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GREEN SUPPLY CHAIN SERVICE PREDICTION AND SCHEDULING OPTIMIZATION STRATEGY BASED ON IMPROVED NSGA-II ALGORITHM: AN EMPIRICAL STUDY UNDER "DUAL CARBON" GOALS

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Abstract

To address the inherent trade-offs among cost control, carbon emission reduction, and service level improvement under the national "dual carbon" goals, this study proposes a novel optimization strategy for green supply chain service prediction and scheduling in the food manufacturing industry. An improved Non-dominated Sorting Genetic Algorithm II (NSGA-II) is developed, incorporating three key improvements: stratified random sampling to enhance initial population diversity, adaptive crossover and mutation operators to balance exploration and exploitation, and a dynamic weight adjustment mechanism to respond to evolving environmental policies and market demands. Experimental results demonstrate the method's effectiveness in navigating multi-objective trade-offs. In the cost-optimization scenario, the average total cost was reduced to 779,000 yuan; conversely, in the carbon-emission-optimization scenario, emissions dropped to 33.8 kg for 945,000 yuan, with a service level fulfillment rate maintained above 79%. This research provides both a practical decision-support tool for enterprises pursuing sustainability and a robust theoretical framework for achieving dynamic equilibrium in complex green supply chains.

Key words: carbon emission control, "dual carbon" goals, green supply chain management, improved NSGA-II algorithm, multi-objective optimization

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