On Construction of Supply Chain System for China's Modern Agricultural Products

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Abstract In view of drawbacks in supply chain of China's traditional agricultural products, this paper proposed building supply chain system for modern agricultural products; taking informationization as basis, channel system as core, organization system as support, and service system and safety system as guarantee, to promote high efficient operation of the supply chain system. The channel system stresses alliance and integration of channel system, informationization of channel management, and terminalization of channel operation; the organization system stresses organization, large scale, group, and brand of participant entities; service system stresses construction of service means, service platform, and operation mechanism; safety system stresses building quality safety based agricultural product supply chain management mode. In order to ensure high efficient operation of supply chain for modern agricultural products, it is required to straighten out supply chain management system, actively cultivate core enterprises of supply chain, strengthen information construction of supply chain, select suitable supply chain mode, and improve benefit allocation mechanism.

Key words Agricultural products, Supply chain, System construction

1 Introduction

With changes in consumer purchase mode, formation of diversified retail formats, rapid development of e-commerce, improvement of agricultural product logistics, shortening of circulation channel, and strengthening of food safety awareness of consumers, the existing agricultural product supply chain system is incapable of adapting to demands of time development. It is required to make reform and innovation on existing agricultural product supply chain system, and build safe and orderly, dynamic and high efficient and well functioned modern agricultural product supply chain system. Construction of modern agricultural product supply chain system is of great theoretical and realistic significance for enriching theories of agricultural product circulation and promoting high efficient, orderly, large scale, professional, organizational, and safe circulation of agricultural products.

Study of agricultural product supply chain started from the beginning of the 1990s, *i. e.* from the study of grocery crisis in the United States. At present, domestic researches on agricultural product supply chain focus on connotation, member relation, organization mode, information management, logistics management and mode innovation.

1.1 Member relation Agricultural product supply chain is a longitudinal and horizontal integration strategic alliance including raw material supply, production and processing, product logistics, and sale of agricultural products. The key to optimization of fresh agricultural product supply chain lies in building information sharing incentive mechanism and building coordinated benefit integrated supply chain partnership relation.

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1.2 Organization mode The strategic goal for organization mode of China's agricultural product supply chain should be established based on "modern single segment dual" circulation mode of "production entity → network platform → consumer entity". There are also two supply chain organization modes with processing enterprise as core and logistics center as core separately. Besides, there is organization mode for fresh agricultural product supply chain with corporate wholesale market and supermarket as core enterprises. In addition, there is the organization mode of "supermarket + agricultural product processing enterprises (farmer cooperatives) + farmer households", to ensure safety of agricultural products.

1.3 Information management The key of agricultural product supply chain management relies on network tool system with Internet as representative and information technology based e-commerce. It uses advanced production and operation management method to establish synergic relationship between enterprises of agricultural product supply chain, to make the supply chain develop in systematic, integrated, and fine direction. For example, RFID and public key based agricultural product information management and traceability system. There are also researches of agricultural product supply chain information management from information transmission, information distortion, information risk, and information sharing. Some scholars proposed building the agricultural product virtual logistics center consisting of virtual supply chain network with information flow monitoring material flow and service flow as characteristic, and "information issue/output subsystem, logistics transaction intelligent processing subsystem, logistics intelligent management service subsystem, and central database subsystem" as major parts.

1.4 Logistics management Some scholars studied agricultural product logistics supply chain mode with wholesale market as

core and discussed optimization of agricultural product supply chain. There is agricultural product supply chain mode based on SCOR model, including logistics supply chain model of "two-level supply chain, two-stage logistics, and three-type logistics chain" fresh agricultural products.

1.5 Mode innovation Some scholars studied dual structure with traditional agricultural product supply chain as major part. They proposed establishing an alliance type supply chain consisting of farmers, specialized farmer cooperatives, leading enterprises, retailing enterprises, and consumers, and building allied and integrated agricultural product supply chain mode with leading enterprises as core, benefit as link, and contract as means through new agricultural cooperatives, so as to reduce production risk of farmers, stabilize supply of agricultural products, and ensure safety of agricultural products.

The above researches provide broad idea and deep basis for in-depth researches of building modern agricultural product supply chain. However, their exploration is mainly based on a certain viewpoint. There is still no comprehensive system. Especially, there are few researches about the supply chain service system. Therefore, the construction of modern agricultural product supply chain should be based on realities of China's agricultural product supply chain. In view of existing drawbacks, it is required to study the agricultural product supply system from the systematic and consolidated perspective.

The modern agricultural product supply chain (MASC) takes information platform of agricultural product supply chain as basis, and rebuilds channel system, organization system, service system, and supervision system of agricultural product supply chain, to reduce circulation cost, raise response speed of all links, realize seamless connection of farmers, enterprises, middlemen, and consumers, and ultimately accomplish the goal of increasing value of agricultural products, increasing income of farmers, and improving satisfaction of consumers.

2 Major existing problems in China's agricultural product supply chain

2.1 Loss of intensive and allied channel chain and unstable relation of channel members Firstly, major existing problems in China's agricultural product circulation system include each participant doing things in his own way, lack of integration, and lack of intensive and allied channel chain. In China, main members of agricultural product channel are separate farmers, ill-developed cooperation organizations, and small and few leading enterprises. Due to low degree of circulation organization (mainly reflected in low organization level of circulation entities, low organization level of circulation process, and low organization level of circulation service), China lacks large agricultural product distribution enterprises (groups) and intensive and allied channel chain. Secondly, due to separation between circulation channel members of agricultural products, it is difficult to form close cooperative relation, the cooperation level is low, and channel relation is unstable.

2.2 Unsmooth information circulation between entities of agricultural product supply chain Firstly, the general information level of domestic agricultural product supply chain is relatively low. At domestic agricultural product market, there is nearly no information system unified planned and there is a great gap in information level of enterprises and the development is relatively not balanced. Enterprises in the supply chain lack unified information platform for information exchange, leading to lack of understanding between enterprises and impairing development of agricultural product supply chain. Secondly, from farmers to retail terminals, all circulation links lack effective agricultural product information collection, arrangement and issue system. The channel for users obtaining market supply and demand information is single, and operation link information lags behind and the distortion is serious. Thirdly, since flow of agricultural products is generally blind, especially logistics information, due to backward information processing means and technology, it is difficult to bring into play functions as information center. Finally, due to many system links, multiple levels of operation entities, backward logistics technology, lack of information processing function, and lagging of e-commerce application, business flow, material flow, fund flow, and information flow lack cooperative effect.

2.3 Imperfect agricultural product supply chain service system The existing agricultural product supply chain service system mainly includes three levels: the first level is production service level, the second level is circulation service level, and the third level is consumption service level. The existing problems include too many levels of service system and lack of cooperative effect; serious mechanism obstacle in supply chain; limited circulation service function of wholesale market; low organization level, simple organization form, unsmooth information communication, backward transaction method, lack of strategic cooperation, and low circulation efficiency; failure to effectively establish and popularize standardized system for agricultural products; lagging in information construction and application of e-commerce; government making no overall planning for establishment of agricultural product supply chain service system, which weakens functions of supply chain service system to a great extent.

2.4 Lack of quality and safety management system for agricultural product supply chain Since the transaction between participants of agricultural product supply chain is mainly one-time deal, there is serious problem of double marginal markup in the transaction. All links consider respective benefit only. It is difficult for entities to consider long-term mutual relation. The quality and safety problem of agricultural products is prominent, reflecting in difficult to record, transmit, and store quality and safety information, which is not favorable for early warning, in-process monitoring, and post tracing of quality and safety issues. As a result, it is difficult to establish effective quality and safety management system in all links of the supply chain. In sum, to create new situation for circulation of agricultural products, it is required to make

reform and innovation of existing agricultural product supply chain system and build modern agricultural product supply chain management system.

3 Construction of modern agricultural product supply chain management system

3.1 Establishing modern agricultural product supply chain channel system In view of lack of information sharing, low cooperation level, and unstable channel relation of agricultural product circulation channel system, it is recommended to insert an information platform in modern agricultural product circulation channel system, to complete integration of traditional channel system. On the basis of information sharing, mutual trust and common long-term goal, it is recommended to establish a strategic cooperative distribution network benefit community through horizontal or longitudinal combination, agreement or equity alliance. It ultimately realizes information sharing and optimization of channel resources through highly developed information system and Internet. Integration refers to the process of integrating production of agricultural product marketing channel, agricultural product processing, and sales into a unified operation entity and integrating into an enterprise, forming completely and semi-completely comprehensive operation mode, reflected in industrial and commercial capital or financial capital directly invested in building factories or agricultural enterprises, and building huge sales group and network system.

3.2 Establishing information based channel management system The connotation of "information-based" refers to infiltration and profound influence of network information and electronic technology on internal major structure and internal relation, including application of Internet in channel structure relation, establishment of online shops, and establishment of channel electronic information processing and transmission center. Information based channel management is becoming a direction of channel reform. The goal of information based channel management is to realize transformation from batch transfer of commodities to batch transfer of information as soon as possible. It includes building information intermediary, establishing virtual channel mode, and carrying out e-commerce of agricultural products.

(i) Information intermediary. The information intermediary refers to providing information search, professional consultation, product search, loan settlement and acting as a go-between for other members in the channel relying on Electronic Data Interchange (EDI) and Internet with channel interchange, communication and transaction as main functions. At present, various information intermediaries in the channel mainly include portals, virtual retailers, integrators, and auction houses. Information intermediary has become a key factor running through the channel with unprecedented advantages.

(ii) Virtual channel mode. In virtual channel model, transaction between channel members does not need specific place but drawing support from network to complete a series of transaction activities. Virtual channel realizes zero stock management between members. The internal structure breaks through limitation in time and space, and trans-regional and trans-national commodity circulation becomes possible.

(iii) E-commerce. E-commerce is the buying and selling of goods and services, or the transmitting of funds or data, over an electronic network, primarily the Internet. E-commerce breaks time and space concept of traditional circulation channel. E-commerce transaction is implemented in virtual environment under support of Internet technology. Without time and space limitation, it greatly reduces transaction costs in the channel, realizes appreciation of channel value, effectively raises circulation efficiency, and is helpful for lifting customers' rights and satisfying individualized demands of consumers.

3.3 Establishing terminal based channel operation system The terminal based channel operation system is manifested as chain operation and supermarket sales. For example, in developed countries, there are few farmers' markets, but mainly chain supermarkets or monopolized shops. Since the 1960s, large comprehensive market and chain supermarket have become mainstream agricultural product retailers and become increasingly prominent in marketing terminal of agricultural products.

(i) Chain operation. Chain operation of agricultural products is a mark of modern agricultural product supply chain. Carrying out chain operation firstly needs actively cultivating chain operation entities. Secondly, it is required to encourage leading enterprises to develop chain operation. Thirdly, it is required to actively promote industrial and commercial enterprises to invest in chain operation of agricultural products, guide enterprises with the same industrial form or similar businesses to make assets and business reorganization through merger, combination and cooperation, develop chain operation of agricultural products, and drive chain operation to realize low cost expansion and trans-regional development. Some enterprises have made some useful attempts in this field. For example, with Suguo Supermarket successively entering field of sales of agricultural products, there appeared three successful chain operation modes: Tianhui chain supermarket + wholesale market + base + insurance in Wuxi City; Wanfang chain supermarket + base in Zhenjiang City; green grain and oil chain store + processing enterprise + base in Yancheng City.

(ii) Supermarket sale. Supermarket sale of agricultural products is a mark of agricultural product entering the stage of brand competition. In essence, supermarket sale of agricultural products is the penetration and expansion of commercial enterprises from circulation field to production field of agricultural products. It takes modern circulation as guidance to better promote development of agricultural industrialization, and accordingly lift competitiveness of agricultural products. Supermarket not only can improve market level and attract more consumers, but also is favorable for guiding agricultural production to organize production, adjust structure, improve quality, and overcome blindness of agricultural and sideline product production, to increase income of farm-

ers.

3.4 Establishing modern agricultural product supply chain organization system A prominent problem in circulation of agricultural products is small circulation entity and low organization level, especially low organization level of farmers. To establish modern agricultural product supply chain system, participant entities should have high organization level. Organization plays a key role in effective operation of modern agricultural product supply chain system.

(i) Organization of farmers. Major means is combination through joint purchase and sales, and technology and service sharing, and also it brings into play functions of circulation entities through establishing specialized farmer cooperative and making effort to expand its scale and strength. For example, it is feasible to establish "farmer production alliance", fully bring into play service functions of scientific and technological personnel, and improve organization level of farmers with the aid of promotion of leading enterprises, specialized associations, societies, village level grass-roots organizations, and rural able people.

(ii) Large scale operation of leading enterprises. Most existing leading enterprises are small and less competitive. Firstly, it is recommended to reinforce strong business of enterprises through in-house business reorganization of leading enterprises, merge small and weak enterprises, expand coverage and business scope of enterprises, and actively promote general enterprises to unite and expand scale. Secondly, it is recommended to accelerate reorganization and reform of state-owned agricultural circulation enterprises. It is recommended to encourage high quality enterprises to make trans-regional, trans-industry, and trans-ownership system reorganization through market mechanism and policy guidance with excellent resources as link, and encourage state-owned capital, collective capital, and nonpublic capital and foreign capital to participate in enterprise reorganization and transformation.

(iii) Corporatization of agricultural product operation. This is the fundamental way for realizing modern agriculture. Firstly, it is recommended to organize, operate and manage specific process of agricultural production in factory-based mode, integrate separate farmer production, and promote industrialization of agricultural production. Secondly, it is recommended to develop marketing type agricultural product operation companies and make innovation of sales channel based on traditional farmer market and wholesale market.

(iv) Brand operation of commodity distribution. It is recommended to support large agricultural product distributors to adopt stock participation, stock control, contracting, merger, purchase, trusteeship, and franchise operation, to help enterprises to realize scale expansion, to help them to become large competitive agricultural product distribution group with independent brand, high competitiveness, and high driving function.

3.5 Establishing modern agricultural product supply chain service system Modern agricultural product supply chain service system is different from traditional agricultural product supply chain service system. As for connotation, modern agricultural product supply chain service system is a series of service means, service platform and operation mechanism using modern organization methods to improve agricultural product production, circulation and consumption efficiency and utility.

3.5.1 Building production platform. The production platform is a basis for establishing modern agricultural product supply chain service system and the fundamental purpose is to realize standardized production and safety. (i) Production standardization. Firstly, conducting standardized production and operation, including division of production zones, design, and use of input products, and farming work. Secondly, establishing agricultural standardized production base, encouraging farmers to circulate land contractual management right in the form of transfer, letting, exchange, and cooperative share, building a good many specialized and standardized high quality agricultural production bases, and sticking to centralized and standardized production, to realize standardization of production bases through unified management, distribution, production, and sales. Thirdly, establishing agricultural product quality and safety standard system, testing and inspection system, and certification and approval system, implementing appropriate monitoring and supervision, to provide external constraint for standardized production. (iii) Safe production. Firstly, strengthening production area environment and agricultural input product supervision, and strictly source pollution. Secondly, strengthening management of agricultural product packaging identification, and enhancing quality and safety tracing. Thirdly, enhancing scientific and technological service ability through extending agricultural product quality and safety researches and technologies. Fourthly, strengthening agricultural product quality and safety monitoring, and regulating information issue. Fifthly, speeding up establishing agricultural product quality and safety early-warning mechanism, quality and safety accident treatment mechanism, agricultural product tracing system, and defective agricultural product recall system.

3.5.2 Building market platform. Market platform is the core for building China's modern agricultural product supply chain service system. The fundamental purpose is to strengthen circulation function. And the key for building market platform lies in construction and innovation of wholesale market. (i) Actively setting up flagship type wholesale groups, expanding size of agricultural product wholesale market, and strengthen organization level of agricultural product wholesale market. It is recommended to promote wholesale market to develop towards modern business entities and centralization and large scale with requirements of modern enterprise system. At present, the urgent task is to actively introduce a good many whole sellers and agents and make reorganization through standardized operation, eliminate those whole sellers without standardized operation and bad performance, realize concentration of resources in few excellent whole sellers, set up flagship whole seller groups, and promote business entity, centralized and large scale development of wholesale enterprises using modern enterprise

system. Whole seller group construction can be realized in the form of share holding system, and also can be built in satellite form. In operation, it is feasible to take the form of "enterprise founding market and enterprise managing market", and establish modern enterprise system with characteristics of clear ownership, explicit right and duty, and scientific management. (ii) Establishing virtual wholesale market of agricultural products, making effort to improve information, and realize cooperative business. A core of cooperative operation of agricultural product production, circulation and consumption is to build comprehensive cooperative agricultural product modern circulation service system with wide participation of wholesale market and intermediaries. The first is cooperative e-commerce, the second is virtual transaction platform, and the third is virtual logistic platform. (iii) Innovating the method to realize combination and alliance of wholesale markets and whole sellers, namely the integration of information flow and logistics of the entire circulation chain. However, at present, China's agricultural product whole seller is relatively small. Therefore, the precondition for realizing alliance of whole sellers is reorganization and merger of them and building large agricultural product wholesale groups. Through large agricultural product wholesale groups, it is expected to realize connection of small farmer households and large markets in the front end, farmer households, cooperatives, and processing enterprises.

3.5.3 Building information platform. Information platform is the fundamental for building China's modern agricultural product supply chain service system. It is of great role in increasing agricultural product circulation efficiency and promoting modern circulation of agricultural products. (i) Building e-commerce website based information network system. On the one hand, it is expected to realize share of market information, supply and demand information, production base, wholesale market, logistics enterprise information collection and exchange network with the aid of multifunction interface platform in e-commerce. On the other hand, it is feasible to realize supplement of the above systems through introducing information intermediary service (namely, providing agent of content, information, knowledge, and experience through information service). (ii) Building information center based information network system. This network functions as integrating information (including agricultural product production and supply information, demand information, and price information) between production bases and wholesale markets. (iii) Building high efficient and cooperative information sharing mode. It is feasible to integrate various types of information collected through information technology into an information sharing platform.

3.5.4 Building mechanism platform. Mechanism platform is the guarantee for establishing China's modern agricultural product supply chain system. The core elements include benefit distribution mechanism and trust mechanism. (i) Establishing trust mechanism to promote cooperation relationship. It is recommended to establish system restrained trust safeguarding mechanism, reputation constraint trust safeguarding mechanism, and social relationship restrained trust safeguarding mechanism. (ii) Establishing reasonable benefit distribution mechanism to strengthen cooperation relationship. Establishing reasonable benefit distribution mechanism is favorable for guaranteeing participants obtain reasonable returns. The key lies in straightening out benefit distribution between enterprises and farmer households. The first is making clear the benefit distribution principle between enterprises and farmer households. The second is improving benefit distribution mechanism between farmer households and enterprises, energetically developing benefit-returning type and cooperative benefit distribution modes. The third is establishing risk security fund system between farmer households and enterprises. The fourth is energetically developing specialized farmer cooperatives. The establishment of cooperatives is to make farmer households get close to cooperation with enterprises, strengthen negotiation ability of farmers in alliance to a certain extent, resist enterprises eroding benefits of farmers, and accordingly effectively guarantee income of farmer households in cooperation.

3.5.5 Establishing modern agricultural product supply chain safety system. The core of modern agricultural product supply chain safety system lies in establishing quality and safety based agricultural product supply chain management mode. In other words, it is recommended to start from risk management, integrate positive monitoring, reverse tracing quality and safety management concept from field to dinning table, including production, processing, sales, supervision and consumption, strengthen source management and responsibility sharing, and enhance contractual coordination and strategic cooperation of entities in the supply chain, especially the quality and safety supervision of government over supply chain entities, and of core enterprises over membership enterprises. This safety management mode is intended to change traditional passive response management mode. Through mutual restriction and monitoring of supply chain entities, it realizes comprehensive guarantee of agricultural product quality and safety for the whole process. This mode strengthens construction of quality and safety based agricultural product supply chain monitoring information platform through conclusion, implementation, restriction, monitoring and encouragement of supply chain members. Besides, it strengthens organization of small and separate farmer households through cooperatives, to ensure quality and safety of agricultural products from the source, and strengthen quality and safety guarantee role of core enterprises and government in the supply chain.

4 Policy recommendations

4.1 Straightening out the supply chain management system

The supply chain management involves different sectors and enterprises, so it is required to take an overall consideration and mutual coordination. To establish modern agricultural product supply chain system, we should firstly break barrier between different departments, and break the situation of each party acting willfully

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mation collection and processing means is backward, and the information service level is still low. The shortage of funds is more prominent in township-level and village-level services.

4 Recommendations

(i) Including informatization cost in public expenditure. In the current development status of China's rural areas, the main body of agricultural information service system construction should be all levels of government, and it should not place one-sided emphasis on revenue-generating function of information services. In addition, to avoid further widening gap between the developed and underdeveloped regions arising from the development of informatization, the central government should put more investments in the central and western regions, and accelerate the pace of informatization construction in the central and western underdeveloped regions. (ii) Developing and establishing the measurement and analysis system for the level of agricultural and rural informatization. It is necessary to focus on the selection of calculation methods for the level of informatization, learn from the international advanced measuring methods for the level of informatization, and focus on the analysis of agricultural and rural informatization level and forecasts for the future. According to the informatization measuring results, we can analyze the overall trend and changes of informatization, and accurately forecast the informatization trends. (iii) Establishing and improving informatization regulations and standards. It is necessary to accelerate research and formulation of relevant hardware and software technical standards, data standards, information collection and processing standards, and focus on the development of information collection, storage, processing, treatment standards and information service standards, and accelerate the development of agricultural information classification and coding standards. (iv) Accelerating the integration of information resources and technology development. It is necessary to actively encourage scientific research departments, research institutions and companies to develop cheap, simple and practical information technology products, to provide technical support and protection for agricultural and rural informatization. (v) Strengthening the talent team building. It is necessary to build a good research team and strengthen information technology innovation, to provide strong technical support. It is also necessary to build a practical and efficient service team and strengthen information service model innovation, to improve the applicability and scientificity of information services for rural areas. (vi) Strengthening information-user training. It is necessary to increase training of all aspects of knowledge, to improve the overall quality of the information services team, enhance the grass-roots information service staff's information identification and analysis capability, and help farmers to obtain true, reliable and useful information. At the same time, it is also necessary to increase education and training for farmers to improve their scientific and cultural quality, foster their informatization awareness, and guide their consumption of information. (vii) Enhancing the level and function of information services and application system. Information services should take into account the actual situation of rural socio-economic development, requirements of the development of modern agriculture, existing basic conditions for informatization, and rural cooperative economy and organizations. Application systems must be prepared to coordinate planning, prevent redundant construction and meet the needs of farmers.

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regardless of over-all interest, and multi-department management. Besides, it is recommended to bring into play function of government in making clear of "enterprise as major party and government as service supplier". Specifically, government should constantly improve circulation laws and regulations of agricultural products, reinforce infrastructure construction, set up agricultural product logistics platform, establish the third party information exchange center for agricultural products, and establish agricultural information platform.

4.2 Actively cultivating core supply chain enterprises It is recommended to cultivate agricultural enterprises with certain scale, high prestige and appeal, good commercial reputation, and high integration ability. Alternatively, it is recommended to organize competent supply chain organizers and encourage them to establish unified supply chain management platform. This is a fundamental guarantee for construction and effective operation of modern agricultural product supply chain.

4.3 Enhancing information construction for all links in the supply chain Firstly, it is recommended to accelerate construction of logistics information system, to realize supply chain information integration. Agricultural enterprises should actively develop information management system according to demands of development, make effort to realize integration of supply chain information, and raise the response speed, to ensure smooth operation of various processes. Secondly, it is recommended to establish ecommerce agricultural public information platform. Government department should actively establish modern agricultural product logistic information platform, bring into play advantages of government public information network in reliability and high prestige, energetically develop e-commerce, and completely transform the information system. Finally, it is recommended to connect farmers, suppliers, whole sellers, retailing terminals, and customers through network platform and information technology, to realize real time tracing, effective control, and whole-process management of all links of agricultural product logistics, and realize resource and information sharing.