

ABSTRAK

Penelitian ini bertujuan untuk mengoptimalkan rute distribusi telur pada CV Adaro Putra di wilayah Kabupaten Gresik dengan menerapkan model *Vehicle Routing Problem with Time Windows* (VRPTW) menggunakan algoritma *Particle Swarm Optimization* (PSO). Distribusi telur dari gudang pusat ke 40 toko mitra di Kabupaten Lamongan dan Gresik menghadapi kendala jarak tempuh yang panjang akibat rute pengiriman yang tidak efisien, dengan total demand harian 3.260 kg, kapasitas 4 kendaraan terbatas (L300 900 kg, Carry 1.5 Pickup 760 kg, T120 SS 800 kg, Grandmax Pickup 840 kg). Algoritma *Particle Swarm Optimization* (PSO) dipilih karena mampu menyelesaikan permasalahan *Vehicle Routing Problem* (VRP) yang kompleks dengan konvergensi cepat, menggunakan parameter terbaik $\omega=0.9$, $c1=0.5$, $c2=0.5$ berdasarkan uji coba *Design of Experiment*, serta menerapkan mekanisme *split delivery* untuk menangani demand besar. Penelitian ini menggunakan data sekunder meliputi 41 titik lokasi, matriks jarak 41×41 , demand harian, waktu pelayanan, jam operasional, serta 4 unit kendaraan. Hasil optimasi menunjukkan bahwa PSO berhasil menurunkan total jarak tempuh menjadi 632 km dari 924.7 km atau jika dipresentasikan menghemat jarak tempuh sebesar 31.65%, serta menghasilkan rata-rata utilisasi kendaraan sebesar 97% dengan seluruh kendaraan memenuhi batasan kapasitas karena total demand (3.260 kg) masih di bawah total kapasitas (3.300 kg). Kesimpulannya, metode PSO terbukti efektif dalam mengoptimalkan rute distribusi telur dengan mempertimbangkan batasan kapasitas, waktu operasional, dan variasi demand, sehingga direkomendasikan sebagai sistem pendukung keputusan bagi perusahaan distributor untuk menekan biaya operasional dan meningkatkan ketepatan waktu layanan. Penelitian ini juga mendukung *Sustainable Development Goals* (SDGs) poin 9 yaitu Industri, Inovasi, dan Infrastruktur melalui penerapan optimasi distribusi untuk meningkatkan efisiensi operasional perusahaan.

Kata Kunci : *Vehicle Routing Problem with Time Windows, Particle Swarm Optimization, Distribusi Telur.*

ABSTRACT

This study aims to optimize the egg distribution route at CV Adaro Putra in the Gresik Regency area by applying the Vehicle Routing Problem with Time Windows (VRPTW) model using the Particle Swarm Optimization (PSO) algorithm. The distribution of eggs from the central warehouse to 40 partner stores in Lamongan and Gresik Regencies faces long mileage constraints due to inefficient delivery routes, with a total daily demand of 3260 kg, a limited capacity of 4 vehicles (L300 900 kg, Carry 1.5 Pickup 760 kg, T120 SS 800 kg, Grandmax Pickup 840 kg). The Particle Swarm Optimization (PSO) method was chosen because it is able to solve complex Vehicle Routing Problems (VRP) with fast convergence, using the best parameters $\omega=0.9$, $c1=0.5$, $c2=0.5$ based on the Design of Experiment trial, and applying a split delivery mechanism to handle large demand. This study uses secondary data including 41 location points, a distance matrix of 41×41 , daily demand, service hours, operating hours, and 4 units of vehicles. The optimization results showed that PSO succeeded in reducing the total mileage to 632 km from 924 km or if presented saving mileage by 31.65%, and resulting in an average vehicle utilization of 97% with all vehicles meeting the capacity limit because the total demand (3260 kg) is still below the total capacity (3300 kg). In conclusion, the PSO method has proven to be effective in optimizing egg distribution routes by taking into account capacity limitations, operational times, and demand variations, so it is recommended as a decision support system for distributor companies to reduce operational costs and improve service timeliness. This research also supports the Sustainable Development Goals (SDGs) point 9, namely Industry, Innovation, and Infrastructure through the implementation of distribution optimization to improve the company's operational efficiency.

KeyWords : Vehicle Routing Problem with Time Windows, Particle Swarm Optimization, Egg Distribution.