

**UNIVERSITI TEKNOLOGI MARA**

**OPTIMISING A WASTE  
MANAGEMENT SYSTEM USING  
THE ARTIFICIAL BEE COLONY  
(ABC) ALGORITHM**

**NUR HAMISHA HELANIE BINTI  
MOHAMAD FADZIL**

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(ABC) ALGORITHM**

**NUR HAMISHA HELANIE BINTI MOHAMAD FADZIL**

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**APPROVED BY:**

.....  
**SITI HAFAWATI JAMALUDDIN**

**Supervisor**

Faculty of Computer and Mathematical Sciences  
Universiti Teknologi MARA

## ABSTRACT

This study proposed the application of the Artificial Bee Colony (ABC) algorithm to address the Capacitated Vehicle Routing Problem (CVRP) in a real-world waste collection scenario. Effective waste management is critical for maintaining urban cleanliness and sustainability. Inefficient waste collection often suffers from inefficiency such as poor route planning, excessive travel distance and underutilization of vehicle capacity. The main objective is to minimise the total travel distance of collection vehicles while reducing carbon emission. The study adopted data from Qiao et al. (2020). The data contain a single depot, 47 waste collection points and 11 vehicles with maximum capacity of 80 tonnes. The ABC algorithm was selected due to its strong global search capabilities, simple structure and ability to balance between exploration and exploitation. The implementation of ABC algorithm consists of four phases which are initialisation, employed, onlooker and scout bee phases. Random insertion applied as a neighbourhood operator to enhance the local search capabilities within the algorithm. The result indicate that the ABC algorithm successfully generates feasible and efficient routing solutions. The result showed a total travel distance of 1408.25 km. Moreover, before optimisation, the total distance travelled was 1458.35 km which resulted in an estimation of 1397.1 kg CO<sub>2</sub>. After optimisation, the overall distance decreased to 1408.35 km resulting in a reduction of CO<sub>2</sub> emission of 1348.8 kg CO<sub>2</sub>. Overall, the proposed approach shows promise in enhancing the efficiency and responsiveness of real-world waste collection systems. Future work may focus on integrating real-time data, adjusting algorithm parameters and hybridizing ABC algorithm with other metaheuristics to further improve performance.

**Keyword:** Waste Management System, Artificial Bee Colony Algorithm, Optimisation

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