

Research on Pricing Decision of Fresh Agricultural Products Supply Chain Based on Consumers' Green Consumption Preference

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Abstract: Based on the background of the optimal pricing of the supply chain of graduate fresh agricultural products, this paper constructs the Stackelberg game model that maximizes the profit function of suppliers and retailers, and discusses the optimal pricing decisions of suppliers and retailers under the condition of comprehensively considering consumers' green consumption preferences and other influencing factors. Green consumers' green spending preferences are positively correlated with the profits of supply chain manufacturers and retailers. Numerical experiments verify the verification results of this paper, and finally summarize the relevant conclusions, green consumption preference is conducive to the overall profit improvement of the supply chain.

1 BACKGROUND

The development of China's agricultural enterprises is inseparable from the development of the supply chain of fresh agricultural products. With the increase of consumers' awareness of environmental protection and food safety, whether the supply chain of fresh agricultural products is safe and environmentally friendly has become a common concern of consumers. In order to explore the degree of consumer demand for green agricultural products, this paper combines consumers' green consumption preferences and studies the pricing strategy of maximizing profits in the supply chain of fresh agricultural products considering green consumption preferences.

2 REVIEW OF DOMESTIC AND FOREIGN RESEARCH

With the increase of consumers' awareness of food safety and environmental protection, there are more and more studies on whether consumers' green consumption preferences affect the supply chain of fresh agricultural products. Jiang Mingjun et al. applied fairness preference theory to green innovation input research in green supply chains (JIANG, 2020); Wang Qinpeng et al. analyzed the impact of emission reduction investment coefficient, consumer green consumption preference and product price competition on the income of each entity in the supply chain (WANG, 2015); Liu Xinmin et al. found that the price of green products decreases with the increase of consumers' price sensitivity coefficient, and the change of green sensitivity coefficient does not affect

the change of product price (LIU, 2018); Xia Xuan divided the heterogeneity of consumer preferences, established centralized decision-making and decentralized decision-making models respectively, and studied the profits of each interest node (XIA, 2019); Yuan Tongde et al. evaluated and determined the weight of a variety of indicators that affect customer preference satisfaction, which promoted the stable development of the supply chain (YUAN, 2019); Therefore, this paper systematically examines the optimal pricing of retailers and manufacturers when considering consumers' green consumption preferences in the supply chain

3 RESEARCH ON PRICING DECISION OF FRESH AGRICULTURAL PRODUCTS CONSIDERING CONSUMERS' GREEN CONSUMPTION PREFERENCES

3.1 Problem Description and Hypothesis

(1) Description of the problem

This paper establishes a Level 2 Stackelberg game model for a supplier versus a retailer. Based on the perspective of consumers, this paper analyzes the optimal pricing decision of fresh agricultural products supply chain when sellers consider consumers' green consumption preferences.

(2) Research hypotheses

Hypothesis 1: Suppose the market environment is a medium-risk market and consumers are absolutely rational. This paper only considers the fresh produce supply chain model of one manufacturer and one retailer,

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and does not calculate the loss in the logistics model.

Hypothesis 2: Let the green cost of such fresh agricultural products have a quadratic relationship with its greenness, and the relationship can be expressed as:

$c(g) = \frac{1}{2} \lambda_1 g^2$, where $c(g)$ is the green investment cost; similarly, The cost of the effort to keep fresh is

expressed as: $c(e) = \frac{1}{2} \lambda_2 e^2$, where $c(e)$ is the input cost of preservation.

Table 1 Symbolic assumptions

meaning	symbol
Retailing price of the seller	p
Supplier wholesale prices	w
Green concentration of agricultural products	g
Market demand potential	a
Level of freshness effort	e
Freshness sensitivity factor	δ
Freshness of produce	θ
Consumer green preferences	σ
Consumer price sensitivity factor	b
Level of green investment	λ_1
Level of freshness investment	λ_2
Supplier production costs	c_m

3.2 Optimal Decision-Making of The Supply Chain of Fresh Agricultural Products Under Decentralized Decision-Making

(1) Solve the supply chain model of fresh agricultural products based on consumers' green consumption preference under decentralized decision-making mode

Assuming that manufacturers and retailers are in a rational state, the order quantity is:

$$Q = a - bp + \sigma g + \delta \theta \tag{1}$$

At this time, the profits of fresh produce supplier and fresh produce retailer are respectively:

$$\pi_{(m)} = (w - c_m)Q - \frac{1}{2} \lambda_1 g^2 \tag{2}$$

$$\pi_{(r)} = (p - w - c_m)Q - \frac{1}{2} \lambda_2 e^2 \tag{3}$$

And there is the optimal values of “w” and “g” can be found to be:

$$w^* = \frac{\lambda_1(a + \delta \theta e) - c_m \sigma}{\lambda_1(b - \frac{\sigma^2}{\lambda_1})} \tag{4}$$

$$g^* = \frac{2\sigma(a + \delta \theta e) - c_m b \sigma}{2b(\lambda_1 - \frac{\sigma^2}{b})} \tag{5}$$

And then it can be obtained p^* , Q^* :

$$p^* = \frac{2(2b^2 \lambda_1^2 - 2b \lambda_1 \sigma^2 + \sigma^4 - \sigma^4 \lambda_1)(a + \delta \theta e) + c_m b(b^2 \lambda_1^2 - 2b \lambda_1 \sigma^2 + \sigma^4)}{4b^2(b \lambda_1 - \sigma^2)^2} \tag{6}$$

$$Q^* = \frac{A_0 + B_0 + C_0 + D_0}{4b(b \lambda_1 - \sigma^2)} \tag{7}$$

$$A_0 = 2ab(2b^2 \lambda_1^3 - 4b \lambda_1^2 \sigma^2 + 3 \lambda_1 \sigma^4 - \lambda_1^2 \sigma^4 + 2b \lambda_1 - 2\sigma^2)$$

$$B_0 = 2\delta \theta e(2b^3 \lambda_1^3 - 4b^2 \lambda_1^2 \sigma^2 + 3b \lambda_1 \sigma^4 - \sigma^6 - b \lambda_1^2 \sigma^4 + \lambda_1 \sigma^6 + 2b^2 \lambda_1 - 2b \sigma^2)$$

$$C_0 = c_m b(b^3 \lambda_1^3 - b^2 \lambda_1^2 \sigma^2 - 2b^3 \lambda_1^2 \sigma^2 + 2b^2 \lambda_1 \sigma^4 + b \lambda_1 \sigma^4 - \sigma^6)$$

$$D_0 = 2a\sigma^6(\lambda_1 - 1)$$

Therefore, under the decentralized model, the optimal profits of fresh produce suppliers and fresh produce retailers are respectively:

(2) Under centralized decision-making, the optimal decision of fresh agricultural product supply chain only considers consumers' green consumption preferences

Under centralized decision-making, assuming that manufacturers and retailers are completely rational, all members of the supply chain are one subject, and the goal is to maximize the total profit of the supply chain, at this time, the order quantity is:

$$Q = a - bp + \sigma g + \delta \theta e \tag{8}$$

As can be seen above: the total profit of the supply chain at this time is:

$$\pi_3 = (p - c_m)Q - \frac{1}{2} \lambda_1 g^2 - \frac{1}{2} \lambda_2 e^2 \tag{9}$$

And there is the optimal values of “ p_3 ”, “ g_3 ” and “ Q_3 ” can be found to be:

$$p_{(3)}^* = \frac{\lambda_1(a + \delta \theta e + bc_m) - \sigma^2 c_m}{2b \lambda_1 - \sigma^2} \tag{10}$$

$$g_{(3)}^* = \frac{\sigma(a + \delta \theta e - bc_m)}{2b \lambda_1 - \sigma^2} \tag{11}$$

$$Q_{(3)}^* = \frac{b \lambda_1(a + \delta \theta e - bc_m)}{2b \lambda_1 - \sigma^2} \tag{12}$$

3.3 Comparison of Optimal Decision-Making Models Considering Consumers' Green Consumption Preferences Under Two Modes

Proposition 1:

$$\frac{\partial p_{(3)}^*}{\partial \sigma} > 0, \frac{\partial Q_{(3)}^*}{\partial \sigma} > 0, \frac{\partial g_{(3)}^*}{\partial \sigma} > 0; \frac{\partial p^*}{\partial \sigma} > 0, \frac{\partial Q^*}{\partial \sigma} > 0, \frac{\partial g^*}{\partial \sigma} > 0$$

Proves:

When,

$$b \lambda_1 - \sigma^2 > 0$$

$$\frac{\partial p_{(3)}^*}{\partial \sigma} > 0, \frac{\partial Q_{(3)}^*}{\partial \sigma} > 0, \frac{\partial g_{(3)}^*}{\partial \sigma} > 0, \frac{\partial p^*}{\partial \sigma} > 0, \frac{\partial g^*}{\partial \sigma} > 0, \frac{\partial Q^*}{\partial \sigma} > 0$$

Proposition 1 shows that in the two decision-making modes of decentralized decision-making and centralized decision-making, retail price, product greening, freshness preservation, order demand and the profits of retailers and suppliers are directly proportional to consumers' green consumption preferences.

Therefore, the higher the value of consumers' green consumption preferences, the better the overall revenue of the supply chain.

3.4 Simulation Analysis

Through the above model calculation and the comparison between models, its rationality and feasibility are analyzed. Now make the following assignments to the parameters in the model:

Table 2 Relevant data values

a	b	c	λ_1	λ_2	σ	δ	Θ	e
400	20	4	8	6	0.5	1	1	1

As shown in the Figure 1, consumers' green consumption preferences are positively correlated with supplier profits and retailer profits.

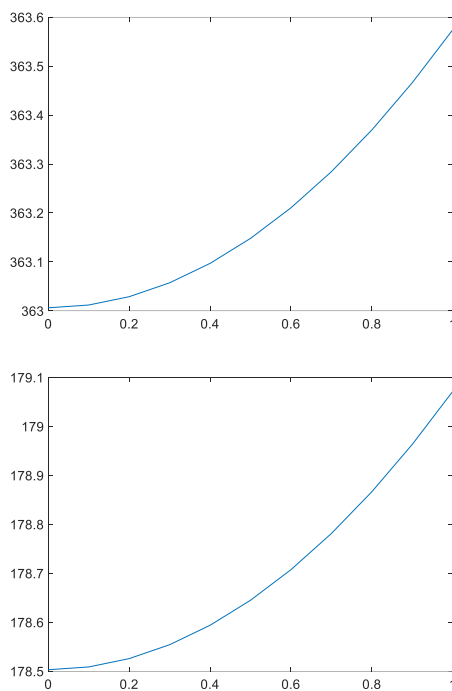


Figure 1 Sensitivity analysis of consumers' green consumption preference, supplier profit and retailer profit

As shown in Figure 2, supplier profits and retailers' profits are positively correlated with the freshness of fresh produce and consumers' green consumption preferences.

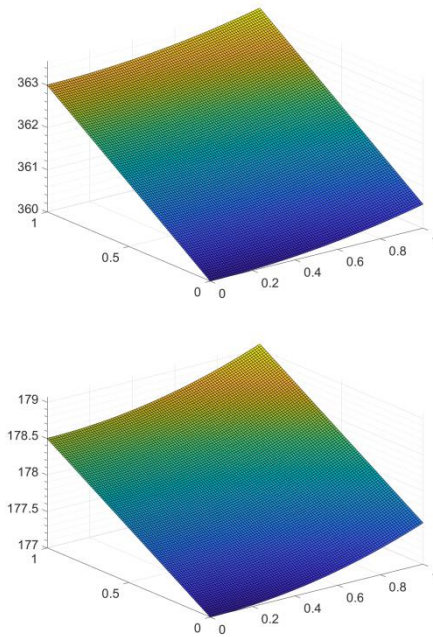


Figure 2 Analysis of the impact of consumers' green consumption preference and freshness of fresh produce on supplier profits and retailers' profits

4 CONCLUSION

Based on the above analysis, it can be concluded that consumers' green consumption preferences are positively correlated with manufacturer profits and retailer profits. In addition, when consumers' green consumption preferences are not significant in the early stages of sales, it is more important for manufacturers to adopt green production methods to profit than retailers to adopt green sales.

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