

# The research on the Influencing factors of farmers' income in supply chain of agricultural super docking

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**Abstract**—In China agricultural super docking in a new circulation mode of agricultural products, compared with the traditional circulation model, it aims to increase farmers' income and reduce the circulation of agricultural products. However, farmers can't gain more benefits from the new circulation mode because they don't understand the market information, their cultural level is low, and industries are small. Based on cooperative game theory, we should reduce costs of agricultural products directly to enter the market in order to improve the status of farmers in the game between the two sides.

**Keywords**—farmers' income; agricultural super docking; rural cooperatives; supply chain

## 1. Introduction

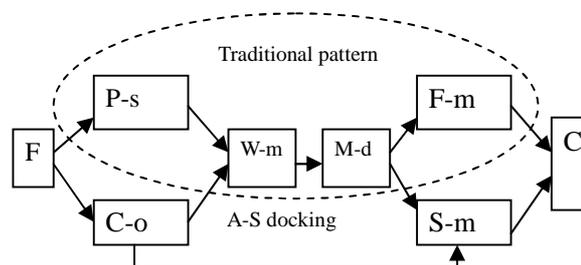
"Agricultural super docking" has decades of history in the European and American countries. In the United States, France, Spain and other countries, due to the high level of modernization of farms, big-scale production, farmers have the ability to directly supply products for supermarkets. In these countries, 70%-80% of the agricultural products in supermarkets are picked by the peasants from the farm directly. It is playing an increasingly important role in daily trading activity. But in Japan, Korea and some developing countries like China, India, the wholesale markets is the main channel for the circulation of agricultural products. Of course, this way of circulation sometimes makes farmers lose money.

According to statistics, circulate cost in agricultural products supply chain is over half of the vegetable price, yet producers are not get extra income from the high price. Poor circulation led to confusion in the market, which directly affect the interests of farmers and consumers. Such as in the winter of 2010, as a result of cabbage yield reduction and the "kimchi crisis", many dealers hoarded a lot of cabbage, resulting the price reached a record high. Yet in spring of 2011, concentration appears of hoarded cabbages and harvested cabbages led the prices reach a record low. A lot of vegetables rotted in the fields without anybody cared. In this background, "Minus link, reduce cost" management idea followed by agricultural products supply chain of "agricultural super docking" attracts attention of governments, scholars and enterprise naturally.

## 2. Comparison with traditional pattern

"Agricultural super docking" is a new supply chain of agricultural products, it overcomes the traditional mode that the circulation of agricultural products for a long time, high cost of transportation and storage, it is

difficult to solve the timeliness and range of these issues, connects the farmers' professional cooperatives with the supermarkets directly, supermarkets can purchase agricultural products directly from the origin (Chart 1). "agricultural super docking" can connect the production and sale, the two major aspects effectively to make the market lead production efficiently and make the production market-oriented, and adjust the state of agricultural products in terms of time, space, species by means of transporting, processing, storage, making it more suitable to the needs of the market in order to make the agricultural products value-added, farmers' income increased, and thus lay the foundation of stabilizing the whole economy. In addition, another key point of "agricultural super docking" is that through this project, you can create products quality tracing system to monitor the quality of agricultural products from the source, take the initiative to safeguard the interests of consumers.



F: farmers; P-s: purchasing station;  
 C-o: cooperative; W-m: wholesale market;  
 M-d: multilevel distributors; C: customers  
 F-m: farmers market; S-m: supermarket  
 Chart 1

## 3. The game between farmers and the supermarket

In the "agriculture super docking" supply chain,

there is a game between farmers and supermarkets. Due to the low productivity of farmers, small-scale production and lack of market information, the supermarket side is often the local retail giant or even a monopoly, farmers usually belong to disadvantaged groups. What are the specific factors affecting the game? What do farmers need to do to enhance their position in the game? Based on these questions, we build a cooperative game model.

(1) The premise of the cooperative game in supply chain

Chart 1 tells that, the farmer-supermarket direct supply chain removes various nodes like wholesalers and dealers in traditional supply chains, so keys to the question whether rural co-operatives can keep a long-term cooperation with supermarkets lie in how to distribute profits generated in these nodes of traditional supply chain, how to share the increased transportation and inventory cost in a new supply chain, and how to distribute some other benefits and costs in cooperation process. Profit distribution of each node in the supply chain should follow the fundamental principle of collaborative supply chain management that input is proportional to the risks and benefits, which mean those who have higher investment (labor included) and take more risks should enjoy more profits. According to the cooperative game theory, cooperation should follow the principle of maximum of overall profit, and profit of each enterprise outweighs that of non-cooperation, that is:

$$y = \max(\pi)$$

$$\begin{cases} \pi = \sum \pi_i & (1) \\ \pi_i \geq H_i & (2) \end{cases}$$

$\pi$  is the overall profit of the supply chain,  $\pi_i$  is the profit of each node in the supply chain,  $H_i$  is the profit gained in non-cooperative pattern of each party. Condition (1) means sum of each party's profit equals the overall profit of the supply chain. Condition (2) means profit of each party should be equal or greater than that of non-cooperation, otherwise the cooperation can not go further.  $y = \max(\pi)$  means the rule of maximization of overall profit should be followed in cooperation.

(2) Establishment and analysis of cooperative game model

From the constraint condition of  $\pi_i \geq H_i$ , we know that, the basic condition of two parties' cooperation is that the farmers' profits of cooperation should outweigh that of non-cooperation. Chart 1 shows that, if farmers do not cooperate with supermarkets, agricultural products will circulate to the market in a multilevel marketing mode. Given  $C$  is the extra unit cost (including information cost and sum of profits distributed to every dealer) generated to enter the market in non-cooperation for a farmer,  $C_1$  is the unit cost of inventory and transportation,  $C_2$  is the unit cost if transportation and inventory expenses are paid by supermarket in a cooperation pattern,  $C_0$  is unit production cost of agricultural product,  $P$  is market price,  $P_1$  is purchasing price of supermarket, farmer & supermarket cooperation supply  $q$  occupies  $\lambda$  of the overall demand of the whole market  $Q$  ( $q = \lambda Q$ ), profits of

farmers  $\pi_1$  account for  $\theta$  of the overall profit  $\pi$  of the supply chain ( $\pi_1 = \theta\pi$ ). This essay focuses on how to improve farmers' profits, namely to maximize  $\theta$  under the condition of two parties' cooperation. Take the above variables to the constraint condition mentioned, constraint condition of an agreement between farmers and supermarkets is,

$$\begin{cases} \pi = (P - C_0 - C_2)q \\ \pi_1 = (P_1 - C_0)q \\ H_1 = (P - C - C_0 - C_1)q \\ \pi_1 \geq H_1 \end{cases}$$

$$\begin{aligned} \because \pi_1 &= \theta\pi \\ \therefore (P_1 - C_0)q &= \theta (P - C_0 - C_2)q \\ P_1 &= \theta (P - C_0 - C_2) + C_0 & (3) \\ \because \pi_1 &\geq H_1 \\ \therefore (P_1 - C_0)q &\geq (P - C - C_0 - C_1)q \\ P_1 &\geq P - C - C_1 & (4) \end{aligned}$$

That is farmers and supermarkets will cooperate only under condition (4). As this essay will discuss what factors will determine  $\theta$ , a function related to  $\theta$  is necessary. By a simultaneous equation of (3) and (4), we can have  $\theta (P - C_0 - C_2) + C_0 \geq P - C - C_1$

$$\theta \geq \frac{P - C - C_0 - C_1}{P - C_0 - C_2} \geq 1 - \frac{C + C_1 + C_2}{P - C_0 - C} \quad (5)$$

Example: We assume that the farmers and supermarkets signed a sale and purchase agreement about tomatoes. The market price of tomatoes  $P = \$3/\text{kg}$ ,  $C = \$0.8/\text{kg}$ ,  $C_1 = \$0.6/\text{kg}$ ,  $C_2 = \$0.5/\text{kg}$ ,  $C_0 = \$1.2/\text{kg}$ . According to the formula we know  $\theta$  must be greater than 0.31, or farmers will not cooperate with the supermarket.

From (5) we can see that proportion of farmers' profits in the whole supply chain is affected by  $C$ 、 $C_0$ 、 $C_1$  and  $C_2$ ,  $C$ 、 $C_0$ 、 $C_1$  and  $C_2$  are in inverse proportion to  $\theta$ , that is if unit agricultural product takes more extra market access cost and more extra transportation and inventory cost, supermarkets take more transportation and inventory cost, and agricultural product takes more unit production cost, farmers will have a lower proportion in the profits.

#### 4. Strategies and propositions for increasing farmers' incomes

(1)  $C_1$ 、 $C_2$  are transportation and inventory costs of agricultural products. Agricultural products should be kept fresh though they are from the countryside, where the infrastructure is not perfect enough and it is difficult for farmers to transport and storage their products. Farmers are so eager to sell out their products, thus put themselves in the location of the adverse negotiations. To solve this problem, the village organization and government should take some measure to improve the infrastructure. As the saying goes "to get rich, first build roads." Transportation is indeed the foundation of agricultural products commerce and other kinds of commerce. Rural credit cooperation should enhance their transportation and inventory ability by purchasing

transport vehicles and setting up depots, if they can afford it, to make themselves equal a voice in the game.

(2)  $c_0$  represents unit production cost. To lower unit production cost will offer farmers extra edge in competition. In China, agricultural production is organized with household contract responsibility system characterized by small scale and low productivity, which to large extent lowers the incomes of farmers. The establishment of large special rural cooperatives will help reduce unit production cost. The cooperatives can organize experienced farmers and agricultural experts to give technical instructions to the farmers, or organize unified operations of seed and fertilizer purchase (the cost of group purchasing is lower than the total cost of individual purchases) as well as production activities like sowing and reaping. If the rural cooperatives could manage to scale up, boost the production of farm produce, then the share of fixed costs on unit produce will be reduced in the process of production. Anyway, the establishment of special normative rural cooperatives and further scaling up will contribute to farmers' income increase.

(3)  $C$  represents the entry costs for unit produce under non-cooperative system, which include information costs and profits distributed to individual dealers. In this cost our main consideration is how to reduce information costs when entering the market, the generating of which is mainly caused by the information asymmetry between farmer and supermarket. Farmers usually don't have good understanding of the market economy and the demand of the market. Therefore they could only grow the produces which are well received in the market for the moment. On the contrary, large-scale supermarkets will usually conduct researches on the market. If the market information could be shared, then the phenomena that the steep rise and fall in prices of a produce like the Chinese cabbage causing farmers' losing their capital could be reduced. Therefore, to establish a information sharing mechanism between supermarkets and rural cooperatives will turn farmers more advantageous in the competition between the two parties.

## 5. Conclusions

Agricultural super docking have very important significance on the settle of the problems about agriculture, rural areas and peasantry. Farmers are weaker than the supermarket on the game, so that it's hard for them really gain bigger profit from the new mode. In this paper, based on the intermediate product pricing method

to find out the appropriate factor interval for the distribution of benefits and propose appropriate countermeasures to improve the farmers' income. To truly form partnership with larger supermarket, farmers should strengthen the construction of agricultural infrastructure, form a certain scale of cooperatives, guide the agricultural production in standardization and use the cooperatives to collect market information then reach information sharing with supermarkets.

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