Research on the influencing factors of consumer satisfaction in agricultural e-commerce supply chain

Wu Chunshang 1 2
1. Heyuan Polytechnic, Heyuan city, Guangdong Province, 517000, China
2. City University of Macau, China
wuchunshang1023@163.com

Abstract. In recent years, e-commerce for agricultural products has developed rapidly, but the overall scale of e-commerce for agricultural products is still small due to consumers' low satisfaction with the overall supply chain of e-commerce for agricultural products. So, it is very important to find out the key factors that affect the satisfaction of agricultural e-commerce supply chain and improve consumer satisfaction. Through the construction of factor analysis model, this paper analyzes the factors that affect the supply chain of e-commerce of agricultural products, and finds that the quality of agricultural products is the most influential factor, followed by after-sales service, e-commerce platform, and the price factor is the least. Therefore, in order to improve consumer satisfaction, we should focus on improving the quality of agricultural products, after-sales services, e-commerce platform convenience.

1. Introduction
E-commerce of agricultural products directly connects producers and consumers, effectively reduces the intermediate links, reduces transaction costs, and eliminates the problem of information asymmetry between supply and demand. E-commerce of agricultural products not only solves the problem of difficult trading and expensive sales of agricultural products, but also increases the employment opportunities and independent business opportunities of farmers, and improves the income of farmers. Therefore, e-commerce of agricultural products has become an important starting point for targeted poverty alleviation and Rural Revitalization in China. In 2019, China's online retail sales of agricultural products reached 397.5 billion yuan, an increase of 27% over 2018, a growth of 1.5 times over 2016, and in 2019, the number of rural online businesses in China exceeded 13 million. However, due to the perishable and perishable characteristics of agricultural products, the difficulty of preservation, and the difficulty of online transactions to ensure the quality of agricultural products, the satisfaction of consumers with agricultural products e-commerce still needs to be improved, so the overall scale of agricultural products e-commerce is still small. Therefore, there is an urgent need to improve consumers' satisfaction with the agricultural products e-commerce supply chain in order to attract more consumers to purchase agricultural products through e-commerce.

Sun Y.B. Wang Z.S. (2016) found that consumers' awareness, trust and participation in e-commerce of fresh agricultural products are not enough, and their satisfaction is not high, which is the biggest obstacle to the development of e-commerce of fresh agricultural products. Therefore, scholars began to pay attention to the research of consumer satisfaction of agricultural e-commerce[1]. Hu Yuan, LAN Hong-xing & (2017) Based on the field survey data, they analyzed the influence factors of Wechat E-commerce customer satisfaction, and they found that the quality and safety of agricultural
products is the primary influence factors[2]. Wu Yanyan (2018) designed a questionnaire, including 20 factors based on agricultural product characteristics, website quality and service quality to evaluate consumers' satisfaction. It is found that service quality, agricultural products' safety, brand and website quality significantly impact consumer satisfaction[3]. Wang Guanlin (2018) used the factor analysis mode to analyze the influencing factors of Chinese consumers' satisfaction with online purchase of fresh agricultural products, and the results show that service quality factor and fresh agricultural product quality factor are the most critical factors[4]. Bhattacharya, S. & Raju, V. (2019) used Condorcet voting theory with analytic hierarchy process to analyse various criteria affecting customer satisfaction in e-commerce systems[5].

2. Methods and Indicators

2.1. Consumer satisfaction evaluation model of agricultural e-commerce supply chain

There are many factors influencing consumer satisfaction in agricultural e-commerce supply chain, so it is necessary to find out the potential key factors from many factors. Factor analysis can solve the problems. The basic idea of factor analysis is to explore the basic structure of research variables by studying the correlation between many variables, and try to use a few linear combinations of "potential variables" to represent the data structure of research variables, in order to reduce dimensions and find out the key influencing factors. Therefore, factor analysis is widely used in economic and management research.

The form of factor analysis model:

\[ X = \sum_{j=1}^{m} \mathbf{X} \mathbf{F}_j + \sum_{j=1}^{m} \mathbf{X} \mathbf{F}_j \mathbf{F}_j + \varepsilon \]

\[ X\in\{X_1, X_2, \ldots, X_p\} \text{ are Observable random variables, } E(X)=0. \]

\[ F\in\{F_1, F_2, \ldots, F_m\} \text{ are unknown vectors, } E(F)=0. \]

\[ \text{Cov}(F, \varepsilon) = 0. \quad D(F)=I. \]

After extracting the common factor, the common factor can be represented by the linear combination of the common factor variables. Formula is (2).

\[ F_j = \mathbf{X} \mathbf{F}_j + \varepsilon_j \]

2.2. Consumer satisfaction index of agricultural e-commerce supply chain

Based on the research of relevant scholars, the evaluation indexes of consumers' e-commerce shopping satisfaction and the influencing factors of consumers' fresh e-commerce satisfaction are divided into five categories, including agricultural product quality, price, logistics distribution, e-commerce platform and after-sales service, with 12 measurement indexes (table 1).

| Table 1. Factors influencing consumer satisfaction in agricultural e-commerce supply chain |
|--------------------------------|--------------------------------|-----------------|
| First level index          | Second level index                | Symbol           |
| Quality of agricultural   | I am satisfied with the quality of | \(X_{11}\)       |
| products                  | agricultural products on e-commerce platform |               |
|                          | I am satisfied with the freshness of | \(X_{12}\)       |
|                          | agricultural products on e-commerce platform |               |
| Price                     | The price of agricultural products purchased by e-commerce platform is cheap | \(X_{21}\)       |
|                          | The platform is cheap for agricultural products, most               | \(X_{22}\)       |
3. Empirical analysis on the influencing factors of consumer satisfaction in agricultural e-commerce supply chain

3.1. Questionnaire design and collection

In order to understand the current situation of consumers' satisfaction with agricultural products e-commerce supply chain, based on the relevant literature, 16 problems of evaluation system of agricultural products e-commerce supply chain satisfaction are set up, including five dimensions of agricultural products quality, price, logistics distribution, e-commerce platform and after-sales service. The survey was conducted by questionnaire stars. 380 people participated in this questionnaire survey, and 352 questionnaires were collected. 278 valid questionnaires were obtained after eliminating the missing answers and the number of questionnaires that had never purchased agricultural products online.

Agricultural e-commerce supply chain satisfaction using the classic Likert five level scale." Very disagree", "disagree", "general", "agree" and "very agree" are given 1, 2, 3, 4 and 5 points respectively according to the order. Therefore, the higher the score means the higher the satisfaction of consumers to the agricultural e-commerce supply chain. From table 2, it can be seen that the satisfaction of e-commerce supply chain of agricultural products is general, with an average of 3.88 < 4, so there is still much room for improvement.

| Variable                  | Mean | S.d. | N  |
|---------------------------|------|------|----|
| X11                       | 3.83 | .644 | 278|

Table 3 is a descriptive statistical table of each influencing factor of agricultural e-commerce supply chain satisfaction. As is shown in Table 3, the average value of e-commerce platform popularity and word of mouth (X41) is the largest, which indicates that consumers are more satisfied with the e-commerce platform of agricultural products, followed by online service (X43) and logistics service attitude (X32), and the agricultural product price (X21) has low satisfaction.

Table 3. Descriptive statistics of factors influencing the satisfaction of agricultural e-commerce supply chain

| Variable | Mean | S.d. | N  |
|----------|------|------|----|
| X11      | 3.83 | .644 | 278|
3.2. Reliability Analysis
Table 4 is the reliability analysis results of factors influencing the satisfaction of agricultural e-commerce supply chain. It can be seen from table 6 that Cronbach's alpha and Cronbach's alpha based on standardized items are close to 0.8, so they have good reliability.

Table 4 Reliability Analysis

| Cronbach's Alpha | Cronbach's alpha based on standardized terms | N  |
|------------------|---------------------------------------------|----|
| .771             | .791                                        | 12 |

3.3. Factor analysis of factors influencing the supply chain satisfaction of agricultural e-commerce
In order to find out the potential factors that affect consumers' satisfaction of agricultural e-commerce supply chain, factor analysis was used to reduce dimensions.

3.3.1 Applicability test
Using SPSS23.0, we get KMO and Bartlett spherical test results (Table 5). KMO 0.823>0.8,sig.=0, Through testing, it is suitable for factor analysis.

Table 5. KMO and Bartlett’s Test

| Kaiser-Meyer-Olkin Measure of Sampling | .823 |
|----------------------------------------|------|
| Bartlett’s Test of Sphericity          |      |
| Approx. Chi-square                     | 524.264 |
| df                                     | 66   |
| Sig.                                   | .000 |

3.3.2 Factor extraction and common factor determination
In order to find potential variables from the impact indicators of e-commerce logistics of agricultural products, common factors need to be extracted, and the number of common factors to be extracted is determined according to the eigenvalue greater than 1. As can be seen from table 9, four common factors should be selected.

Table 6. Total Variance of Explained

| Factor | Initial Eigenvalues | Total | Variance % | Cumulative % | Total | Variance % | Cumulative % | Rotations Sum of Squared Loadings |
|--------|---------------------|-------|------------|--------------|-------|------------|--------------|---------------------------------|
|        |                     | Total |            |              |       |            |              |                                 |
| 1      |                     | 4.148 | 34.568     | 34.568       | 4.148 | 34.568     | 34.568       | 3.272                           |
| 2      |                     | 1.327 | 11.060     | 45.629       | 1.327 | 11.060     | 45.629       | 1.884                           |
| 3      |                     | 1.195 | 9.956      | 55.585       | 1.195 | 9.956      | 55.585       | 1.492                           |
| 4      |                     | 1.058 | 8.815      | 64.400       | 1.058 | 8.815      | 64.400       | 1.081                           |

|                      | Ctraction Sum of Squared Loadings | Total | Variance % | Cumulative % | Rotations Sum of Squared Loadings | Total | Variance % | Cumulative % |
|----------------------|----------------------------------|-------|------------|--------------|---------------------------------|-------|------------|--------------|
|                      |                                  |       |            |              |                                 |       |            |              |
3.3.3 Calculation factor load
In order to calculate the contribution of each variable in two common factors, factor loads need to be calculated. It can be seen from table 7 that the explanatory tendency of variables on two factors is not obvious, so rotation is required.

Table 7. Component Matrix and Rotated Component Matrix

| Index  | Component Factor | Rotated Component Factor |
|--------|------------------|--------------------------|
|        | 1                | 2            | 3    | 1          | 2        | 3    |
| X11    | .570             | -.188        | .015 | -.202      | .606     | .129  | .028 |
| X12    | .695             | -.251        | .024 | -.136      | .733     | .155  | .045 |
| X21    | -.014            | -.275        | -.037| .900       | -.026    | -.025 | -.026 |
| X22    | .458             | .398         | .410 | .307       | .179     | .193  | .726 |
| X31    | .316             | -.294        | .162 | -.170      | .796     | .043  | .119 |
| X32    | .718             | -.168        | .123 | -.110      | .718     | .148  | .179 |
| X33    | .763             | -.343        | .109 | .126       | .804     | .110  | .122 |
| X41    | .150             | .259         | .566 | .064       | .054     | -.163 | .620 |
| X42    | .402             | .558         | .347 | -.025      | .097     | .258  | .697 |
| X43    | .741             | -.142        | -.127| .147       | .649     | .373  | .069 |
| X51    | .635             | .487         | -.445| .018       | .219     | .871  | .159 |
| X52    | .620             | .357         | -.562| .106       | .243     | .882  | .009 |

As it is showed from table 7, the common factor F1 has a higher load on X11, X12, X31, X32, X33 and X43, and a lower load on other indicators. These six indicators mainly reflect the quality of agricultural products and the quality of logistics and distribution, so it can be named as the quality factor of agricultural products e-commerce supply chain. The load of common factor F2 on X51 and X52 is higher, and the load on other indexes is smaller. Therefore, F2 can be named as after-sales service factor. F3 has a high load in X41, X42 and X22, which are all related to e-commerce platform, so it can be named e-commerce platform factor. F4 has the largest load on X21 and smaller load on other indexes, so it can be named as price factor.

So, the satisfaction of the agricultural e-commerce supply chain is mainly affected by four potential public factors: the quality of agricultural e-commerce, after-sales service, e-commerce platform and price.

3.3.4 Calculation factor load
After extracting the common factors, the factor scores need to be calculated by the factor load score coefficient, and the score coefficient of each common factor needs to be calculated by the known variable observation value.

\[ F_j = \beta_{j1}X_1 + \cdots + \beta_{jp}X_p \quad j=1,\cdots,m \] (3)

Table 8. Factor Score Component Matrix

| Factor | 1  | 2  | 3  | 4  |
|--------|----|----|----|----|
| X11    | .220| -.045| -.071| -.141|
| X12    | .260| -.055| -.074| -.067|
| X21    | -.043| .008| .013| .875|
| X22    | -.066| .019| .514| .187|
| X31    | .302| -.153| -.014| -.093|
3.3.5 Calculation factor score
In order to reflect the regional agricultural products logistics capacity of Guangdong Province in general, the overall factor score \( f \) needs to be calculated. Generally, the ratio of the relative variance contribution rate of each factor to the total cumulative contribution rate of each common factor is used as the weight of each factor, and the calculation formula is shown in formula (4).

\[
F = 0.42F_1 + 0.24F_2 + 0.19F_3 + 0.14F_4
\]  

It can be seen from formula (4) that the quality factor \( F_1 \), the potential public factor, has the greatest impact on the satisfaction of consumers with e-commerce of agricultural products, followed by the after-sales service factor \( F_2 \) and e-commerce platform factor \( F_3 \), and the price factor \( F_4 \) has relatively small impact. It shows that consumers purchase agricultural products through e-commerce, the most concerned is the quality and after-sales service of agricultural products e-commerce supply chain, and the impact of price on consumer satisfaction. Therefore, in order to improve the rapid development of agricultural e-commerce, agricultural e-commerce should focus on the quality of agricultural products and after-sales service, rather than the price of agricultural products. And with the rise of residents’ income level, consumers will pay more attention to the quality of agricultural products and services.

4. Conclusions
Through the construction of factor analysis model of agricultural e-commerce supply chain satisfaction, we found that agricultural product quality is the most critical factor, followed by after-sales service and e-commerce platform. The impact of price is the smallest. Therefore, in order to promote the development of agricultural e-commerce, it is necessary to improve the satisfaction of consumers, increase their trust in agricultural e-commerce. Therefore, we must do the following work:

(1) To improve the quality of agricultural products, we should establish long-term cooperation with agricultural products and bases to ensure the safety and green of agricultural products, establish a cold chain logistics system to ensure the freshness of agricultural products, and establish a traceable supply chain system for agricultural products to further ensure the quality of agricultural products.

(2) We should establish the whole process of consumer service system to ensure the quality of service. The service system shall provide pre-sale service, in sale service and after-sale service, especially we should focus on improving the quality of after-sales service. Some studies have shown that if after-sales can deal with customer complaints in a timely and effective manner, it can effectively eliminate customer dissatisfaction. This service system is a comprehensive service system including pre-sale, sale and after-sale, especially focusing on improving the quality of after-sale service. Research shows that if after-sales can deal with customer complaints in a timely and effective manner, it can effectively eliminate customer dissatisfaction.

(3) We should optimize the functions of e-commerce platform, make full use of new ways such as social e-commerce, reduce the cost of consumer search, and improve the convenience of consumer e-commerce in purchasing agricultural products.

Acknowledgements
This research was financially supported by Guangdong Provincial Education Department 2017 key platform and research projects (Grant No. 2017GWTSCX044).
References

[1] Sun Y.B. Wang Z.S. (2016). An empirical study on the factors influencing consumers' satisfaction with online shopping of fresh agricultural products. Journal of Beijing Technology and Business University(Social Sciences).03,65-73

[2] Hu Yuan, LAN Hong-xing, SHI Huan. (2017). Analysis of factors influencing wechat e-commerce customer satisfaction of agricultural products. Journal of Anhui Agricultural Sciences.

[3] Yanyan, W. (2018). Empirical analysis of factors influencing consumers' satisfaction in online shopping agricultural products in china. Journal of Electronic Commerce in Organizations, 16(3), 64-77.

[4] Wang Guanlin(2018). An empirical study on the factors influencing consumers' satisfaction with online shopping of fresh agricultural products. Journal of Commercial Economics.06,47-49

[5] Bhattacharya, S., & Raju, V. (2019). Analysis of factors affecting customer satisfaction in e-commerce applications using condorcet - ahp method. International journal of internet protocol technology, 12(1), 2-10.