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Development of a Decision Model to Optimize Total Cost in Food Supply Chain

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Abstract : All along the length of the supply chain, fresh food firms face the challenge of managing both product quality, due to the perishable nature of the products, and product cost. This paper develops a method to assist logistics managers upstream in the fresh food supply chain in making cost optimized decisions regarding transportation, with the objective of minimizing the total cost while maintaining the quality of food products above acceptable levels. Considering the case of multiple fresh food products collected from multiple farms being transported to a warehouse or a retailer, this study develops a total cost model that includes various costs incurred during transportation. The practical application of the model is illustrated by using several computational intelligence approaches including Genetic Algorithms (GA), Fuzzy Genetic Algorithms (FGA) as well as an improved Simulated Annealing (SA) procedure applied with a repair mechanism for efficiency benchmarking. We demonstrate the practical viability of these approaches by using a simulation study based on pertinent data and evaluate the simulation outcomes. The application of the proposed total cost model was demonstrated using three approaches of GA, FGA and SA with a repair mechanism. All three approaches are adoptable; however, based on the performance evaluation, it was evident that the FGA is more likely to produce a better performance than the other two approaches of GA and SA. This study provides a pragmatic approach for supporting logistics and supply chain practitioners in fresh food industry in making important decisions on the arrangements and procedures related to the transportation of multiple fresh food products to a warehouse from multiple farms in a cost-effective way without compromising product quality. This study extends the literature on cold supply chain management by investigating cost and quality optimization in a multi-product scenario from farms to a retailer and, minimizing cost by managing the quality above expected quality levels at delivery. The scalability of the proposed generic function enables the application to alternative situations in practice such as different storage environments and transportation conditions.

Keywords : cost optimization, food supply chain, fuzzy sets, genetic algorithms, product quality, transportation
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