Voting Committee (PPS) at the Kelurahan / Village level and then to the Polling Station. Distribution from the KPU warehouse to the sub-district is the initial distribution process so that it has a crucial role because it must be carried out effectively and efficiently and on time so that the forwarding of distribution to the polling stations is not hampered and on time according to planning.

The selection of transportation modes for the distribution of election logistics of the Bulukumba Regency KPU is adjusted to the demand for ballot boxes and voting booths in each sub-district. The mode of transportation that can be used in the distribution of logistics for the



Bulukumba Regency elections by taking into account road and geographical conditions is to use the *Colt Diesel Engkle* (CDE), *Colt Diesel Double* (CDD) *Box*, *Colt Diesel Double Long* (CDDL) *Box*. The number of transportation modes used is 4 units of CDD Box, 3 units of CDD Long Box, and 1 unit of CDE Engkle.

Determination of distribution routes after analysis using the nearest neighbor algorithm method by considering the distance and capacity of the transportation mode, the results obtained 6 routes with a total of 3 trips. The first trip is route A from KPU Warehouse - Ujung Bulu Sub-district - Rilau Ale Sub-district - Bulukumpa Sub-district - KPU Warehouse, route B KPU Warehouse - Kindang-District - KPU Warehouse. The second trip is route A from KPU Warehouse - Ujung Loe sub-district - Bonto Bahari sub-district - KPU warehouse, route B is KPU Warehouse - Bontotiro sub-district - Herlang- KPU warehouse. The third trip is route A from KPU Warehouse - Kajang-District KPU Warehouse, route B is KPU Warehouse - Gantarang District KPU Warehouse.

Scheduling the distribution of election logistics from the KPU of Bulukumba Regency to the sub-district was carried out within 1 day. Distribution is carried out in accordance with the plan, namely 3 trips starting at 06.00 WITA with an estimated completion of distribution and all modes of transportation returning to the KPU warehouse at 22.30 WITA.

## 7. Implications and Direction for Future Research

This research is expected to be a consideration for logistics service provider companies, especially PT Pos Indonesia Bulukumba Branch Office in designing the operational pattern of the Bulukumba Regency election distribution. In addition, this research is also expected to be useful for the KPU of Bulukumba Regency so that it can carry out the 2024 election distribution process effectively and efficiently. This research is only limited to using one research method, namely the capacitated vehicle routing problem (CVRP) nearest neighbor algorithm. The nearest neighbor algorithm in this study in determining routes and modes of transportation only considers transportation capacity without considering costs. Suggestions for further research can be done using two or more research methods so that comparisons can be made in finding the best solution. Another suggestion is to add other variables as considerations in determining routes and modes of transportation such as direct and indirect costs, labor costs, overhead costs, and other costs.

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