Dynamic Simulation of Consumer Purchase Intention Forecast by using SD model

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Abstract

In this paper, the system dynamics method is used to describe the relationship among the variables, and simulate the change law of the system, which is used to analyse the problem of consumer purchase intention, to realize the medium and long term forecast and policy simulation. In this study, the logistic regression analysis was conducted to investigate the data of 368 consumers by using SPSS16.0 statistical software. The results show that 32.6% of consumers agree with the brand effect, 44.6% of consumers expressed concern about product quality and safety, while 9.8% of consumers think that the product price is too high, beyond the acceptable range. According to the above analysis, the author puts forward the suggestion as develop differentiated marketing strategy, strengthen the supervision of the price, and enhance the brand awareness of enterprise products.

Key words: Quantitative analysis, Consumer Purchase Intention, Flow diagram, System dynamics

1. INTRODUCTION

China's government for years to the formulation and implementation of various policies to protect and promote the stable development of grain production, but in the food policy also had some mistakes, such as policy targeted poor, failing to anticipate changes in supply and demand, the indirect effect of the policy and the long term effect of estimation problems and so on (Joshua, 2015; Delgado, 2015; Milad, 2015). Past of traditional experience judgment and qualitative analysis of agricultural policy analysis, has been far cannot meet the new situation policy and economic development demands more scientific, systematic and quantitative policy analysis tool, study of agricultural policy in China has gradually from qualitative analysis to quantitative analysis. At the same time, in recent years, the frequent occurrence of food quality and safety problems caused by the strong reaction of the consumer group, which has a lot of scholars on the issue of food safety and consumption (Ali, 2014; Gopal, 2014; Natascha, 2015). For consumers of stratified sampling survey, through descriptive statistics and cross project analysis method to measure consumer purchase intention of on food safety based, verify the food safety information can be fortified to increase consumer's willingness to buy.

High quality green food industry under the joint efforts of relevant government departments and green food enterprises, there has been a considerable development, well-known high-quality green food producing areas of green food products on the market price food has been much higher than the average market price food of the common green food, but most of the country's green food production has not yet been completed by ordinary green food to the transformation of high quality green food, green food products on the market price food is not high, even in accordance with the standard production of high quality green food products, it is difficult to obtain the consumer recognition, green food products of good quality and low price food to achieve a long-term and arduous task(Ilyoo, 2013; Aurelio, 2013). If it is difficult to achieve higher price foods for better quality, will inevitably affect the green food farmers planting of high quality green food enthusiasm, make the quality and safety of products of green food is not stable supply, influence of our country food security. The realization of high quality and low price food of green food products is not only a process of changing from "lemon market" to "high quality market", but also an important means to improve the income level of farmers and processing enterprises. Therefore, it is necessary to the realization path of green food industry high quality construction, realize the production, processing and marketing links closely connected, of industry in the aspect of the subject of interest coordination and stable and good quality green food production, meet the needs of consumers for the purpose of the demand of high quality green food.

2. SYSTEM DYNAMICS MODELING

System dynamics to build in control theory, system theory and information theory based on the study of the feedback system structure, function and dynamic behavior of a kind of method for long-term social economic analysis and prediction, known as the "strategy and decision Lab. Professor Wang Qi fan in the early 1980s introduced the system dynamics method into China, has triggered a hot SD, in recent years, system dynamics application of growth trend once again has become one of the hot topics in the study of complex systems. Change law of China's food security is a complex economic problems, many of the details we did not fully grasp the rules and inherent relation, for this kind of complicated problem of SD method is an effective
method to solve the problem. In this paper, the system dynamics method is used to describe the relationship among the variables, and simulate the change law of the system, which is used to analyze the problem of grain, to realize the medium and long term forecast and policy simulation.

2.1 System factor analysis

The basic balance of grain supply and demand means that there is enough grain supply to meet the demand of grain. The grain supply capacity of a country or region depends on the amount of grain production, the amount of imports and the beginning of the period, the demand of grain depends on the amount of consumption, the export volume and the final reserve quantity. Total food production is jointly decided by the per unit area yield of grain and grain sown area, respectively, on Grain Yield and grain sown area were analyzed: there are many factors affecting grain yield per unit area, generally speaking, are mainly six aspects: labor input, agricultural production inputs, the promotion of agricultural science and technology progress and technology, National Water Conservancy Agricultural Public Investment in infrastructure, related system and policy and natural disasters influence; grain sown area is mainly composed of arable land resources, multiple cropping index and grain planting area accounts for crop acreage proportion of three aspects.

Based on domestic resources to achieve self-sufficiency in grain, is the basic policy to solve the problem of grain supply and demand in china. The State Council issued the “China's grain problem” white paper pointed out that under normal circumstances China's grain self-sufficiency rate of not less than 95%, net imports not more than 5% of domestic consumption. Previous experts have suggested that the self-sufficiency rate is about 90%, taking into account the 10% of China's imports of food will lead to fluctuations in the international market food price foods, and thus affect the third world food supply. In the medium and long term prediction, the aggregate supply and demand for food is the focus of our attention, and food supply and demand situation affects the food price food changes, price food changes and further affect the next period of grain production.

2.2 Causality diagram (CLD)

Considering the purpose of modeling, analysis of the information collected from various elements of abstract description of system overview and representative variables, establish the system variables: the total grain yield (Total Production), yield (Production per Unit), labor input (Labor), the total power of agricultural machinery (unit, Machine) per mu per mu the amount of chemical fertilizer (unit Fer), the effective irrigated area (Irri Area), water conservancy investment accounted for the national infrastructure investment proportion (Irri Rate), agricultural science and technology three accounted for the proportion of fiscal expenditure (AgriTech/GovExp), the disaster area ratio (DisRate), grain sown area (Planting, Area) (Plant Area), cultivated land area multiple cropping index (MI), the sown area of grain sown area of crops accounted for the proportion of (Grain/Crop Area), the total food consumption (Consumption), total population (total population), per capita food consumption (consumption per person), inventory (stock), inventory coefficient (Stock Co), expectations (expected stock inventory, expect (expected price food)) price foods, grain price food change rate of food price food change, price foods and grain price food), net import amount (net import).

According to the analysis of the main influence factors and determine the set of variables, which can be used to build the system the main feedback loop: total production arrows $\uparrow \Rightarrow$ Stock arrows $\uparrow \Rightarrow$ StockCo arrows $\uparrow \Rightarrow$ Expected price food $\downarrow \Rightarrow$ Food price food change $\leftrightarrow$ Grain/Crop Area $\downarrow \Rightarrow$ Planting area $\downarrow \Rightarrow$ Total production decreases. This circuit said food production caused by inventory increase, which leads to the reduction of the expected price foods and grain sown area reduced, leading to a period of food production. Based on the above, the causality diagram is drawn, as shown in Figure 1. The variables that affect grain production can be quantified by the variable of black body marker.

![Figure 1. Causality diagram of the supply and demand](image-url)
2.3 SD flow diagram
Causality diagram can only be qualitatively a rough description of system feedback mechanism, if to quantitatively describe and shall be Figure 1 shows the causality diagram change plotted SD flow chart, as shown in Figure 2, and on this basis, the use of SD special dynamo language writing equations.

![Figure 2. SD flow diagram of supply and demand situation](image)

3. SYSTEM SIMULATION AND ANALYSIS

3.1 Simulation results
Application of system dynamics modeling software Vensim PLE model of food supply and demand situation in China from 1996 to 2030 the time span of 35 years of simulation, the main output results as shown in Figure 3, figure 4 and figure 5 shows. As can be seen from the simulation results, the increase of grain yield in China depends on the increase of yield, which is mainly caused by the decreasing of cultivated land in China. The next two years, thirty years, China's grain production and consumption tends to be stable, food self-sufficiency rate of 93% to 107% fluctuations. From a long-term point of view, in food production to keep steady growth, China's food price food volatility is very small, compared with the price foods of other consumer goods, price foods steadily trend.

![Figure 3. Price foods situation simulation curve](image)
System dynamics method is mainly through the analysis of the structure of the social economic system, with the help of computer simulation technology research, known as the actual system of the laboratory. In the model, the policy parameters take different values, which can be considered as different simulation schemes. The parameters in this paper are based on the historical development of the system and the experience of experts. In fact, these parameters can be adjusted with the real changes of the national policy, which makes the model more realistic and effective. The simulation model itself is a kind of abstraction and simplification of the realistic problems, due to a lot of data that are difficult to quantify, coupled with the difficulties of data collection, the SD model is constructed in this paper without considering agricultural water shortage, for farming land quality, international price foods of the impact and our government implementation grain food purchase price food policy and other factors. In addition, system dynamics model is mainly used for quantitative analysis of long-term, dynamic and strategic. It focuses to study the dynamic behavior of a system that is more concerned about the trend prediction rather than the accuracy of the simulation results.

4. EMPIRICAL RESEARCH

4.1 Econometric analysis model

This study to consumers to buy quality and safety of green food (the quality and safety of green food is to reflect the quality and safety for the purpose, according to the organic food, green food and pollution-free food standard production of organic green food, no environmental pollution of green food in general, also known as for green food, the main products of known for the quality and safety of green food or green food safe) will as explanatory variables, and will be interpreted variables were transformed into binary variables (i.e. green food consumers positive with "1", the other with "0") is a 0/1 binary variables. In the research of social science, the general multiple linear regression models cannot be established directly when the explanatory variables are 0/1 two variables, and most of the two Logistic models are used in the study. Therefore, this study uses two yuan Logistic model, which is interpreted as a variable range of 0-1. When the explanatory variable is the two...
categories, the explanatory variable y is subject to two distributions, The overall probability of setting the y=1 is
\[ P(y=1) = P^*(1 - p)^{(1-y)} \] (1)

Under such a definition, the parameters of the model can be estimated by the maximum likelihood estimation method. Log likelihood function:
\[ l(\beta) = \log l(\beta) = \sum_{i=0}^{n} \left[ y_i \log[1 - F(x_i'\beta)] + (1 - y_i) \log F(-x_i'\beta) \right] \] (2)

The Logit model obeys the logistic distribution:
\[ p(y_i = 1|x_i) = \frac{e^{x_i'\beta}}{1 + e^{x_i'\beta}} \] (3)

General form of the Logit model is as follows:
\[ p_i = G\left( \alpha + \sum_{j=1}^{m} \beta_j X_{ij} \right) = \frac{1}{1 + \exp \left[ - \left( \alpha + \sum_{j=1}^{m} \beta_j X_{ij} \right) \right]} \] (4)

4.2 Sample description statistics
Data from large supermarkets in Heilongjiang, residents of the area and part of the province of green food consumption more area investigation and. Details of the survey involved in the investigation of the family of basic information, family income, the purchase of safety awareness of green food and the safety of green food consumption behavior and other aspects of the detailed information. After several revisions, the author issued a total of 450 questionnaires, 421 questionnaires were recovered, the examination does not conform to the logic of the sample 53, a total of 368 valid questionnaires, the effective rate of the questionnaire reached 81.8%. The statistics of the basic survey sample are shown in Table 1.

<table>
<thead>
<tr>
<th>Item</th>
<th>Max</th>
<th>Min</th>
<th>Average</th>
<th>Standard deviation</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality safety</td>
<td>1</td>
<td>0</td>
<td>0.64</td>
<td>0.48</td>
<td>1</td>
</tr>
<tr>
<td>Gender</td>
<td>1</td>
<td>0</td>
<td>0.51</td>
<td>0.50</td>
<td>1</td>
</tr>
<tr>
<td>Age</td>
<td>4</td>
<td>1</td>
<td>2.63</td>
<td>0.83</td>
<td>3</td>
</tr>
<tr>
<td>Educational level</td>
<td>3</td>
<td>1</td>
<td>2.29</td>
<td>0.80</td>
<td>3</td>
</tr>
<tr>
<td>Price food</td>
<td>5</td>
<td>1</td>
<td>2.95</td>
<td>1.16</td>
<td>3</td>
</tr>
<tr>
<td>Quantity</td>
<td>4</td>
<td>1</td>
<td>2.53</td>
<td>0.76</td>
<td>2</td>
</tr>
<tr>
<td>Place</td>
<td>5</td>
<td>1</td>
<td>2.67</td>
<td>1.11</td>
<td>3</td>
</tr>
<tr>
<td>Package</td>
<td>3</td>
<td>1</td>
<td>2.24</td>
<td>1.16</td>
<td>2</td>
</tr>
<tr>
<td>Concern</td>
<td>6</td>
<td>1</td>
<td>3.38</td>
<td>1.46</td>
<td>4</td>
</tr>
<tr>
<td>Price food assessment</td>
<td>1</td>
<td>0</td>
<td>0.55</td>
<td>0.50</td>
<td>1</td>
</tr>
<tr>
<td>Price food increase reception</td>
<td>3</td>
<td>1</td>
<td>1.76</td>
<td>0.62</td>
<td>2</td>
</tr>
<tr>
<td>Security green food</td>
<td>4</td>
<td>1</td>
<td>2.48</td>
<td>1.04</td>
<td>3</td>
</tr>
<tr>
<td>Consumption influencing factor</td>
<td>6</td>
<td>1</td>
<td>2.27</td>
<td>1.01</td>
<td>2</td>
</tr>
</tbody>
</table>

At this stage of the green food market in the face of frequent emergence of green food quality and safety problems, this study designs the green food consumers of green food and the suffering of the market survey, in the "buy green food, worry about whether green food quality and safety," the survey, 44.6% of consumers said worry, 55.4% of consumers said not very worried, that most consumers still has not formed the green food quality and safety consciousness of suffering. At present, the price of green food in the green food market is generally low, and consumers in the survey also think so. In the current price of green food on Evaluation of the survey, 34.2% of consumers believe that the market the price of green food is low, 56.0% of consumers believe that green food price foods are moderate, only 9.8% of consumers green food price foods are too high, is outside the acceptable range. For at this stage, the vast majority of consumers think that the price
food of green food bear in the range, consumer survey for the quality and safety of green food paid to afford the highest price foods, the design problem of a price food increase to receive the degree of. The results showed that the quality of the safety of green food was higher than that of the ordinary green food price food range <50% consumers accounted for 80.2% of the total sample.

Consumers have an important role in the safety of green food consumers to choose the quality and safety of green food consumers. Therefore this study of consumers on green food understanding cognition degree and the quality and safety of green food cross analysis, the results of pollution-free, green, organic green food, the more understanding of consumers that is in line with the "Sanpin" standard is the quality and safety of green food. In the "buy green food, how to identify the quality and safety of green food, 32.6% of consumers think" brand green food is the green food quality and safety, brand effect to consumers with a suggestive role, 26.1% of consumers use look and comparison of "goods than traditional way" to choose, also labels indicate has a more important effect on consumers.

4.3 Estimation results

In this study, the logistic regression analysis was conducted to investigate the data of 368 green food consumers by using SPSS16.0 statistical software. The results of the model show that the log likelihood function of -2 times is 186.423, and the numerical value is smaller. At the same time, the NagelkerkeR2 is close to 1, so the model fitting degree is higher. In data processing, all of the explanatory variables are adopted in this study. After repeated adjustment and selection, the model is analyzed and the following results are obtained (Table 2).

<table>
<thead>
<tr>
<th>Item</th>
<th>Coefficient</th>
<th>Standard error</th>
<th>Wald outcome</th>
<th>Significance</th>
<th>Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Gender</td>
<td>4.788***</td>
<td>1.306</td>
<td>13.873</td>
<td>0.000</td>
</tr>
<tr>
<td>II</td>
<td>Place of purchase</td>
<td>-1.926***</td>
<td>0.415</td>
<td>21.547</td>
<td>0.000</td>
</tr>
<tr>
<td>II</td>
<td>Purchase concerns</td>
<td>0.639***</td>
<td>1.405</td>
<td>20.711</td>
<td>0.000</td>
</tr>
<tr>
<td>III</td>
<td>Market Worry Degree</td>
<td>0.089*</td>
<td>0.169</td>
<td>3.765</td>
<td>0.060</td>
</tr>
<tr>
<td>IV</td>
<td>Increase acceptance range</td>
<td>-0.825***</td>
<td>1.178</td>
<td>49.110</td>
<td>0.000</td>
</tr>
<tr>
<td>IV</td>
<td>What is the quality and safety of green food</td>
<td>0.614***</td>
<td>1.485</td>
<td>17.103</td>
<td>0.000</td>
</tr>
<tr>
<td>K</td>
<td>constant</td>
<td>29.074***</td>
<td>5.741</td>
<td>18.803</td>
<td>0.000</td>
</tr>
</tbody>
</table>

The influential factors for the individual characteristics of consumers in the consumer to consumers to buy green food quality and safety has the positive effect of the 1% significance level, that female consumers to buy green food pay more attention to the quality and safety of green food. Female consumers because of the unique serious, meticulous inner characteristics, items on the requirements are relatively high; at the same time, the majority of female consumers as the main person in charge of the family diet, on the health of family members has a more stringent standards and requirements, so buy green food meters will pay more attention to the quality and safety of green food, which is in line with consumer behavior rationality. In the influencing factors of the consumption characteristics, the attention points of green food buy place and consumers buy green food have a significant impact. Green food consumers purchase place on consumer purchase behavior of quality and safety of green food had a significant negative to influence by the 1% significance level, indicating that consumers consider the brand of green food shops selling green food quality and safety level is higher, were more likely to buy quality and safety of green food. When consumers buy Green food's concerns are significant at the 5% level, indicating that the purchase of green food on quality and safety information to consumers more willing to purchase green food quality and safety. In the market environment factors, the sense of the market through the significant level of 10%, the quality and safety of green food price food increases by 1% of the significant level. Consumers are aware of the quality and safety of green food in the existing market, but also hope to find the quality and safety of green food from the level and type of hybrid market.

Quality and safety of green food to accept the magnitude of the increase in consumer purchasing quality and safety of green food will decline in the behavior of green food. From the result of the model can be seen, price food increases an amplitude variable coefficient is negative, that with the quality and safety of green food price foods relative to the common green food rise amplitude bigger inhibition of consumer purchase behavior of quality and safety of green food, which is in line with the economics principle of elasticity of demand. Quality and safety of green food is not only to maintain the effectiveness of the life, but also to enable consumers to have a more healthy body, more energy to engage in social activities, has a strong external effect. Therefore, consumers on the quality and safety of green food to understand the more detailed, the more they want to buy quality and safety of green food. At the same time, the accuracy of the understanding of quality and safety of green food, will better guide consumers to buy quality and safety of green food.
5. CONCLUSION

This study based on consumers' purchase willingness of green food quality and safety and its influencing factors empirical analysis, the conclusions are as follows: green food consumers to buy green food quality and safety will affected by gender, green food place to buy, buy green food attention, degree of the suffering of the market, quality and safety full price food for green food to accept the influence of amplitude and the quality and safety of green food degree of understanding factors. Different factors influence and affect the direction of each in a different way. Specifically, women often in franchise stores to buy green food, buy green food attention to safety and quality, with strong green food market consciousness, can bear larger quality and safety of green food price food accepted range, on the quality and safety of the green food to understand the profound and clear understanding, has the characteristics of consumers to buy quality and safety of green food a greater willingness. Green food as a consumer's necessities, and other agricultural products, consumers have a higher level of quality and safety, more stringent requirements. According to the above analysis, the author puts forward the following suggestions: first, according to the consumer characteristics of individual characteristics and location, to buy green food points of concern to the green food market segmentation, develop differentiated marketing strategy of the quality and safety of green food; second, starting from the consumer awareness and the quality of the price food point of view, should strengthen the supervision of green food market, beware of fake the security market is flooded with fake green food, the implementation of high quality strategy, in order to foster harmonious green food market; third, through various publicity channels, shaping the quality and safety of green food quality image, so that consumers are fully aware of the ecological value of the quality and safety of green food, in order to improve the quality and safety of consumers to buy green food willing.

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