

Study on storage efficiency of the fresh food e-commerce

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Abstract. As the last cake in the area of e-commerce industry, the temperature of fresh food e-commerce is always rising starting from about 2014. This paper is based on the imperfection that the existing study about fresh food e-commerce is lack of studies on storage efficiency. And we took some variables in this paper such as consumers' satisfaction and length for preservation and storage time. On this basis we built the model of storage efficiency of fresh food e-commerce. We find that as the development of fresh food e-commerce, the fresh food e-commerce enterprise will pay more attention to the consumers' satisfaction. They can take some effective ways like reducing the wastage of fresh food and lengthening the refreshing time of fresh food and so on.

1 Introduction

As the last cake in the area of e-commerce, the temperature of fresh food e-commerce is rising starting from about 2014. Every e-commerce giant is taking part in the fresh food e-commerce area in active, such as T-mall, Jingdong, Amazon, Motion optimization, Yihaodian, I buy nets and so on. So many experts took study on the fresh food e-commerce, such as: Meilin Shi, Juanjuan Wang(2014)^[1] proposed the O2O model of fresh food e-commerce and took analysis on it, and then gave some suggestions about the future of fresh food e-commerce. Jinghuan Li, Minjie Cui(2015)^[2] put forward the new developing trend of the fresh food e-commerce in the future through comparing the operating model and logistics distribution model of fresh food e-commerce industrial. Yakun Li^[3] innovatively put forward the model of "1+N+G" to promote the development of fresh food e-commerce industrial and solve many existing problems of fresh food e-commerce. Chuanshu Wu^[4] analyzed the developing model of the fresh food e-commerce abroad and listed four representative developing models. Basing on it she provided several countermeasures to promote the development of fresh food e-commerce inland.

As the developing of fresh food e-commerce, the storage of fresh food is becoming the most important factor that restricting the development of fresh food e-commerce. Many scholars took study on the storage of fresh food. For example: Jin Liu(2014)^[5] took a storage enterprise of fresh agriculture product for example, and took a deep exploration for its frame of fresh food system solution and its specific technical detail using modern Internet of Things technologies. Zhuokui Wu, Wenfeng Zhang(2015)^[6] put forward a storage temperature-humidity monitoring system of fresh agriculture product based on WIFI aiming at the special temperature and humidity requirements of the fresh agriculture product. Fangjie Wang(2016)^[7] studied the problem of price discount and inventory management of fresh food using the two-phase method basing on the supply chain including two-stage members of supplier and retailer.

In addition, some scholars took study on the storage efficiency, such as: Robeson(1994)^[8] took analysis for the direct cost and indirect cost of storage enterprise. Hamdan(2004)^[9] took a series of



study on American storage enterprise and put forward a cost structure method of storage enterprise. Peng Yang(2012)^[10] studied the market competitiveness of folk logistics storage in rural-urban continuum using the theory of equilibrium. He also took comprehensive analysis and evaluation on its economic benefit and social benefit using data envelopment analysis. Ying Zhang(2014)^[11] took the HD company's logistics center for example. She proposed many problems existed in this logistics center, such as the warehouse management confusion, the warehouse distracted distribution and the low warehouse informationalized level. Then she gave some suggestions of epibolic storage to solve the problems above. Maolei Gong(2015)^[12] mainly considered the relation between space resources and capital resources. He built a model using systems dynamics modeling technology. And he carried a system simulation based on the software of Ithink systematic thinking. He carried out empirical study on it.

From the literature above we can see that existed study about fresh food e-commerce are mainly focused on these aspects like the fresh food e-commerce mode and the present developing status and countermeasure and so on. The present study on fresh food storage are mainly focused on the storage technology and storage management. It's lack of the study on storage efficiency of the fresh food and the measurement of storage efficiency of the fresh food. In this paper, we put forward the measurement model of fresh food e-commerce enterprise's efficiency.

This paper gives some relevant factors that influence the profit of fresh food e-commerce enterprise. Then we give several relevant suggestions and countermeasure and at last obtain some useful conclusions.

2 Getting started model of fresh food e-commerce enterprise's efficiency

2.1 Model building

To keep it simple in this paper, in the fresh food e-commerce supply chain, the fresh food storage distribution center sell the products to consumers. We assume that the price of it is p , the operating cost of unit product is c , the fixed cost is f . Here p is the endogenous variable of the model, c is constant. In this paper, to the consumers in this supply chain, their consuming behavior will not be considered separately. The consumers' demand is given by the market demand function. As the rapidly development of fresh food e-commerce, the competition among fresh food e-commerce enterprises is becoming more and more competition for the final customers. Thus the consumer's satisfaction is becoming more and more important to the development of fresh food e-commerce enterprise. We take the concept of customer's satisfaction in this paper and take it into the market demand function. At last, we get the inverse function of market demand:

$$p = a - \frac{bq}{1+s} \quad (1)$$

In this function, q means the quantity of the fresh food e-commerce storage enterprise. a , b are both greater than zero and are both constant. s means the consumers' satisfaction to the fresh food supply chain and it's constant. $0 < s < 1$. We use it to show the quality of service of fresh food supply chain.

To the normal e-commerce supply chain, we take the profit of e-commerce storage enterprise as π , we can easily get the formular as follows:

$$\pi = (p - c)q - f \quad (2)$$

For the storage of fresh food e-commerce, there are certain wastage because of the particularity of the fresh product. The most direct elements related to the wastage of the fresh product are it's refreshing time and it's storage period in the warehouse. So we use these two variables to measure the wastage of fresh product in this paper. We take the refreshing time of fresh product is t_1 , the storage period in the warehouse is t_2 , the wastage of fresh product is r . Then we can easily get the formular:

$$r = \frac{t_2}{t_1}$$

Then we can get the profit of fresh food e-commerce enterprise storage enterprise is as the formular as follows:

$$\pi = (p - c)q - rpq - f \quad (3)$$

Easily we can see that:

$$\begin{aligned} \pi &= a - \frac{bq}{1+s} - cq - \frac{t_2}{t_1} a - \frac{bq}{1+s} q - f \\ &= a - c - \frac{at_2}{t_1} q - \left(1 - \frac{t_2}{t_1}\right) \frac{bq^2}{1+s} - f \end{aligned} \quad (4)$$

2.2 Model analysis

To the fresh food e-commerce storage enterprise, the most important goal is to get the profit maximization. We take the derivative of q for π :

$$\frac{\partial \pi}{\partial q} = a - c - \frac{at_2}{t_1} - 2 \left(1 - \frac{t_2}{t_1}\right) \frac{bq}{1+s} = 0$$

Then we can get the optimal selling quantity:

$$q^* = \frac{(1+s)[a(t_1 - t_2) - ct_1]}{2b(t_1 - t_2)} \quad (5)$$

And we can get the optimal profit:

$$\pi^* = \frac{(1+s)[a(t_1 - t_2) - ct_1]^2}{4bt_1(t_1 - t_2)} - f \quad (6)$$

2.2.1 Relation between the profit of fresh food e-commerce storage enterprise and the customer's satisfaction. Take the derivative of s for π :

$$\frac{\partial \pi^*}{\partial s} = \frac{[a(t_1 - t_2) - ct_1]^2}{4bt_1(t_1 - t_2)},$$

Easily get:

$$[a(t_1 - t_2) - ct_1]^2 > 0, b > 0, t_1 > 0$$

And because in normal, the refreshing time of fresh product is must greater than it's storage period.

That is to say that $t_1 > t_2$. We can get the proposition as follows:

$$\text{Proposition 1} \quad \frac{\partial \pi^*}{\partial s} > 0$$

This proposition shows that the profit of fresh food e-commerce storage enterprise is proportional to the customer's satisfaction. The higher the customer's satisfaction is, the higher the profit of fresh food e-commerce storage enterprise is.

2.2.2 Relation between the profit of fresh food e-commerce storage enterprise and the storage period of fresh product in the warehouse. As we can not analyze the relation directly between the profit of fresh food e-commerce storage enterprise and the storage period of fresh product in the warehouse from formular (6), then we use mathmatics method to get the formula (6) deformation:

$$\begin{aligned}\pi^* &= \frac{(1+s)[a(t_1-t_2)-ct_1]^2}{4bt_1(t_1-t_2)} - f \\ &= \frac{a^2(t_1-t_2)^2 - 2act_1(t_1-t_2) + c^2t_1^2}{t_1(t_1-t_2)} - f \\ &= \frac{a^2(t_1-t_2)}{t_1} + \frac{c^2t_1}{t_1-t_2} - 2ac - f\end{aligned}$$

If $k = \frac{t_1-t_2}{t_1}$, then

$$\begin{aligned}\pi^* &= a^2k + \frac{c^2}{k} - 2ac - f \\ &= c^2\left(k + \frac{1}{k}\right) + (a^2 - c^2)k - 2ac - f \\ &\geq 2c^2 - 2ac + (a^2 - c^2)k - f \\ \frac{\partial \pi^*}{\partial k} &= a^2 - c^2, \quad a > c,\end{aligned}$$

Then we can get the proposition as follows:

$$\text{Proposition 2} \quad \frac{\partial \pi^*}{\partial k} > 0$$

This proposition shows that the profit of fresh food e-commerce storage enterprise is inversely proportional to the wastage of fresh product. The higher the wastage of fresh product is, the higher the profit of fresh food e-commerce storage enterprise is.

From the formular above we can see that the greater k is, the greater π^* is.

$$k = \frac{t_1-t_2}{t_1} = 1 - \frac{t_2}{t_1}$$

We can easily get the proposition as follows:

$$\text{Proposition 3} \quad \frac{\partial \pi^*}{\partial t_2} < 0, \frac{\partial \pi^*}{\partial t_1} > 0$$

This proposition shows that the profit of fresh food e-commerce storage enterprise is proportional to the refreshing time of fresh product and is inversely proportional to the storage period of fresh product in the warehouse. The longer the refreshing time of fresh product is, the higher the profit of fresh food e-commerce storage enterprise is. Similarly, the shorter the storage period of fresh product in the warehouse is, the higher the profit of fresh food e-commerce storage enterprise is. We can easily see that these conclusions are all corresponded to reality.

From the three propositions above we can see some conclusions. This paper build the profit calculation model of the fresh food e-commerce storage enterprises. Then we get the relation between profit of fresh food e-commerce storage enterprise and the consumer's satisfaction via the calculation model this paper built: The profit of fresh food e-commerce storage enterprise is proportional to the customer's satisfaction. The higher the customer's satisfaction is, the higher the profit of fresh food e-commerce storage enterprise is. The profit of fresh food e-commerce storage enterprise is inversely proportional to the wastage of fresh product. The higher the wastage of fresh product is, the higher the profit of fresh food e-commerce storage enterprise is. The profit of fresh food e-commerce storage enterprise is proportional to the refreshing time of fresh product and is inversely proportional to the storage period of fresh product in the warehouse. The longer the refreshing time of fresh product is, the higher the profit of fresh food e-commerce storage enterprise is. Similarly, the shorter the storage

period of fresh product in the warehouse is, the higher the profit of fresh food e-commerce storage enterprise is.

Firstly, about the relation between the profit of fresh food e-commerce storage enterprise and the consumer's satisfaction, the existing studies have not proved that the two have positive correlation. In this paper, we build the profit calculation model of the fresh food e-commerce storage enterprise. And through this model we proved that the profit of fresh food e-commerce storage enterprise and the consumer's satisfaction have positive correlation indeed. From this conclusion we can deepen the tenets of "customer-centric" in the fresh food e-commerce industry. Secondly, about the relation between the profit of fresh food e-commerce storage enterprise and the wastage of fresh product, we can see easily that the two have negative correlation. And we can also prove that the conclusions getting from the profit calculation model of fresh food e-commerce storage enterprise are reliable. Thirdly, about the relation between the profit of fresh food e-commerce storage enterprise and the storage period of fresh product in the warehouse and refresh time. We can also easily see the relation between them. Under the circumstance of all other things being equal, the longer the refreshing time of fresh product is, the higher the profit of fresh food e-commerce storage enterprise is. Similarly, the shorter the storage period of fresh product in the warehouse is, the higher the profit of fresh food e-commerce storage enterprise is. We can also prove that the profit calculation model of fresh food e-commerce that built in this paper is relatively reliable.

3 Way to boost the profit fresh food e-commerce storage enterprise

According to the context above, this paper gives three ways to boost the profit of fresh food e-commerce storage enterprise:

(1) Actively promote the development of "last mile" and enhance user experiences

To all the fresh food e-commerce storage enterprise, "last mile" is their common key problem. As the rapid development of fresh food e-commerce, the competition among fresh food e-commerce enterprises is more and more becoming the competition for the final customers. User experiences are becoming more and more important for the fresh food e-commerce enterprise. In my opinion, we can promote the development of "last mile" and enhance user experiences through the following measures:

1) Increase the number of offline stores or offline pick up in store. Customer can place an order online, and take the fresh product in the nearby offline stores or offline pick up in store. And we can increase the speed of distribution. Of course, in this way the fresh food e-commerce will increase the cost of building this offline stores or offline pick up in store. But no costs, no profits. The input on the customers are all will be output.

2) The fresh food e-commerce storage enterprise can cooperate with the community stores to actively promote "last mile". The community stores can be taken as the offline pick up in store of the fresh food e-commerce storage enterprise, and consumers can take the fresh product in the door of the community. The community stores finish the distribution of the fresh product on the one hand and search for more sales approach for their own products on the other hand. Nowadays, people are all "lazy" to walk a long way to get the express themselves. They don't like to be limited the pick up time of the express. Then through cooperating with the community stores to actively promote "last mile", people can get their express on the time they are convenient or after work. And through this way we can improve the costumer satisfaction of fresh food e-commerce.

(2) Strictly control the wastage of fresh product, lower wastage and increase profit

The fresh product has their specificity. The wastage of fresh product is a very strict problem that fresh food e-commerce storage enterprise faced. According to the survey, at this stage, the wastage of fresh food e-commerce are all above 10% whether it's self-distribution or third part distribution. Some of them even reach to 30%. So it is imperative to lower the wastage of fresh food. In this paper, we think we can lower the wastage of fresh product through some ways as shown below:

1) Starting from the source, we can take pretreatment to the fresh product. We can purchase the fresh product from the source. For example we can purchase the apples from the apple orchards. In this way we can not only decrease the purchase cost but also control the quality of fresh product. We can also take some pretreatment to the fresh product. For example, to some fresh product which is

afraid of wet, we can take dehydration to them at the source of supply chain so that we can lower the wastage of fresh product.

2) Create suitable refreshing circumstance. As the developing of fresh-keeping technology and equipment, many advanced fresh-keeping technology have emerged in. For example, the fresh-keeping technology by ultraviolet ray, heat, electromagnetism, ozone and many other technology. We can lengthen the refresh time of the fresh product by using these advanced preservation technology. Take different storage for the different demand for temperature of fresh product in the process of storage.

3) Take effective sale promotion and speed up turnover. As the refresh time of the fresh product are all very short, so as for the fresh product, we should take special, strong and effective way of promotion. And we can speed up the velocity of turnover of fresh product and reduce the wastage of fresh product.

4 Conclusion

This paper is based on the imperfection that the existing study about fresh food e-commerce is lack of study on storage efficiency. And we took some variables in this paper such as consumers' satisfaction and length for preservation and storage time. On this basis we built the model of storage efficiency of fresh food e-commerce. As the developing of fresh food e-commerce, the fresh food e-commerce enterprise pay more attention to the consumers' satisfaction, reducing the wastage of fresh food, lengthening the refreshing time of fresh food and give some effective ways. The conclusions of this paper are all make certain sense for the storage efficiency of fresh food e-commerce enterprise.

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