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OPTIMIZATION ON COST FOR SOLID WASTE COLLECTION

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ABSTRACT – This study tries to determine the ideal cost for a private company's waste collection that occurs once a month and acknowledges the use of goal programming to determine the optimal cost. This study uses goal programming to reduce the cost of rubbish collection for a private Malaysian company. E-Idaman Kangar Sdn Bhd manages solid waste management in Perlis. The goal programming model was created with Lingo software version 18.0 and minimizes five cost categories for each route: labor cost, collection cost, vehicle cost, consumable cost, and financial statement of operation. The results of the study show that the company's collection expenses are at their optimal state. The cost of each vehicle included in the collection activity is optimized, and the total spending can still be reduced by RM3, which is a decrease of 0.01%. This shows that the company is already achieving collection in an ideal manner. The paper concludes by discussing the implications of the study for other private waste collection companies in Malaysia. The goal programming model developed in this study can be used by other companies to optimize their waste collection costs.
Keywords: Optimization, cost, solid waste collection, waste management, goal programming method

1. INTRODUCTION

The word "solid waste" refers to undesired items generated by commercial, industrial, and household operations (Prajakta et al., 2015). The rapid population growth and industrialization in Malaysia have led to a significant increase in solid waste generation. According to Waste to Energy for A Sustainable Future (2021), Malaysia's population has reached 32.8 million, indicating a quickly rising state with a tremendous amount of solid garbage being created. The current waste management system is inefficient and insufficient, which has negative consequences for public health and the environment. Waste collection is the most expensive component of waste management systems. The cost of waste collection includes both direct and indirect expenditures. All direct expenses incurred in an area's solid waste management are included in the term "direct costs." (Sakawi, 2011). Proper and effective waste management is essential to maintain a good environment, health, and economic stability in Malaysia. The goal programming model was used to minimize the total cost of waste collection while meeting certain constraints.

2. METHODOLOGY

Data were collected from a private waste collection company, E-Idaman Sdn Bhd in Kangar. A total of five cost that are carried out for collection per month were collected which are labor cost, collection cost, vehicle cost, consumable cost, and the financial statement of operation for each route. There are two routes included in the data set which are Beseri, Kangar to Jalan Santan which consists of three different vehicles where two basic vehicle and one included with an arm roll. These data are formulated into Goal Programming equations and were solved using Lingo software version 18.0. There are five goals that are required to meet, and the constraints were included in the formulation.

3. RESULTS AND DISCUSSION

According to the results, the ideal solution of 3 is the total cost that can be reduced when compared to the initial total cost of 92511.17. This represents a cost reduction of 0.01%. This means that in a month, a total of RM3 can be saved. This may also be seen in each of the vehicle costs, including labor, collection, vehicle, and consumable costs, where there is no reduction from the goal programming method. As a result, the goal programming method can be used to accomplish cost optimization. The solid waste collection company can obtain cost optimization for each route and vehicle based on the Lingo software output.

3.1 Data Analysis

Before putting the model through the Lingo software, a goal programming code was created. The code has five objective functions that were created based on the five goals to be acquired from each vehicle. Based on the Lingo software coding, the variables v1, v2, and v3 were exposed to the decision variables x_1, x_2 and x_3, respectively, where:

x_1 = Beseri route
x_2 = Kangar to Jalan Santan route
x_3 = Kangar to Jalan Santan route + arm roll

4. NOVELTY OF RESEARCH / PRODUCT

There is a numerous number of articles that focuses on waste management. To be exact, few research are using goal programming method but not necessarily on waste collection. Waste management is a huge environmental issue that has been a main concern around the world as the cost of waste management is expensive. Waste management includes the resources used in waste management planning, implementation, and management, such as storage, collection, transportation, and disposal. Not much research on local waste collection has been made where this study focus on the smallest state in Malaysia, Perlis Indera Kayangan. E – Idaman Sdn. Bhd. Kangar, a private company conducts the waste management in Northern Malaysia including Perlis. Goal programming is a multi-objective optimization technique that can be used to optimize numerous objectives, such as reducing garbage collection costs. The study focuses on the local area that can help with creating a better decision making towards waste management for any waste collection company.

5. CONCLUSION

In conclusion, the implementation of goal programming method to achieve the optimal cost for solid waste collection is met. The results of the study show that the goal programming model can reduce the total cost of solid waste collection by 0.01% which means that the company can save RM3 by implementing the model. The study also concludes that goal programming is not a perfect solution, and there may be circumstances where it is not possible to achieve all goals simultaneously. However, the model is a valuable tool for optimizing the cost of solid waste collection, and it can help to improve the financial and budget planning for E-Idaman Sdn. Bhd and can be used as reference for future research with a much bigger and complex dataset.

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