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*Research Article*

# Consider on Risk Forecast and Safety Management of Agricultural Product Production Outsourcing Based on Internet of Things Technology

**Yeming Qiu,[1,2] Jing Zhou ,[1] and Liqiang Tang[3]**

[1]*College of Economics and Management, Shenyang Agricultural University, Shenyang, 110000 Liaoning, China*
[2]*College of Economics, Bohai University, Jinzhou, 121000 Liaoning, China*
[3]*School of Management, Bohai University, Jinzhou, 121000 Liaoning, China*

Correspondence should be addressed to Jing Zhou; zhoujing@stu.ahu.edu.cn

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Risk prediction refers to a measure that predicts and formulates countermeasures to prevent accidents from occurring during the work process and work results before work. With the development of the global economy, fresh agricultural products, as one of the agricultural products with the largest daily consumption, will have a serious impact once a problem occurs. The emergence of Internet of Things technology makes the supply of agricultural products in more forms to the market. This article analyzed the related literature about agricultural calendar year outsourcing research; the scholars have identified factors influencing the quality of security screening and classification, common process and characteristics of domestic agricultural products outsourcing, standing in the perspective of external environment and internal processes, from the natural environment of supply chain, the production processing, transportation, circulation, and marketing chain. The factors that may affect the quality and safety of fresh agricultural products were identified, and the risk assessment index system was finally determined. Then, the risk of risk index is evaluated from the perspective of six attributes of risk; that is, the risk of each risk index is considered from the possibility of occurrence, loss caused, infectivity, mitigation, controllability, and predictability, rather than just the possibility and loss of risk. Finally, the system evaluation data shows that the stability of the system is as high as about 80, indicating that the system has a good stability.

## 1. Introduction

Since China's accession to the WTO, our country's agricultural product import and export trade has been showing a double growth trend. With the increasing frequency of foreign trade, the quality and safety of agricultural products has become borderless. In recent years, due to the increase in environmental pollution, the quality and safety of agricultural products has never been as serious as it is now. Although the government is very concerned about the quality and safety of agricultural products, incidents of pollution and unsafe quality of agricultural products still occur frequently. In fact, developing countries should pay more attention to PRA (pest risk analysis) measures and their applications. This is because the global annual trade value of agricultural products is 580 billion US dollars, and the value of agricultural products trade is 400 billion US dollars. Among the 500 million tons of agricultural products, 75% of agricultural products are exported to developed countries, and more than 50% of fruits, vegetables, sugar, and nonalcoholic beverages are provided by developing countries. Therefore, the quality and safety of agricultural products have gone beyond the agricultural products themselves and have become a major issue related to society, econoour, and people's livelihood. The current quality and safety of outsourced agricultural products have attracted great attention and close attention from governments at all levels of our country, the general public, and related scientific and technological workers. It is urgent to solve this problem.

The main reason is that it not only provides an effective guarantee for the safety of agricultural products. This will not only have a serious negative impact on consumers' buying confidence, but also have a negative impact on consumers' purchasing power. But it also threatens people's daily food security. In the context of the continuous progress, the use of advanced technology not only improves the overall quality of agricultural production, but also improves transportation efficiency. Risk management is the key link of agricultural product supply chain management. Only by mastering the laws of agricultural product risk development can we effectively prevent and avoid risks and promote the steady development of supply chain networks. Through risk assessment, the use of relevant index factors to establish a risk assessment system, to give the supply chain risk research scientific and systematic, and to provide new ideas and new methods for the risk identification and risk prevention of the agricultural product supply chain from a new perspective.

At present, with the repeated occurrence of the quality of agricultural product outsourcing, many researchers have begun relevant research work in this area. Vandergeten E described the experience of developed countries in China. And combined with the current situation of our country to analyze the existing problems of the current agricultural product traceability system, and use the Internet of Things technology to create a new agricultural product traceability system, but there is not enough research to solve the root cause of this problem [1]. Materia VC conducts a detailed analysis of the construction and operation of the agricultural product quality and safety system of the Internet of Things and then proposes a construction and implementation plan based on the actual situation. The agricultural product safety control system based on the Internet of Things ensures that the Internet of Things technology is scientific and reasonable, while improving the efficiency and quality of agricultural products. The supervision, safety, and applicability of this type of research are not very good [2]. Sun D is a feasible and effective method. Through measures such as attaching electronic labels to products, the quality control and safety of agricultural products can be strengthened, and a governance system compatible with "market access" and "origin" can be created to achieve quality and safe progress. The source control gate realizes that the whole process of agricultural products from the place of production to the processing, including consumers, is effectively supported and monitored, but the research has been trying to keep up with the pace of the times [3]. In response to many problems in the field of agricultural production and supply safety, LIU uses the Internet of Things, 3G/3S, and advanced technologies to establish agricultural production informatization and provide a safe process control platform with independent intellectual property rights. The platform can realize the production, supply, distribution, transaction, and intelligent control of the entire traceability process. And this system is outdated in today's 5G era [4]. Nero ME takes the design of agricultural product safety traceability system as the research object. The research showed that big data, big platform, big technology, and other methods test the three hypotheses needed to verify product quality and the safety traceability of agricultural products' Internet operators and generate five hypotheses through regression analysis. This model has been verified, but the final test results did not achieve the expected effect [5]. Man NB understands the basic concepts and key features of the Internet of Things and analyzes and studies its impact on food security governance. Determine the specific measures for using the Internet of Things technology to monitor food security, and discuss the practical significance of applying the Internet of Things technology to food security governance. The impact is that it can effectively deal with food security issues, but the analysis of the problem is not in-depth and detailed [6]. Pereira Sánchez uses the modern technology of the Internet of Things to use the rapid detection of agricultural products. The LIMS automated agricultural product testing laboratory system starting from the soil heavy metal detection and agricultural product quality and safety detection system explores new concepts of agricultural product quality control and safety, but new research the method is not mature enough to be applied [7].

This paper takes the safety supervision system of outsourcing agricultural products based on the Internet of Things technology as the research theme. Based on the analysis of the safety supervision system of outsourcing agricultural products and based on the application of the Internet of Things technology and the information needs of different entities outsourcing agricultural products, it analyzes China's outsourcing agricultural products. Based on the current status of safety supervision and informatization, this paper analyzes the shortcomings of the application of IoT technology in the field of outsourcing agricultural products and then investigates consumers' safety information needs for outsourcing agricultural products through questionnaires, starting from the business of outsourcing agricultural products operators to optimizing the regulatory process. The application platform, the national outsourcing agricultural product safety supervision information platform, the outsourcing agricultural product safety credit system platform, and the outsourcing agricultural product safety emergency response platform are designed in four aspects to support the realization of a comprehensive framework system for outsourcing agricultural product safety supervision based on the Internet of Things technology, and propose corresponding development suggestions to provide a certain reference and reference for the application and promotion of the Internet of Things technology in the safety supervision of outsourcing agricultural products.

## 2. Introduction to Related Concepts and Theories

*2.1. Introduction to the Internet of Things.* The Internet of Things is an important force in the information industry. Its application will promote the accelerated development of the industry, liberate the productive forces, and promote the full speed development of the world economy [8–10].

China is a large agricultural country, and agriculture, as the primary industry, plays a decisive role in economic development. Since the Ninth National Congress of the Communist Party of China, China has emphasized the priority development of agriculture and rural areas and promoted the process of agricultural modernization. Therefore, it is of practical significance to apply the Internet of Things technology to the marketing of agricultural products to promote China's economic development.

Common object devices have some important characteristics. Automatic terminal connection and generalized service intelligence have two meanings: first, the core and foundation of the Internet of Things are still the Internet. It is an expansion and expansion network based on the Internet. Second, the user's endpoint is extended and extended to any list and item to carry data. Therefore, the definition of the Internet of Things is to connect ubiquitous endpoints and facilities through RFID and various wireless or wired communication networks to establish connections between them. Realize functions such as online monitoring, positioning and tracing, alarm linkage, dispatching and commanding, plan management, remote control, and security protection. The perception layer is the eyes of the Internet of Things, which is responsible for identifying objects and collecting information, including QR code tags and readers, RFID tags and readers, and cameras, GPS, sensors, terminals, and sensor networks, which combines with the industry's needs to achieve extensive intelligence [11, 12]. Its structure flow chart is shown in Figure 1:

The above has used a simple example, the intelligent management of warehouse and logistics operations, to show the consistent relationship with the core technologies at all levels of the Internet of Things. Once the purchasing department generates a receipt, the items to be put into the warehouse are electronically marked (EID) with the attributes of the items, and the Eid data is scanned on any link within the warehouse and stored in the Eid database and is moved and delivered. Issuing and counting any Eid reader deployed in the warehouse will know the changes of Eid data within the scope, send the Eid data to the middleware and middleware through the network layer, and locate the name resolution server object (ONS) 120 using the Eid data to obtain the network address of the Eid database of the article, and then, the middleware will search the Eid database to obtain the information of the article. Once the data is converted, M2M program will be used to supplement the so-called agricultural Internet of Things, that is, to obtain data such as crop growth and production rotation through technology. Through intelligent agricultural information technology, planting and crop management, animal husbandry, and livestock and poultry fertilization are the basic elements of agricultural production. Improving agricultural production capacity and promoting comprehensive rural reform, the application of Internet of Things technology in agriculture has not only changed the mode of comprehensive agricultural management, but also improved the ability to prevent animal and plant epidemics, ensure the quality and safety of agricultural products, and lead the development of modern agriculture [13].

*2.2. The Meaning of HACCP and the Control of Key Points in Each Link.* The HACCP system is an internationally recognized and accepted food safety assurance system, mainly for the safety control of microbial, chemical, and physical hazards in food. The Food and Agriculture Organization of the United Nations and the World Health Organization began to strongly recommend this food safety management system in the late 1980s. The fields of HACCP system include drinking milk, cream, fermented milk, lactic acid bacteria beverages, cheese, raw noodles, tofu, fish ham, and egg products. HACCP (hazard analysis and critical control points) represents hazard analysis and critical control points. It is a strong and systematic agricultural product quality assurance system. It has tight structure, strong adaptability, and significant advantages. It was first proposed by NASA in 1959 for special situations. Control the processing places or processing points that may be dangerous in the manufacturing process. The control process shall include the processing, storage, and transportation of raw materials to consumption. In 1972, the international codex commission on agricultural products (CAC) decided to promote the use of HACCP system in agricultural production management regulations to control the safety and health of various agricultural production processes. Agricultural product manufacturing, agricultural product preparation, and rotation and retention are considered to be three key links, and one or two key points are determined in each link. Implement appropriate prevention and control to achieve health and agricultural product safety objectives. Agricultural production: comply with the provisions of the national agricultural product safety law and the national agricultural product safety and quality law. The agricultural administrative department is responsible for supervising and managing the agricultural production process. Agricultural products refer to agricultural products, fruits and vegetables, livestock, poultry, fish, and other products planted or raised. Pesticides, veterinary drugs, animal feed, and additives shall be the main control points affecting health and agricultural product safety [14, 15].

The layers other than the input layer and the output layer are called hidden layers, and the hidden layers do not directly receive signals from the outside world, nor do they directly send signals to the outside world. Determine the number of hidden layer nodes. The role of the hidden layer in the BP neural network is to establish the mapping relationship between the input layer and the output layer. How to determine the proper number of hidden layer nodes is critical to the accurate operation of the network. If the number of nodes is too small, the learning process may not be able to converge to the global minimum, or it may get unsatisfactory training results and poor adjustment. On the contrary, if the number of nodes is too large, it will cause problems such as too cumbersome network calculation and long running cycle. In order to set a reasonable number of neurons in the hidden layer and ensure the generalization ability of the network, based on previous research experience, one is usually achieved by the "trial and error method"; that is, a smaller value is first given, according to the training results, the minimum number of neurons in the hidden layer

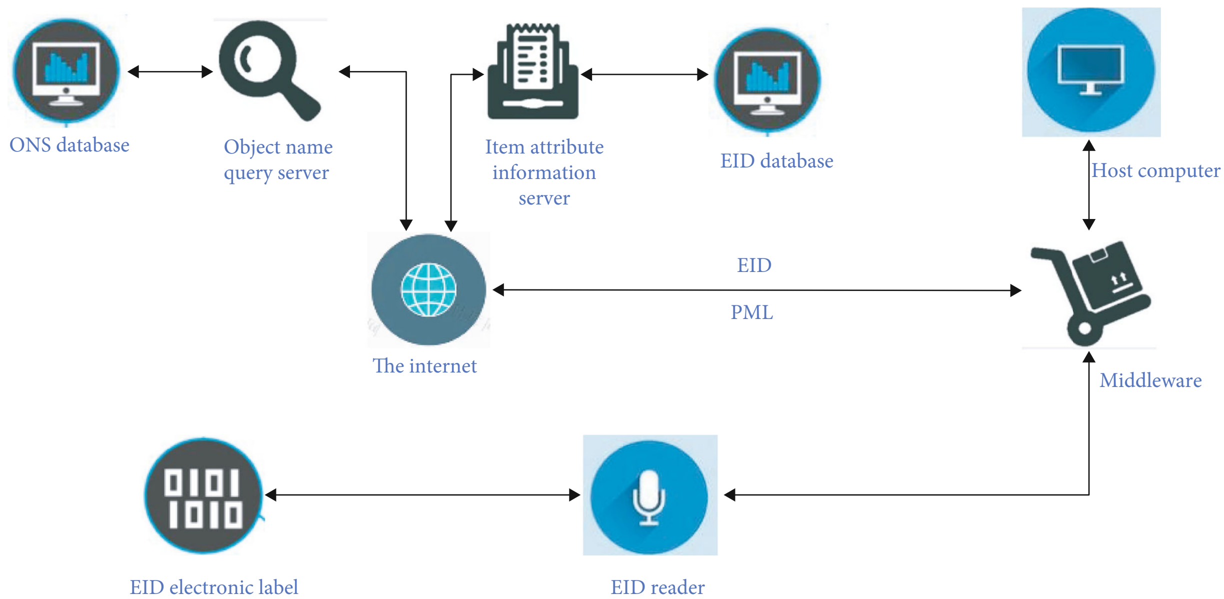


Figure 1: Schematic diagram of the Internet-based process structure.

of the model can be found, thereby improving the stability of the network. The second is to quote some empirical formulas; the common formulas are as follows:

$$m = \sqrt{n + l} + a, \tag{1}$$

$$m = \sqrt{nl}, \tag{2}$$

$$m = \log_2 n, \tag{3}$$

$$m = \frac{n + l}{2}, \tag{4}$$

where $m$ is the number of hidden layer nodes, $n$ is the number of input layer nodes, 1 is the number of output layer nodes, and $a$ is a constant, usually less than 10. Formula (4) is commonly used. In this paper, the number of nodes is finally determined to be 7 based on the following experiments.

BP neural network is a multilayer feedforward network trained by error back-propagation algorithm, and it is one of the most widely used neural network models. BP network can learn and store a large number of input-output pattern mapping relationships without revealing the mathematical equations describing this mapping relationship in advance. Its learning rule is to use the steepest descent method to continuously adjust the weights and thresholds of the network through backpropagation to minimize the sum of squared errors of the network.

The mathematical relationship of each layer is as follows: for the output layer, there are

$$\begin{aligned} O_k &= f(\text{net}_k) k = 1, 2, \cdots, l, \\ \text{net}_k &= \sum_{f=0}^{m} w_{jk} y_j \, k = 1, 2, \cdots, l. \end{aligned} \tag{5}$$

For the hidden layer, there are

$$\begin{aligned} y_i &= f\left(\text{net}_j\right) j = 1, 2, \cdots, m, \\ net_j &= \sum_{i=0}^{n} v_{ij} xi \, j = 1, 2, \cdots, m. \end{aligned} \tag{6}$$

When the network output is not equal to the expected output, the output error is $E$:

$$\begin{aligned} E &= \frac{1}{2}(d - O)^2, \\ \frac{1}{2}(d - O)^2 &= \frac{1}{2}\sum_{k=1}^{i}(d_k - O_k)^2. \end{aligned} \tag{7}$$

Expand the error $E$ in the hidden layer; there is

$$\begin{aligned} E &= \frac{1}{2}\sum_{k=1}^{l}\left[d_k - f(\text{net}_k)\right]^2, \\ \frac{1}{2}\sum_{k=1}^{l}\left[d_k - f(\text{net}_k)\right]^2 &= \frac{1}{2}\sum_{k=1}^{l}\left[d_k - f\left(\sum_{f=0}^{m} w_{ij} y_j\right)\right]^2. \end{aligned} \tag{8}$$

Further expand in the input layer; there are

$$\begin{aligned} E &= \frac{1}{2}\sum_{k=1}^{l}\left\{d_k - f\left[\sum_{f=0}^{m} w_{jk} f(\text{net}_j)\right]\right\}^2, \\ \frac{1}{2}\sum_{k=1}^{l}\left\{d_k - f\left[\sum_{f=0}^{m} w_{jk} f(\text{net}_j)\right]\right\}^2 &= \frac{1}{2}\sum_{k=1}^{l}\left\{d_k - f\left[\sum_{f=0}^{m} w_{jk} f\left(\sum_{i=0}^{n} v_{ij} x_i\right)\right]\right\}^2. \end{aligned} \tag{9}$$

Gradient descent may not be able to find the global optimal solution; it may be a local optimal solution. Of course, if the loss function is a convex function, the solution obtained by the gradient descent method must be the global optimal solution. The error $E$ can be changed by adjusting the weights. The error is continuously reduced by adjusting the weight. The adjustment of the weight is proportional to the gradient of the error, that is

$$\Delta w_{jk} = -\mu \frac{\partial E}{\partial w_{jk}} \; j = 0, 1, 2, \cdots, m \, ; k = 1, 2, \cdots, l, \tag{10}$$

$$\Delta v_{ij} = -\mu \frac{\partial E}{\partial v_{ij}} \; i = 0, 1, 2, \cdots, n \, ; j = 1, 2, \cdots, m. \tag{11}$$

In the formula, the negative sign represents the gradient descent, and the constant $\eta \in (0,1)$ represents the proportional function, which reflects the training rate. For the output layer, formula (10) can be written as

$$\Delta w_{jk} = -\mu \frac{\partial E}{\partial w_{jk}} = -\mu \frac{\partial E}{\partial net_k} \frac{\partial net_k}{\partial w_{jk}}. \tag{12}$$

For the hidden layer, formula (11) can be written as

$$\Delta v_{ij} = -\mu \frac{\partial E}{\partial v_{ij}} = -\mu \frac{\partial E}{\partial net_k} \frac{\partial net_k}{\partial v_{jk}}. \tag{13}$$

Define an error signal for the output layer and the hidden layer, let

$$\begin{aligned} \delta_k^0 &= -\frac{\partial E}{\partial \text{net}_k}, \\ \delta_j^y &= -\frac{\partial E}{\partial \text{net}_j}. \end{aligned} \tag{14}$$

It can be seen that the three eigenvalues of the cloud model skillfully combine ambiguity and randomness to form a qualitative (concept in discourse domain > membership degree of attribute value in discourse domain) knowledge base. The bell-shaped cloud model is the most common type of cloud, and it is also the most basic method for describing fuzzy concepts. As shown in Figure 2, there are also various forms such as half-falling clouds and half-rising clouds, which means that there is a specific one-sided feature or its expected value is a range of linguistic values [16]. Cloud model is the specific implementation method of cloud, and it is also the basis of cloud-based computing, reasoning, and control. It can represent the process from qualitative concept to quantitative representation and can also represent the process from quantitative representation to qualitative concept.

*2.3. Characteristics of Agricultural Product Outsourcing Supply Chain.* The supply chain of fresh agricultural products puts forward very high requirements on the level of logistics technology. Fresh agricultural products are inherently perishable, seasonal, and difficult to store, which determines that fresh agricultural products have relatively high requirements for environmental conditions. Therefore, the supply chain is highly dependent on the level of logistics technology. However, at this stage, our country's cold chain logistics technology started relatively late, and it is difficult to achieve a balance in temperature and cost control. Therefore, there is a lot of room for development. The cold chain logistics management also needs to be further improved, as shown in Figure 3 for agricultural products. The outsourcing security control inspection diagram is shown in Figure 3:

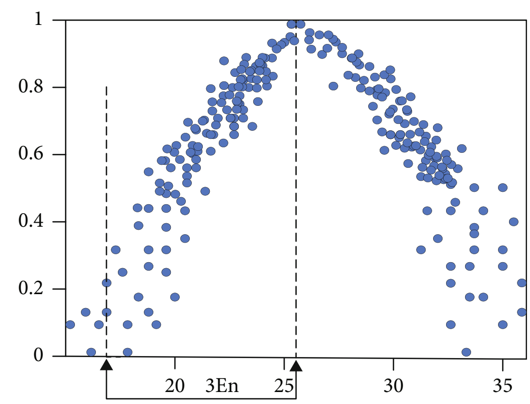


Figure 2: General cloud model.

The information transmitted in the fresh produce supply chain is not equal. There is a disconnection between consumption and production in our country's fresh agricultural product supply chain, resulting in very scattered distribution of supply and demand information. Independent production farmers usually do not understand the demand on the market, resulting in an imbalance between supply and demand. At the same time, there is also asymmetric information on agricultural product safety. In addition, there is little cooperation between enterprises, and information on product quality and safety is often not shared. The agricultural product supply chain is like a rolling network chain, transporting agricultural products from farmers at the starting point to consumers at the end and passing through nodes such as processing companies, wholesalers, retailers, and distribution centers on the way. Different links and organizational carriers constitute the agricultural product supply chain, as shown in Figures 4 and 5.

This article divides the fresh agricultural product supply chain into three links, namely, production and processing links, transportation and circulation links, and sales links. The production and processing links are mainly through the input of agricultural inputs, such as chemical fertilizers, pesticides, and seeds, and then the next step of planting or breeding fresh agricultural products. Fresh agricultural products will encounter animal and plant diseases in addition to the natural environment during the growth process. Fresh agricultural products must be ready to enter the market when they are mature; that is, they enter the transportation and circulation stage [17, 18]. Since fresh agricultural products usually do not need to be processed or undergo

Figure 3: Agroproduct safety monitoring map.

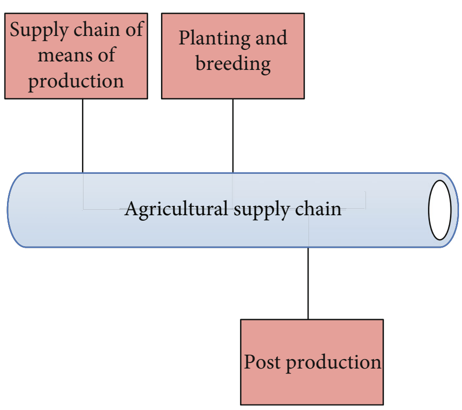


Figure 4: Logical structure diagram of agricultural product safety monitoring the supply link of the means of production (seeds, feed suppliers) → the production link of the planting and breeding industry (farmers or production enterprises) → postproduction packaging, transportation, processing, storage, and sales links → consumer. The agricultural product supply chain is compared to "seeds→ agricultural products" in foreign countries, and "fields→ dining table" in China. These factors all belong to the situation of information asymmetry, which increases the probability of the occurrence of risks in the fresh agricultural product supply chain.

preliminary processing, some of the fresh agricultural products that require preliminary processing are initially processed in a certain part of the transportation and circulation links, such as cutting and cleaning, so the product is involved in the preliminary processing hygiene in the process. In addition, when the finished products of fresh agricultural products enter the market, they will go through special transportation and storage. Therefore, the environment where the fresh agricultural products are located during transportation and storage will have a direct impact on the quality and safety of the products. Because the shelf life of fresh agricultural products is too short, some illegal businesses may illegally add some additives or excessive use of additives during transportation and circulation. But before entering the market, they may be subject to random inspections by relevant departments. Any inadequate sampling inspection or low level of sampling inspection technology will make it unqualified. Products flow into the sales market, bringing huge hidden dangers to consumers [19]. The sales market of fresh agricultural products is rather mixed, and it is inevitable that there will be situations where hygiene is not up to standard. Table 1 shows the supervision departments that the agricultural product transportation chain passes through.

## 3. Agricultural Product Outsourcing Risk Analysis and Model Establishment

*3.1. Agricultural Product Safety Issues.* Data acquisition refers to the automatic acquisition of nonelectricity or electric quantity signals from analog and digital units under test such as sensors and other devices to be tested and sent to the host computer for analysis and processing. The data acquisition system is a flexible, user-defined measurement system combined with measurement software and hardware products based on computers or other special test platforms.

Although the European HACCP system is very sound, there are still incidents like poisonous cucumbers, which show that there are still shortcomings in the implementation. The safety of agricultural products is an interlocking overall concept that needs to be guaranteed step by step from "farm to table". HACCP is a systematic method to confirm, analyze, and control the biological, chemical, and

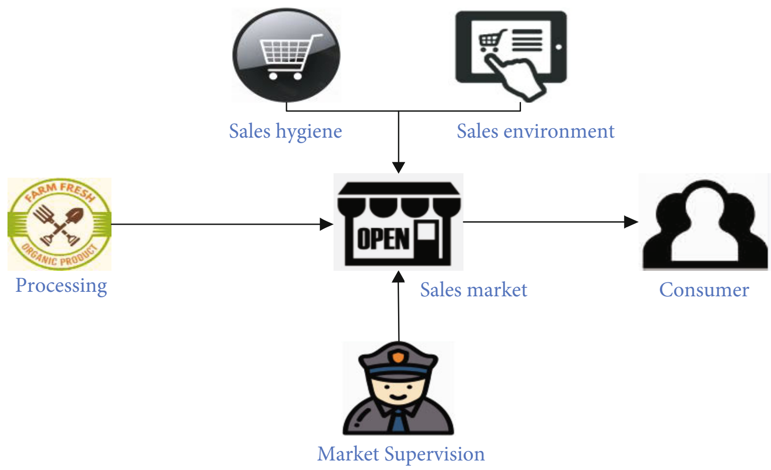


Figure 5: Schematic diagram of the agricultural product supply chain process.

Table 1: Regulatory authorities in the agricultural product chain.

| Regulatory authority | Planting/ breeding | Production and processing | Operating circulation | Food and beverage consumption |
|---|---|---|---|---|
| Food Safety Commissioner | | | | |
| State Food and Drug Administration | | √ | √ | √ |
| National Health and Family Planning | | √ | | |
| Ministry of Agriculture | √ | √ | | |
| General Administration of Quality Supervision | | √ | √ | √ |
| Administration for Industry and Commerce | | √ | √ | √ |
| Ministry of Commerce | √ | | | |

physical hazards that may occur during the production process. But it is worth mentioning that HACCP is just a prevention system, not zero risk; it is preventive, not reactive [20]. Even if some agricultural products are produced in accordance with the current good production practices, the key point detection meets the HACCP requirements, but there are still hidden safety hazards that are malicious or difficult to prevent such as genetic mutations. The hidden hazard risk function diagram in recent years is shown in Figure 6.

The specific questions are as follows:

(1) The entire process of farming, production, and transportation of agricultural and sideline products is not fully monitored.

HACCP has unique advantages in the analysis of "anatomical sparrows" on the hazards of agricultural product safety. The problem is that the hazards that endanger the safety of agricultural products are by no means limited to existing experience and knowledge. In recent years, agricultural product safety accidents have emerged one after another, and companies have privately added illegal additives during processing [21]. For example, in the production of agricultural products, industrial use of Sudan red heart eggs is added to poultry breeding; in the processing of agricultural products, chrysanthemums are fumigated with sulfur, and milk products added with melamine cause kidney stones in infants. Agricultural products supervision departments cannot detect these hazardous substances. It is also difficult to "prevent problems before they happen." Therefore, the agricultural product production and processing units that pursue the maximization of economic benefits are equipped with a full process monitoring system, and RFID scanning technology is used for electronic filing of pesticides and additives. The Internet-based agricultural product quality traceability table is shown in Table 2:

(2) There is a lack of a "firewall" to actively prevent malicious damage in all links from the production of agricultural products to storage and transportation.

The unfair competition of economic interests drives the perpetrators to take illegal and unethical means to damage the competitors' products and their quality, and the harm will occur. A large number of eaters died: Many competitors sneak into the production line to add illegal additives for the purpose of smearing each other's reputation, resulting in the death of a large number of diners. Therefore, an intrusion alarm mechanism needs to be added to the agricultural product supervision system to prevent man-made sabotage [22].

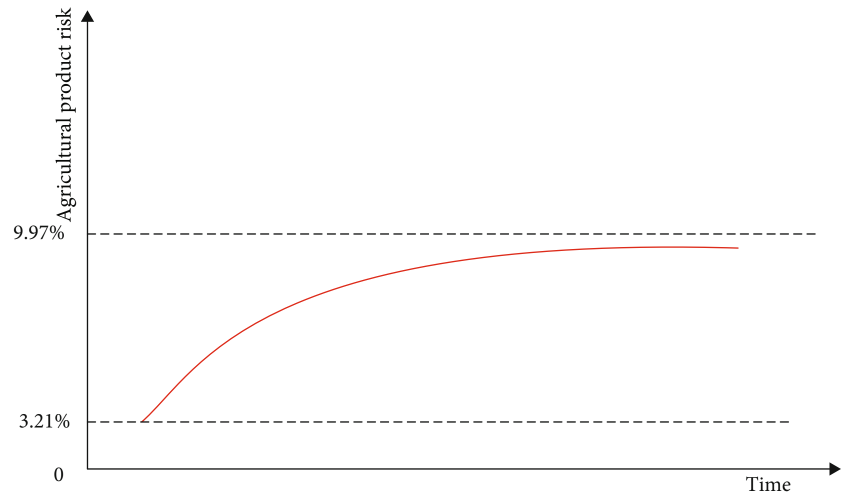


Figure 6: Agricultural product risk rate and time function diagram.

Table 2: Analysis of traceability information on the quality and safety of agricultural product production links based on the Internet of Things.

| Serial number | Retrospective content | Traceability data | Index reference value |
|---|---|---|---|
| 1 | Basic information of production enterprises such as farmers | Name, organization code, legal representative, telephone, address, etc. | — |
| 2 | Information on the quality and safety of agricultural products during planting | pH value, temperature, humidity | Refer to NY 5010-2002 |
| | | Pesticide and bacteria content | Refer to NY 5010-2002 |
| | | Hormones, antibiotics, etc. content | If not used, fill in "none" |
| | | Harm prevention time and method | — |
| | | Specific symptoms | Specific manifestations of agricultural products when they are sick |
| | | Treatment methods and effects | Detailed treatment methods and specific medication effects |

(3) The HACCP system does not pay enough attention to the destruction of agricultural products and the production of restaurants.

Since the state legally recommends this system to the whole society, it should bear the burden of improving the safety of agricultural products; otherwise, it will lose its meaning. The current HACCP system basically does not consider agricultural product destruction and restaurant production and its risks and ignores its important impact on agricultural product safety. This is a major flaw. For example, milk products containing melamine have not been completely destroyed, and some have returned to second- and third-tier cities; the use of waste oil is widespread in some small- and medium-sized restaurants, endangering the health of customers [23]. This kind of agricultural product safety hazards is not currently included in the HACCP system, and there is an urgent need for a complete supervision system. This supervision system is shown in Figure 7:

*3.2. Agricultural Product Safety Management.* Establishing a fast and unobstructed traceability system, strengthening the tracking of each link in the entire process of agricultural product quality and safety, finding the cause, tracing the source of infection, improving the efficiency of agricultural safety supervision, and reducing the cost of traceability are extremely important. According to our country's major shortcomings in the establishment of a traceability system for agricultural product quality and safety, the following specific measures should be taken to improve:

(1) Tracking management of large-scale agricultural enterprises and production enterprises should be implemented, and each agricultural product produced should be labeled; each label has an independent bar code and established its information file. The traceability system is a preventive response measure that can detect risky products in time based on the information on agricultural products and the information connection between each producer and

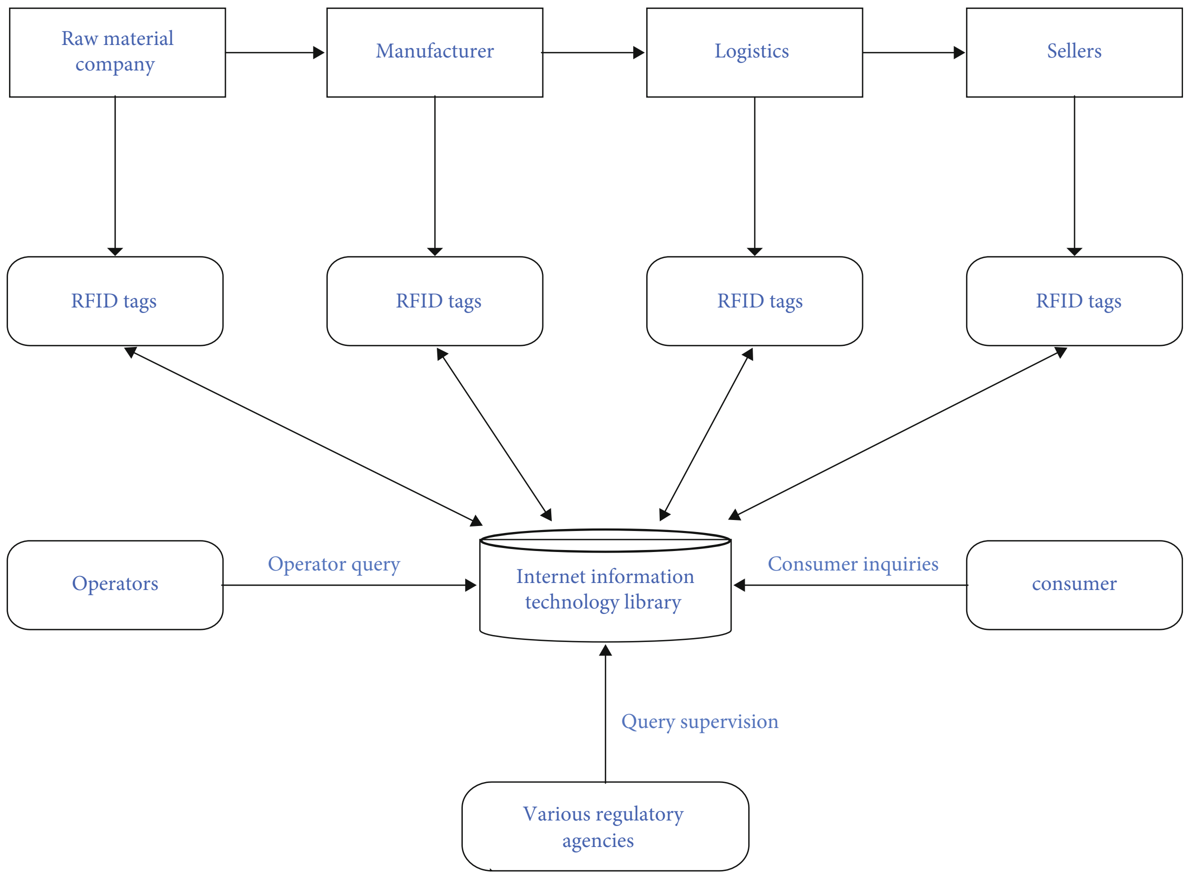


Figure 7: Agricultural product chain supervision system.

immediately withdraw from the market [24, 25]. Therefore, strict agricultural product labeling and corporate identification systems, standardizing product packaging, and establishing and improving information networks are the core technical links in implementing product traceability and transparency systems. The risk safety factor of outsourced agricultural products is shown in Figure 8:

From the data in Figure 8, it can be seen that the risk safety factor range of outsourced agricultural products 1 is between 20% and 35%, and the risk safety factor range of outsourced agricultural products 2 is between 16% and 32%.

(2) The principle of openness and transparency should be implemented for the occurrence of major agricultural product infectious diseases or major agricultural product quality safety incidents. This is the basis and prerequisite for establishing a traceability system for agricultural product quality and safety, as well as identifying the source of quality and safety problems and tracing the causes of the problems. It is necessary to distinguish the nature of the problem and the responsibility

(3) Through the perfect agricultural product quality and safety organization system, build an organizational network of "supermarkets, specialty stores + leading agricultural product processing enterprises + intermediary service organizations + farmers," and strengthen the exchange of records and information between units through the establishment of "order plus sales and safe supply contracts." Transparency enables all links of production, processing, and marketing to unite to form a community of interests. This is conducive to the establishment of agricultural product epidemic prevention and agricultural product quality and safety guarantees. Even if quality and safety problems arise, it is also convenient to find out which link and which unit the problem occurs, which is conducive to changing our country for a long time. Disorderly and unrecorded transactions between various agricultural-related entities have led to the issue of unknown responsibility and difficulty in traceability. Table 3 shows the organization of agricultural products supervision in Japan:

(4) Through the time stamp of the origin of agricultural products by the agricultural product enterprises, the original records of agricultural products processing and preservation, together with the origin trademark, label, and production date, this is conducive to the identification and selection of products by consumers; the quality and safety problems of agricultural products can be quickly checked through the computer primary products and origins of

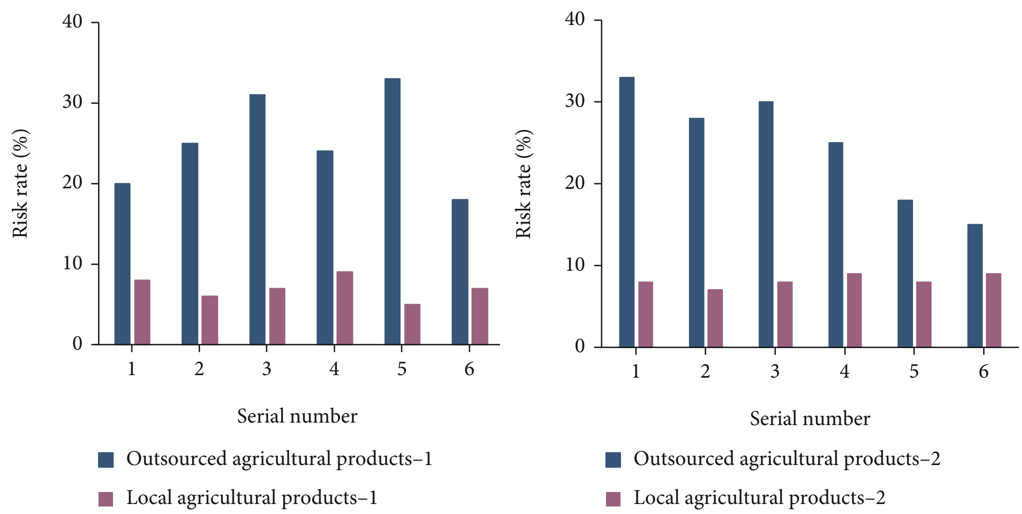


Figure 8: Proportion of onset time distribution of children in NEC group.

Table 3: Japanese food safety regulatory structure.

| Food Safety Committee | |
|---|---|
| Ministry of Rural and Fisheries | Ministry of Health, Labor, and Welfare |
| Consumer Security Bureau | Food Sanitation Council |
| Food, agriculture, rural policy review | Food hygiene supervisor |
| Consumer Security Bureau | Medicine and Food Bureau |

agricultural products; for processed agricultural products that have passed their expiration date and are unsafe, they can be forcibly withdrawn from the market after inspection and announced to consumers; for defective agricultural products and agricultural products, relevant companies are ordered to implement a recall system and rectify within a time limit [26, 27].

(5) In the farmer's market, we must explore new models for properly organizing the quality and safety of agricultural products from merchants, individual vendors, family workshops, and street vendors who have been operating agricultural products for a long time

*3.3. Agricultural Product Safety Monitoring System.* Relying on HACCP key control point technology, security technology, and Internet of Things technology, establish a large platform integrating agricultural product quality inspection and supervision information resources. Realize the combination of key point detection and full process monitoring and tracking, prehazard prevention, supervision information, and integration of monitoring and detection, and gradually form a unified and scientific agricultural product safety information evaluation and early warning indicator system, and timely study and analyze the agricultural product safety situation. Realize function:

(1) Video monitoring throughout the entire process: The system can conduct a full range of video monitoring and multiscreen real-time video browsing for the cultivation, animal husbandry, production, processing, storage and transportation, circulation, restaurant cooking, and destruction of agricultural products, so as to realize the monitoring of each link. In addition, for inspection agencies, they can retrieve on-site video recordings by time or batch number of agricultural products to collect suspicious information or clues

(2) Intrusion alarm: Every staff member needs to pass the RFID identification of the access control. An unauthorized intruder will trigger the alarm device and send an alarm to the monitoring personnel. At the same time, the scene image will be switched for automatic tracking

(3) Agricultural product control based on HACCP key point technology: all agricultural product additives (including pesticides, feed, chemical additives, and biological additives) need to be scanned by RFID and backed up to the back-end data center [28]. The HACCP plan in the system can compare various indicators of agricultural products with standard thresholds and provide correction schemes. The comparison chart is shown in Figure 9:

(4) Agricultural product safety information sharing: A variety of information can be provided to third-party organizations such as the government, agricultural product enterprises, and mass agricultural product industry organizations to achieve data

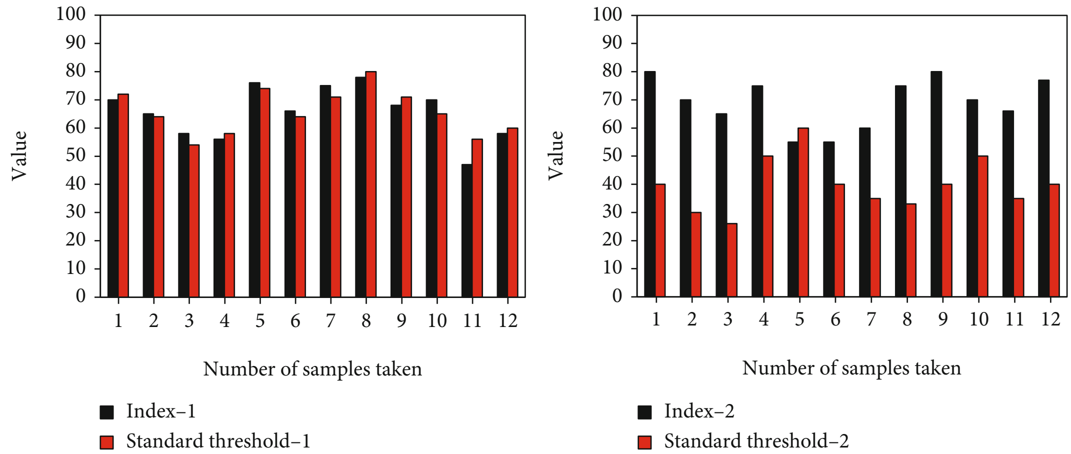


Figure 9: Comparison of various food indicators and standard thresholds.

interaction between various organizational structures and consumers. The government can disseminate corporate video surveillance data through the agricultural product safety information platform and provide online disclosure of government agricultural product safety activities. Through the information platform, consumers can intuitively observe and control agricultural products in the circulation process

(5) Agricultural product safety data tracking: CCTV and card readers can automatically record the flow of agricultural products during the entire rotation process. The data is stored in the IoT data control system that supports mass storage and maintenance, which can provide consistent and efficient information and search mechanism identification search, audit data, traceability, and analysis

(6) Security management: It has complete user rights and record management mechanism, so the security of the system is ensured, and the requirement for the corresponding system functions are user management, role management, and folder management

(7) Resource management: Comprehensive resource management of system resources uses cameras, video walls, and image storage

For the HACCP plan management subsystem, this system customizes HACCP management plan for enterprises. Each product has a detailed HACCP plan and forms a standard management system. The plan includes the reconstruction of key point control and the reconstruction of key thresholds. Companies can also change the HACCP plan for certain agricultural products according to the market changes in the current season. The system structure table is shown in Table 4:

## 4. Results and Data Analysis

*4.1. Risk Prediction Data Analysis.* Through the identification and analysis of risk factors above, the risk index system for risk evaluation is finally established. Risk evaluation is to evaluate the risk of risk factors, which is also one of the necessary steps for risk management in the supply chain [29]. In the research of relevant literature over the years, it is found that the methods often used when assessing the risk of supply chain risk factors include analytic hierarchy process, fuzzy comprehensive evaluation, BP neural network method, and OWA operator. In risk assessment, qualitative and quantitative methods are usually combined; that is, risk identification is performed first, and then, risk factors are quantified based on the results of risk identification. The actual risk and the predicted risk are compared as shown in Figure 10:

Through the analysis of risk, it can be found that risk contains two most basic attributes, namely, the loss and possibility of risk. Loss here not only refers to economic loss, but also includes time and reputation, which is a comprehensive loss. These are also two attributes that most scholars often consider when conducting risk assessments, namely, the use of the product of the loss caused by the risk and the probability of occurrence of the risk as the data of the risk value. On the basis of influence and possibility, three attributes of controllability, mitigation, and predictability are added, and three attributes of hazard, possibility, and controllability are added. The four attributes of controllability and infectiousness are used to evaluate the influence of risk factors. Among them, the impact and the harmfulness refer to the loss caused by the risk. When evaluating supply chain risks, many scholars seldom consider the attributes of risks in depth, but roughly evaluate the magnitude of risks directly from a single aspect. As scholars continue to study supply chain risks, they have discovered that the attributes of risk are not only loss and possibility, but also contain more abundant content. Therefore, it turns out that it is not scientific enough to rely on only two attributes for risk evaluation. Taking into account the other attributes of risk, four types of attributes are currently found: infectiousness, controllability, mitigation, and predictability. After studying the literature, it is found that risk assessment based solely on these two attributes of risk is not comprehensive enough. This article uses the improved triangular fuzzy number

Table 4: System architecture.

| | |
|---|---|
| Application set | Data mining and storage, intelligent business analysis, and other data analysis and processing methods |
| Middleware | Data analysis smart component |
| Communications network | Wide area network, local area network |
| M2M hardware | Embedded communication hardware |
| Machine | Modification of the machine |

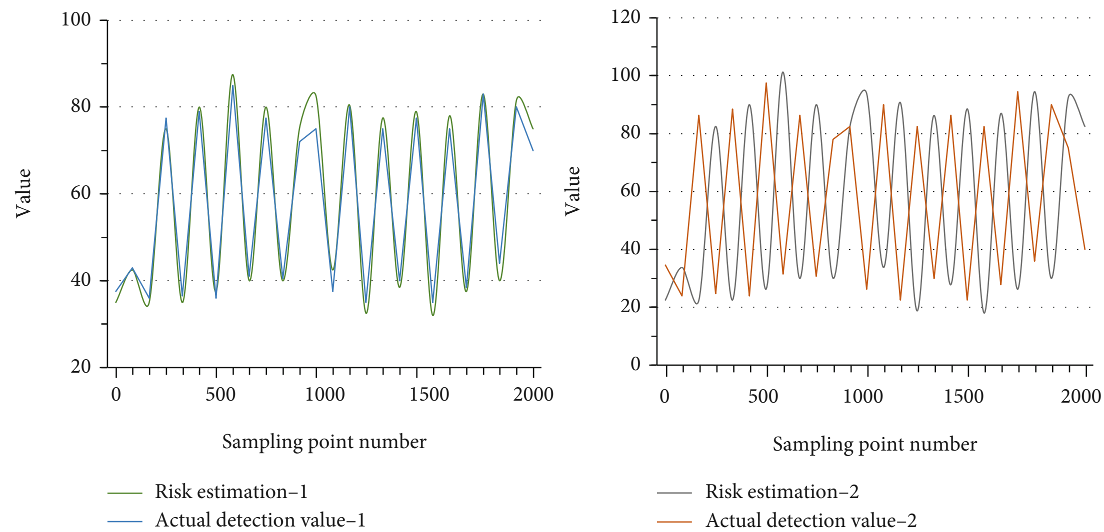


Figure 10: Actual and predicted risk map.

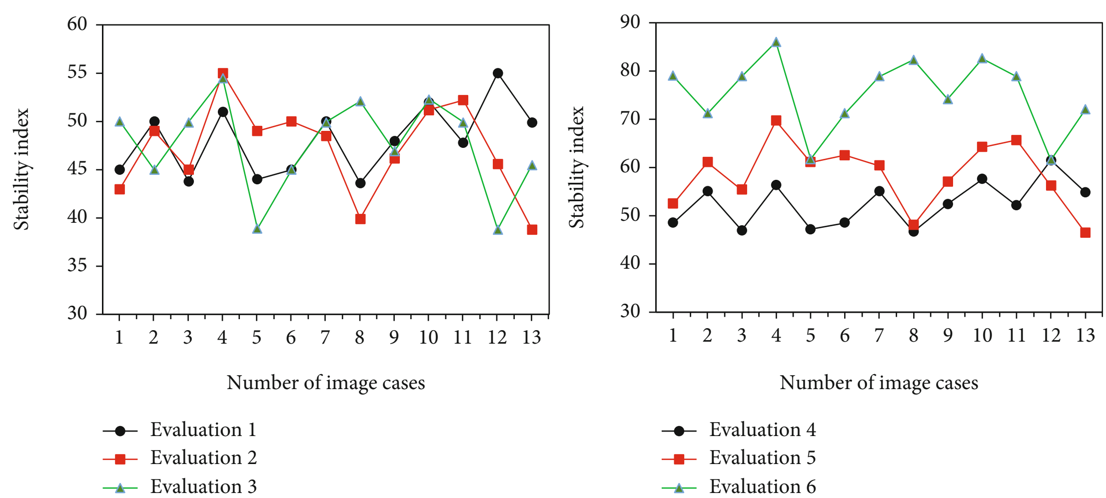


Figure 11: The evaluation curve of the agricultural product safety management system.

analytic hierarchy process to determine. As for the score data of each risk indicator in these six attributes, it is determined by the expert's scoring situation, and then, the expert's scoring situation is transformed by the corresponding relationship with the three-scale fuzzy number, and finally, the fuzzy TOPSIS method is used to combine each attribute to calculate the risk of each risk index.

*4.2. Evaluation of Agricultural Product Safety Management System.* At present, the Internet integrates a variety of Internet of Things technologies to realize agricultural product information based on exchanges; an optimized comprehensive framework system for agricultural product safety supervision will be constructed. In the previous research, it has been pointed out that the comprehensive framework system for agricultural product safety supervision must be realized and applied by relying on advanced Internet of Things technology, comprehensively using the information collected through sensing devices into the agricultural product safety supervision platform system, in order to give full play to the supervision. Information sharing platforms for law enforcement agencies, business application platforms, and consumer information query systems are all important platforms for completing the integrated management system. Figure 11 shows the evaluation curve of the agricultural product safety management system.

Strengthen the construction of the security guarantee system for the Internet of Things. Due to the risks of the agricultural product supply chain in the Internet of Things environment, a scientific and comprehensive security guarantee system needs to be established to enable close cooperation between supply chain partners, reduce industrial chain cost risks, and realize the Internet of Things environment, through the use of the Internet of Things, sensor networks, mobile traceability terminal equipment, and communication technology, improve the economic benefits of the agricultural supply chain, establish an agricultural product quality and safety archive, and realize the tracking of the entire process of agricultural product production and turnover. Through the use of data transmission, data collection, data and information retrieval, link aggregation, verification of agricultural origin, and other related functions, traceability and responsibility positioning can be better. On this basis, the quality and safety of agricultural products can be better guaranteed. It can be seen in the data graph that in the sixth evaluation, the average rate of system stability reached about 80 about; it shows that the system has a very good stability.

## 5. Conclusion

The risk of agricultural products mainly lies in the false deduction of purchase invoices. The countermeasures are as follows: improve the invoice approval system, verify the authenticity of purchase invoices, use the traceability system for the origin of agricultural products, and strengthen daily inspections by administrators. This thesis uses the theoretical knowledge of ecology, sociology, and economics and adopts a combination of qualitative analysis and quantitative analysis and a combination of normative research and empirical research. On the basis of literature review and extensive collection of data, the Internet technology is used to conduct research on risk prediction and safety management of agricultural product outsourcing, and the relationship between agricultural product quality and safety and pest risk analysis is also studied, and the pest risk analysis is summarized. The evaluation method of the risk analysis and evaluation method is used to establish a loss evaluation model and measurement method for the impact of the invasion of fake agricultural products on our country's econoour, so that people can understand the economic loss caused by the introduction of pests in the process of economic development in a timely manner and intuitively improve the public's image awareness of nature protection. Due to the relationship of risk attributes, select appropriate risk assessment methods, and introduce them in detail. Then based on this method, the weights of the six attributes of risk are determined, and the risk assessment model of the fresh agricultural product supply chain is established. Apply the established risk assessment model in practice to obtain the risk values of 6 risk indicators, and sort them to obtain the corresponding risk assessment results, and then, analyze the rationality of the assessment results according to the actual situation, thereby verifying the assessment model reasonableness. In the follow-up research, it is hoped that several methods can be systematically compared to verify the best method suitable for risk assessment of our country's agricultural product supply chain.

## Data Availability

No data were used to support this study.

## Conflicts of Interest

The authors declare that there is no conflict of interest with any financial organizations regarding the material reported in this manuscript.

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