Research on the Optimization of Agricultural Supply Chain Based on Internet of Things

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Abstract. Technology of IOT which used in agricultural supply chain can help to improve operational efficiency and reduce supply chain costs. This paper analyzes the basic structure of agricultural supply chain, current status of the research, and summarizes major obstacles of the development process. The paper also describes application of IOT principle, as well as agricultural supply chain optimization approach based on internet of things, including agricultural production, processing, transportation and sales process. The results show that: integration and information management through IOT can reduce logistics costs and improve circulation efficiency and effectiveness. The government should develop policies to achieve agricultural internet of things, improve efficiency of agricultural supply chain operations.

Keywords: Internet of Things, Agricultural Supply Chain, Status Analysis, Optimization.

1 Introduction

The development of agriculture in China is backward. Farmers' income is low. The reasons are varied. One important reason is the circulation of agricultural supply chain is poor. Major agricultural supply chain process is from initial production to consumption of agricultural products. Among them, the core business is the main component, related to information flow, capital flow and logistics, etc. (main structure shown in Figure 1). Agricultural supply chain is characterized by many volume, broad area, the strong timing requirements of agricultural spending, more agricultural supply chain departments, more staff.

In recent years, agricultural supply chain has been developed rapidly. However, due to starting late, the development faces many difficulties, such as the backwardnesses of rural logistics infrastructure, low level of technology, lag agricultural supply chain standardization system and operation mode, weak administrative details and other issues, led to agricultural supply chain operational efficiency low. At present, optimization research of agricultural supply chain is less. As Wamba(2006)[1] used radio frequency identification (RFID) technology which be applied to the integrated food supply chain to replace bar code recognition technology , builded management information system. Bottani(2009)[2] used IOT to coordinate logistics and information flow, improve the integrated food supply chain management and reduce its cost. Thiesse(2009)[3] established a system through IOT, which assess the quality of agricultural products and processed products "from farmers to table". Li Jianwei(2011)[4] analyzed the specific application of

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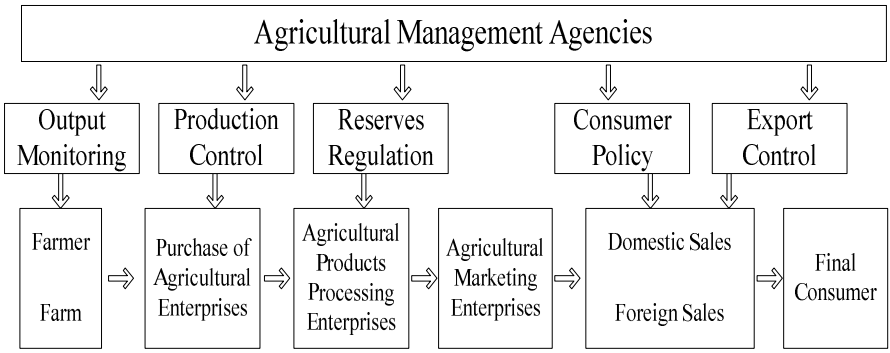

Fig. 1. Structure of Agricultural Supply Chain

IOT in agricultural production and farming, transportation, inventory, sales, and information management and other aspects. Liu Xuemei(2011)[5] analyzed the agricultural supply chain system according to recent incidents of food safety problems, effectively promoted the rapid development of agricultural supply chain. Zhou Hang(2011)[6] studied optimization of the food supply chain relies on IOT. Based on the above, we find that on agricultural supply chain research domestic and foreign scholars has focused on macro-level, multi-round concept, circulation system and other conditions and policy analysis, failed to put forward efficient optimization method. The rapid development of computer technology provides a solution to improve the efficiency of agricultural supply chain operations process. The development of IOT accelerates the progress of this trend.

2 Internet of Things

In 1999, MIT professor proposed IOT (Internet of Things). The purpose of IOT is to form a system of production and living smarter. IOT is defined as follows: through two-dimensional code reading equipment, radio frequency identification (RFID) devices, infrared sensors, global positioning systems and laser scanners and other information sensing device, according agreed protocol, it connects the Internet for information exchange and communication in order to achieve intelligent identify, locate, track, monitor and manage a network.

The structure of IOT can be divided into three layers: the perception layer, network layer and application layer. Perception layer is constituted by a variety of sensors, including temperature and humidity sensor, two-dimensional code label, RFID tags and readers, camera, GPS and other sensing terminals. Things perception layer is used to identify objects and collect information sources. Network layer is constituted by a variety of networks, including the Internet, wide network, network management systems and cloud computing platforms. It is the hub of things, responsible for transferring and processing information obtained by perception layer. IOT application layer is the interface of IOT and user. It combines with the industry needs to realize the intelligent application of IOT.

3 Optimization of Agricultural Supply Chain Based on IOT

3.1 Status Analysis

In recent years, our governments develop agricultural supply chains vigorously. The total amount of agricultural products logistics is growing. In the total social logistics, the importance of IOT is increasing, mainly reflected in the sensitivity to the customer, quality of life and social macro adjustment. From Figure 2 we can see that the total agricultural product logistics increased steadily year by year, as of 2010 reached 2.2355 trillion. However, the growth rate of agricultural logistics is relatively large, indicating that agricultural supply chain is vulnerable to be influenced by economic conditions and other external factors. The stability of the supply chain is poor.

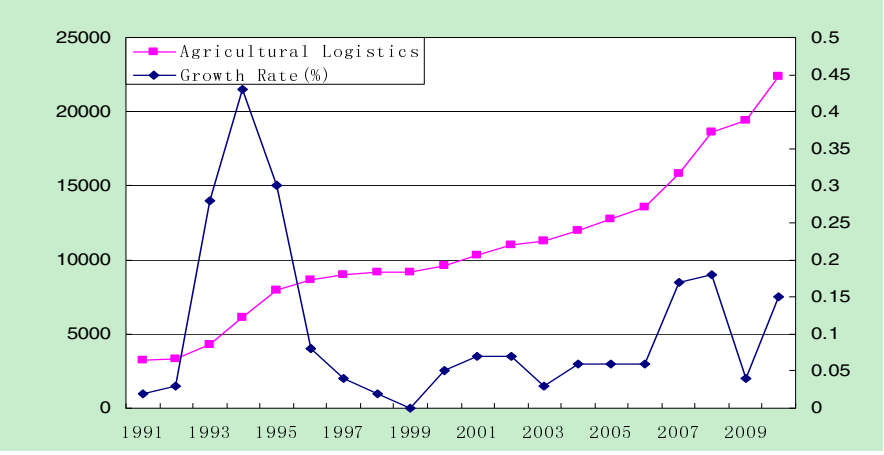

Fig. 2. Amount and Rate of Growth of Agricultural Product Logistics

Because development of agricultural supply chain is not perfect, its level of development is far behind developed countries. As shown in Table 1.

Table 1. Main Economic Indicators

	Cost	Loss rate	Processing Proportion	Value-added Processing	Proportion of Supermarket Sales
Developed Country	10%	5%	80%	1:4	80%~95%
China	40%（Food） 60%（Fruits and Vegetables）	15%（Food） 25%(Fruits and Vegetables）	10%	1:0.8	Less than 30%

3.2 Main Problems

In production, agricultural supply chain depends on natural conditions, environmental and human factors obviously. The Production is different from traditional industrial products and services; it has a universality and dispersion of consumption. Logistics is burdensome: Because diversity of market demands, this production led to a regional agricultural need in different areas. Perishability of agricultural products increases with distance and time, which limits the development of its circulation. Technology of agricultural logistics is backward: The rural logistics infrastructure and equipment are backward, technical conditions can not meet market demand. Given the low level of development of logistics technology, the level of mechanization of processing and packaging products is low and does not meet the conditions for the transport of agricultural products, processing, packaging, processing, and other terms. Uncertainty of market is big: Because agricultural production, consumption and market dispersion, we can not fully grasp market information, market volatility is a big settlement. In rural economic restructuring, the non-standard supply chain operations easily lead farmers to produce blindness. Input costs of agricultural supply chain are high: In order to ensure that products meet quality requirements of consumption and consumption, we need to take necessary measures in the circulation to strengthen asset specificity.

3.3 Applications of IOT in the Agricultural Supply Chain

The impact of IOT is enormous. Application of IOT can optimize agricultural supply chain facilities, inventory, transportation, information and procurement and other sectors, as well as manage agricultural production, transportation, consumption and other sectors, reduce supply chain costs, and achieve highly agile supply and fully integrated.

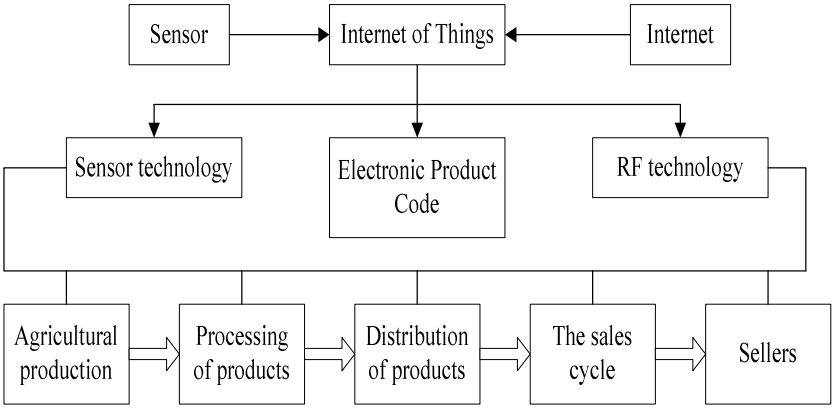

Fig. 3. Logistics Network Application in Agricultural Logistics

(1) Improve the overall construction of IOT: Putting IOT, sensor network, and internet together, using Sensor technology, electronic product code, radio frequency technology, we can accurately understand and grasp from procurement, manufacturing, handling, storage, transportation, distribution, sales to the service supply chain each link, reducing the agricultural supply chain in the "bullwhip effect" exists.

(2) The application in the process of production: IOT can solve problems that accord to the manufacturer's requirements to operate, the operation is not higher transparency in traditional agricultural production. In the procurement of raw materials, IOT can tag encoding, establish database, and monitor products throughout the entire production process, including current temperature, humidity and the corresponding operators, all entered into the database to make it clear process prone to risks.

(3) The application in the process of transportation. IOT improves the efficiency of transportation greatly. First, this can realize visualization of the transport, agricultural transport vehicles are scheduled timely, try to avoid invalid transport. Second, the use of RFID tags can provide temperature monitoring, achieve agricultural vehicle dynamic perception, dynamic monitoring of the quality and safety of agricultural products. Again, IOT can dynamically acquire all cold storage inventory and in-transit traffic conditions in order to make transportation decisions science to achieve an effective cold chain logistics of agricultural products circulation.

(4) The application in the sales process: it reads information of product automatically through embedded tags using RFID, monitors the quantity and inventory quantity of goods, adds goods and deals expired products timely. The use of IOT can monitor the supply of goods and sales progress, determine the amount of purchase according to the proportion of sales.In the customer checkout time, we use radio frequency technology to shorten the time for the items of information literacy, improve the efficiency of the customer's purchase and checkout.

(5) Application of the supply chain information transfer: For any one of the agricultural supply chain node enterprises, from the origin to the pin, using IOT you can understand the production of raw materials, processing conditions, who is responsible for inspection, storage warehouse, the current agricultural position, the current storage environment conditions and so on. IOT through effective information technology achieve a blending between man and agricultural.

4 Conclusions

This paper analyzes the basic structure of agricultural supply chain, current status of the research, and summarizes major obstacles of the development process. The paper also describes application of IOT principle, as well as agricultural supply chain optimization approach based on internet of things, including agricultural production, processing, transportation and sales process. It can promote the development of agricultural products logistics industry through modern agricultural logistics and networking technologies, change the practical problems of rural logistics problems. The government should develop policies to achieve agricultural IOT, specify IOT "perception of agriculture" direction, play an active role on the optimization of agricultural supply chain.

References

[1] Fosso, W.S., Ygal, B., Lefebvre Louis, A., Elisabeth, L.: RFID technology and the EPC network as enablers of mobile business: a case study in a retail supply chain. International Journal of Networking & Virtual Organisations, 450–462 (2006)
[2] Eleonora, B., Roberto, M., Andrea, V.: The impact of RFID and EPC network on the bullwhip effect in the Italian FMCG supply chain. International Journal of Production Economics, 426–432 (2009)
[3] Frederic, T., Cosmin, C.: RFID data sharing in supply chains: What is the value of the EPC network? International Journal of Electronic Business, 21–43 (2009)
[4] Li, J.: Research on the Optimization of Agricultural Supply Chainunder the Background of Internet of Things. Journal of Henan Agricultural Sciences 8, 10–12 (2011)
[5] Liu, X., Li, T.: Agricultural Supply Chain Risk. Agricultural Economics 1, 47–48 (2011)
[6] Zhou, H., Sun, H.: The Research on Integrated Grain Supply Chain Management Based on Internet of Things. Chinese Agricultural Science Bulletin 7, 315–317 (2011)