ABSTRACT

Transportation and distribution is an important part of the supply chain, where the activity of moving goods or products from one location to another is carried out to meet consumer needs. However, this process is often limited by distance and operational costs, such as fuel oil (BBM). Cooperative ABC, as a salt producer in Indramayu Regency, faces challenges in terms of transportation, specifically related to the collection of salt from 12 collection locations spread across various regions. The collection process is carried out using 3 vehicles with the same capacity (homogeneous fleet). However, the routes used so far do not consider the shortest distance between locations, resulting in fuel wastage. Fuel costs that increased significantly, on average by 24% above the set budget limit, became one of the main problems faced by the cooperative.

To overcome this problem, this study aims to design a more effective and efficient salt picking route to minimize the fuel costs incurred by ABC Cooperative. In this research, the Saving Matrix method is used, which is one of the heuristic methods in solving the Capacitated Vehicle Routing Problem (CVRP). CVRP itself is a variant of the Vehicle Routing Problem (VRP), where vehicles with limited capacity must serve a number of pickup locations or customers. The main objective of CVRP is to minimize the total cost, which in the context of this research focuses on fuel costs.

The Saving Matrix works by calculating the potential distance savings between two pickup locations, and then combining them in the same route if the savings are significant. The basic principle is to minimize the total travel distance, which will directly impact the reduction of fuel consumption. The calculations in this method are done computationally using Python programming implemented in the Google Collaboratory platform.

This research goes through several stages including data collection, data processing, and route simulation. The data collected includes the distance between pickup locations, vehicle capacity, fuel consumption, and historical data from the actual route used by ABC Cooperative in December 2023. Based on historical data,

it is known that the current salt collection process is carried out by dividing the collection locations into three groups of areas, where each vehicle is responsible for collecting salt from four locations. However, the route does not consider the shortest distance between locations, so the driver has to make several trips to complete the pickup on the same day, known as the multiple trips concept. This condition contributes to an increase in operational costs, especially fuel usage.

The results of designing a new route using the Saving Matrix method showed a 11,97% decrease in mileage compared to the actual route used by the cooperative. This decrease has a direct impact on reducing fuel consumption, with a 11,97% decrease in fuel costs as well. This decrease shows that the shorter the distance traveled by the vehicle, the smaller the fuel consumption required, so that operational efficiency can be achieved.

In addition, this study also conducted a sensitivity analysis to see the impact of route changes on fuel consumption. The results of the analysis show that small changes in routes can have a significant impact on mileage and fuel costs. Although the Saving Matrix method has successfully provided an efficient solution in the context of fuel cost reduction, this study still has limitations, especially in dealing with dynamic conditions in the field, such as traffic congestion or poor road conditions. In addition, this study did not consider the time window at each collection location, which can be an important factor in actual salt collection operations.

Overall, this study makes a significant contribution to improving the operational efficiency of ABC Cooperative, especially in designing a more optimal salt picking route. With the application of the Saving Matrix method, the cooperative is expected to reduce fuel costs, thereby being able to offer more competitive salt prices to consumers and improve the welfare of salt farmers who are cooperative partners. This research also provides a strong basis for future research to develop route optimization algorithms by considering other dynamic factors, such as time windows and road conditions.

Keywords — Minimization, Pick-up, Route Optimization, CVRP, Saving Matrix