

A Thesis for the Degree of Ph.D. in Engineering

Flexible Operation Modes in Fresh Fruit
Supply Chains with Cold Storages

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Thesis Abstract

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Thesis Title Flexible Operation Modes in Fresh Fruit Supply Chains with Cold Storages			
<u>Thesis Summary</u> This dissertation explores flexible operation strategies in fresh fruit supply chains (FSCs) with cold storages. In traditional FSCs, growers usually sell fresh fruits with thin profit right after harvesting due to the perishability. In order to mitigate the deterioration of fresh fruits, cold storages, which are generally divided into the regular atmosphere storage (RAS) and the controlled atmosphere storage (CAS), are built accelerating in rural areas. Depending on the extension period of shelf life, we propose flexible operation modes in fresh FSCs with RAS and with CAS, respectively. For RAS, we propose the flexible supply contract with put options (SCPO) for a rural fresh FSC with RAS, where the grower stores fresh fruits in RAS to extend the shelf life, which incurs extra storage costs that can be recovered by salvaging at a higher price later. The proposed model is analyzed from both the grower’s and the buyer’s perspectives. And the buyer’s and the grower’s profit functions are formulated. We derive the buyer’s optimal policies for the initial order and put options as well as the grower’s optimal policy for the planting quantity. The grower’s optimal supply tariff can be obtained only numerically. In particular, we obtain closed-form formulae to determine the buyer’s optimal order policy and the grower’s optimal planting quantity in a special case. We show numerical experiments in which we examined the effectiveness of the proposed model and analyze how the parameters affect the performances of both the grower and the buyer. For CAS, we consider a single-period, three-stage model in a rural fresh FSC with CAS. With CAS, the grower produces fresh fruits and then sells them to a two-stage market, i.e., in-season and off-season, in sequence. We formulate the grower’s profit function, propose the solution for the grower to make the optimal planting quantity and derive the optimal rental capacity of CAS. In particular, we study this model in a special case, and analyze numerically how the parameters influence the grower’s behavior in such a supply chain. Finally, the conclusions of this dissertation are presented and we explain the future direction of this research.			