Research on Self-constructed Traceability System Based on Agri-food Supply Chain Management

Shouping Gui, Fei Wang, Zhiyong Zhang, Lei Yang
Department of Logistics Engineering and Management
School of Economics and Commerce, South China University of Technology
Guangzhou 510006, China
E-mail: feiwang@scut.edu.cn

Abstract: ***At present, some of our agri-food products with quality issues, not only turmoil in domestic, but also had credit crisis in the international community. A number of food export enterprises have also been implicated in. Based on agri-food supply chain management, agricultural products retailers or food processing enterprises establishing traceability systems voluntarily is not only a strong guarantee for the quality of products, but also companies can own in the market. But the domestic researches are mostly based on macroeconomic environment and policy, lacking of guiding for the corporate. This paper discusses the existing problems during companies establishing the traceability systems voluntarily, and constructs a better theoretical model. After further analysis we proposed the relevant recommendations for the system's implementation.***

Key words: Agri-food supply chain; Traceability system; Food safety; Identification system

I INTRODUCTION

On September 2008, China's outbreak of Sanlu infant milk powder contamination incident, milk powder was mixed with melamine, leading to the infants who milked the contaminated formula have kidney stone diseases. Without timely reporting, and to the public, “Sanlu” leaded to the final events irreparable.

In similar circumstances, at March 2007, a pet food manufacturing company named "menu" to wrote a letter the United States Food and Drug Administration(FDA). The letter said that 14 pets had suddenly dead after eating their company's products. The company actively recalled the related products about 100 kinds of immediately, and identified the security incident caused by melamine with the assistance of FDA. Finally, under the menu company's active treatment, the storm halted.

Both events are melamine-induced food security crisis. The two companies deal with different practices, access to a different conclusion. We can see that the "menu" company has a complete traceability system to complete product recalls, as well as to trace the source, and finally ultimately preserve the corporate reputation and brand. On the contrary, without traceability system, "Sanlu" lost its own brand, but also affected the credibility of the entire Chinese dairy industry. Discredit Chinese food in the international community once again.

Traceability system plays an important role in the food processing enterprises. This paper basing on the supply chain system leading by the food processing enterprises would discuss problems of self-constructing and issue the countermeasures for the related companies.

II RELETED RESEARCH

Around the 80's emerged the concept of supply chain management, since the 90's became a hot research. From the early 90’s, study the United States grocery stores in crisis based on supply chain management began to carry out the concept of agriculture supply chain and food supply chain. The agri-food supply chain can be simplified as shown in Fig. 1.

Codex Alimentarius Commission and the International Organization for Standardization defined "traceability" as "…ability to trace the history, application or location of an entity by means of recorded identifications”. Therefore, a traceability system may relate to: The origin of materials and parts; the product processing history; and the distribution and location of the product after delivery.

Foreign scholars’ studies show that the main body to set up traceability systems should be enterprises rather than government. Jill E. Hobbs (2004) assumed that there are three options for the enterprises, self construct, enforce to set up by the Government, or do nothing. The research results show that the self-constructing systems earn highest, and the mandatory systems cost highest and gain smallest. Elise, Golan (2001) consider a mandatory system will increase the cost of enterprises, resulting in unnecessary waste.

Domestic scholars did various research on traceability systems. CHEN Hong-hua et al (2007) built an afterwards traceability model in game theory, to discussed recommendations to set up traceability system. QIAO Juan et

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al (2007) analyzed the importance and restrictive factors to build up traceability system. YUAN Tao (2007) initially completed the construction of the system. Cao jiang-tao(2007), has clarified the principle, methods and the implement key point for building the information management system about edible farm produce safety. However, these proposals are too macro, lack of Specialized comments for enterprises which prepared to self-construct a traceability system.

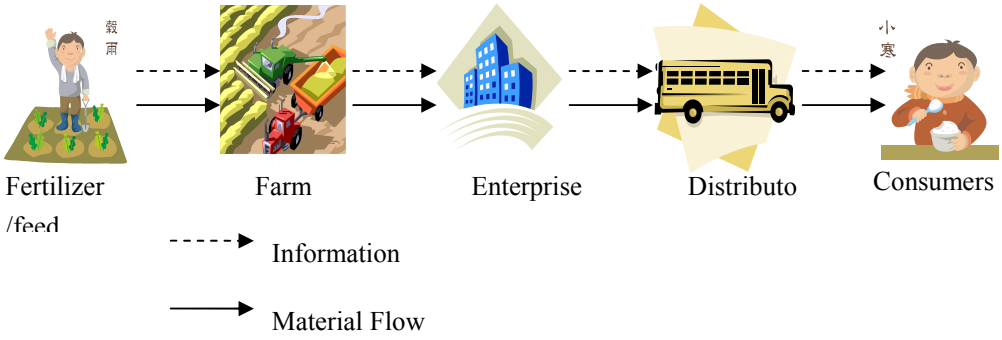

Figure1: The simplified agri-food supply chain

III SELF-CONSTRUCTED TRACEABILITY SYSTEM

A. *Advantages of Self-constructed Traceability System*

Agricultural enterprises constructing traceability systems actively are very beneficial to the enterprises themselves, mainly expressed by the following aspects:

1) Enhance consumer confidence

The most significant advantage is to improve the confidence of consumers. When consumers understand the systems, the society has a higher acceptance of the safe food. For example, when a food crisis happened, the storm would spread to the whole industry. Enterprises have constructed traceability systems can declare that their products have quality assurance, to avoid the loss of customers.

2) Lower Recall Costs

Many foreign enterprises have set up their own traceability system based on supply-chain, once found the existence of food safety or quality problem, we can respond quickly to take appropriate measures (e.g. the downstream product recall, etc.), to avoid negative impacts to the enterprises brand and themselves. Traceability system based on the food supply chain help enterprises master “where the food comes from” and “where the products go to”. It shortens the time of problems identification and recall effectively, thereby reducing costs.

3) Ensure the Products’ Quality.

In fact, this is a function of the traceability system: tracing upward. Agri-food processing enterprises master the more comprehensive information from upstream suppliers, the easier to control the quality of processed products, such as chemical fertilizer, pesticide, plant / breeding environment and livestock’s immunity. As a result, the enterprises can reduce the risk of a Food safety crisis at source. Some enterprises with high technology-based systems can record the information more comprehensive, and carry out more stringent quantitative and qualitative management.

4) Improve Sales

Food or agricultural products as one kind of commodities has its uniqueness. Consumers should not make a full assessment about its quality, even after use may not be able to immediately discover its problems. After setting up the system, Enterprises can create a Info-search platform or traceability terminal within the appropriate scope. Consumers can query the relevant information (for example, genetically modified food, food production, etc.), which are not readily available before and help consumers to better distinguish between the quality of food and agricultural products. With some promote of the system, sense of identity between consumers will build up bit by bit. Finally, the enterprise will get not only a fair return, but also a consumer trusting brand.

B. *Problems*

1) Lack of a Unified Identification System

At present, China has not yet set up a unified identification system. At the international level, the EAN • UCC system prepared by EAN International was used more widely. The European Union prepared the "beef labeling law" base on it. Downstream meat products manufacturers and consumers should be able to get the relevant information of all aspects by the bar code, to ensure that the meat food safety and quality. And some stages of China's agricultural supply chain didn’t use identification systems, and the other use different systems, which blocks the information flow in the entire supply chain, useless to construct the traceability system.

2) Low level of agricultural modernization

In China, level of agricultural modernization is still low and still accounts for a small number of large-scale farms. It relates to China's large population and the national conditions. But it hinders the preparation of agricultural production standards, and results in the uneven quality of agricultural products. It will be difficult to promote the traceability system in the supply chain, particularly to the upstream farmers.

3) High Initial Investment

Some enterprises only see the cost of the system required, and did not see its earnings. Therefore little enterprises build the systems actively. In fact, traceability system is a long term system, which must be the future trend. After a certain time, the system will earn back for the enterprises.

C. Theoretical Model

The theoretical model of traceability system can be expressed by Fig. 2. In a simplified agri-food supply chain, the first stage is the fertilizer or feed suppliers, next is the farmers. Enterprises are the third stage, which purchase the harvesting agri-food for processing. The finished products go to the consumers by the distributors. The information flow based on traceability system is expressed by the dotted lines. The members of the supply chain upload the information to a unified database by the product identification (such as electronic ear tags, RFID, etc.). They also can read the related information from the database. Consumers can query through the network for more information of their purchase. When crisis occurs, the enterprise can be known about the flow of product direction immediately through the database, then recall the Product in the hands of retailers and consumers in time. At the same time, relevant information would be uploaded to the database, so that consumers and retailers can be known.

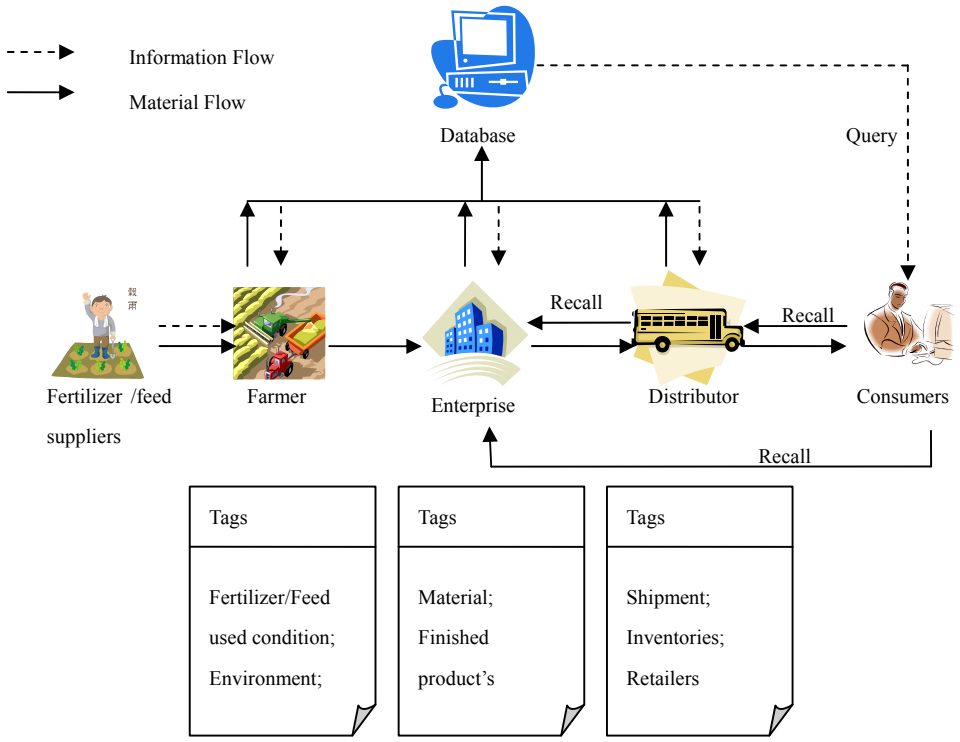

Figure2: The theoretical model

D. Strategy of Self Construction

1) To push ahead the establishment of third-party organization

The third-party organizations between farmers and enterprises can speed up the establishment of a unified identification system of agricultural products, so as to the traceability system. In addition, being concerned with China's current situation, there are still many scattered small-scale farmers. It's difficult for these small producers to participate in the system.

Third-party professional organizations can strengthen small-scale farmers and the market to assist their production standardization, and integration into the agricultural supply chain. In particular the leading enterprises in the supply chain once set up a system, it require for its upstream suppliers to use the same system for the smooth coordination of supply chain. The third-party organizations can provide technical support for small farmers, and help them upload information to the database.

2) Analysis Cost and Benefit of the System

The system's cost can be divided into hardware and software costs. Hardware costs include the expenses on PCs, tag readers, as well as tags. The software costs include the cost of human resources and training costs. It can be expressed by the formula as:

$$TC = \sum_{i=1}^{n} S_i \times D_i + P_L \times Q_L + W \times (T_L + T_I) + TRC$$

S_i: the cost of the system facilities
D_i: depreciation rate of the facilities, equals to one minus the residual value divided by the useful life
P_L: unit cost of tags
Q_L: the number of used tags (different with total product sales)
W: the hourly wages of employees
T_L,T_I: annual Product labeling and information collected time
TRC: the costs of training

The system's majority proceeds are invisible. For instance, consumers are willing to pay a higher purchase price for the traceability food. The system can also increase product sales, enlarge market share, break trade barriers. We can use qualitative methods for evaluation. In this article, the total revenue includes the gains for the higher price and the earnings from reducing the rate of food crisis. It expresses as follow:

$$\mathrm{TR} = (P_1 Q_1 - P_0 Q_0) + L \times (r_0 - r_1)$$

P_1: the improved price after system setting up
P_0: the original price
Q_1: sales after the implementation of the system
Q_0: sales before the implementation of the system
L: average loss in crisis of the food industry
r_0: average rate of food safety crisis
r_1: average rate of food safety crisis after the implementation of the system

3) Promote the System to Seize the Market Gaps

As a marketing strategy, enterprises in the implementation of system should vigorously publicize the system effects to the public. For the increasingly rate of food safety crisis, food with quality assurance is more and more welcomed by the consumers. For example, enterprises can be modeled on Japan's practice in the supermarket, such as terminal settings can be found, so that consumers can self-check information about the agricultural products or food. When public acceptance reaches a certain degree, consumers would rely on the comprehensive information, so that the market share will increase.

IV SUMMARY

In this paper, how to self-construct a traceability system for agricultural products processing enterprises based on supply chain management were studied. We drew the following conclusions:

(1)Consumers have ever-increasing demands on the quality of food. As the heart of a food supply chain, setting up a traceability system voluntary is particularly necessary for the food processing enterprises. However, domestic studies of traceability system are mostly about macroeconomic environment and policy, and lack of guidance for enterprises' self-constructing.

(2)In China's national conditions, problems of self-constructing still exist, including a lack of a unified identification system, and small-scale farmers; and in the enterprises conditions, the initial investment is too high, and the lack of public awareness of the system. In response to these questions, this paper designed a theoretical model about self-constructed traceability system for enterprises.

(3) Refer to the theoretical model, we bring out strategies for the enterprise: push ahead the establishment of third-party organization, Analysis cost and benefit of the system and promote the system to seize the market gaps.

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