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Review

Metaheuristic Algorithms Applied to Bioenergy Supply Chain Problems: Theory, Review, Challenges, and Future

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Abstract: Bioenergy is a new source of energy that accounts for a substantial portion of the renewable energy production in many countries. The production of bioenergy is expected to increase due to its unique advantages, such as no harmful emissions and abundance. Supply-related problems are the main obstacles precluding the increase of use of biomass (which is bulky and has low energy density) to produce bioenergy. To overcome this challenge, large-scale optimization models are needed to be solved to enable decision makers to plan, design, and manage bioenergy supply chains. Therefore, the use of effective optimization approaches is of great importance. The traditional mathematical methods (such as linear, integer, and mixed-integer programming) frequently fail to find optimal solutions for non-convex and/or large-scale models whereas metaheuristics are efficient approaches for finding near-optimal solutions that use less computational resources. This paper presents a comprehensive review by studying and analyzing the application of metaheuristics to solve bioenergy supply chain models as well as the exclusive challenges of the mathematical problems applied in the bioenergy supply chain field. The reviewed metaheuristics include: (1) population approaches, such as ant colony optimization (ACO), the genetic algorithm (GA), particle swarm optimization (PSO), and bee colony algorithm (BCA); and (2) trajectory approaches, such as the tabu search (TS) and simulated annealing (SA). Based on the outcomes of this literature review, the integrated design and planning of bioenergy supply chains problem has been solved primarily by implementing the GA. The production process optimization was addressed primarily by using both the GA and PSO. The supply chain network design problem was treated by utilizing the GA and ACO. The truck and task scheduling problem was solved using the SA and the TS, where the trajectory-based methods proved to outperform the population-based methods.

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Conflicts of Interest

The author declares no conflict of interest.

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