Alliance Game of Agricultural Resource Sharing Platform

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Keywords: Agricultural system; Resource sharing; Alliance Game.

Abstract. On the basis of reviewing the history of China's agricultural system and the current situation of foreign agricultural organizations, this paper puts forward the establishment of resource sharing platform. From the point of view of the investors, the benefit function under the strategy of cooperation and non-cooperation is established. On the premise of satisfying individual rationality and maximizing collective benefit, a game model of alliance is constructed.

Introduction

Under the condition of not considering the ownership of land, taking large-scale production as a combination and small farmers' management as the sub-system, the change of agricultural production in our country is divided into two parts: one is divided and the other is combined. From the whole process, there are only two direct results of agricultural system, but the change of each time is different. Today, the world environment, domestic social development has reached a relatively stable state, which is a good time for agricultural development to adapt to the economic market.

Problems Existing in the Development of China's Agricultural System

A Complete Agricultural Service System Has not yet Been Established

The development of agricultural union in our country is beginning to take shape, but it is still insufficient compared with the mature system of foreign countries. The agricultural association in Japan is divided into three levels, from the top to the bottom, the national agricultural association, the county level agricultural association and the grass-roots agricultural association; Germany's rural cooperative system of goods and services is also three levels-national cooperatives, local cooperative federations and grass-roots cooperatives; Agricultural cooperatives in the United States are part of their socialized agricultural service system, roughly geographically based Can be divided into grass-roots cooperation-cooperatives, middle-level cooperatives, regional cooperatives, national cooperatives, grass-roots cooperatives[1]. Their common characteristics are that they have a clear hierarchy, complete system, national cooperatives have an important impact on government laws and regulations, industry standards, but independent of government agencies, belong to the spontaneous formation of profit-making organizations.

Yet, China's agricultural service system does not form a complete chain, and the current situation is that farmers alone, cooperative operation, union operation three modes coexist. Foreign United societies rely on farmers (the smallest unit of agricultural workers) under the background of market freedom to actively establish cooperative relations for their own development needs, and form from bottom to top. Coalition organization There are two reasons why China's agriculture has not developed to this level: Firstly, the influence of the political system, China is a socialist country, land ownership only belongs to the state or collective, farmers do not have the right to sell land, land annexation, reduced opportunities for mass production. Secondly, the impact of the imbalance in rural development, the country has made many efforts to control the gap between the rich and the poor, but the distribution inequality brought about by the rapid economic growth will still exist for a long time. The differences in regional economic levels have led to the distribution of unions / cooperatives mainly in the eastern and coastal provinces. At the same time, because of the premise
of joining the cooperative voluntarily, some farmers with large amount of producing areas still choose to operate independently, so there is a situation that three kinds of organizations coexist at present.

Problems of Cooperatives Themselves

Management, the state law only quotes the status and conditions of the existence of cooperatives, but it does not really fall into management, which leads the managers of cooperatives to have no absolute say over their subordinate farmers, although it seems to be "democratic". But it also brings great difficulties to unified management.

Technology. Equipment such as agricultural facilities, product circulation and processing can only be reduced under mass production. The costs used by small farmers are too high, and the scale of most cooperatives / unions is too small to cover these additional investments. Without the introduction of new technology, the output and product added value cannot be increased. In the market competition, because of weakness, the income is reduced, and no additional investment is made, thus falling into a negative feedback cycle.

Personnel, the trend of aging of agricultural personnel has increased. Nowadays, the proportion of the young generation who are willing to engage in agricultural production activities is extremely low. Most of the employed people are between 50 and 70 years old. Their ability to accept science and technology is poor. The education level is generally not high, the body function is limited and cannot work for a long time, is not sensitive to the social environment change, to the industry development prospect and the market information attention is not high, pays more attention to the present income.

Constructing Resource Sharing Platform

The core of the resource-sharing platform refers to the establishment of distribution centers in areas where the scale of cooperatives / unions is not sufficient to meet the standards of grass-roots unions, so as to attract self-employed farmers. The government also belongs to investors. That is to say, the platform is led by local governments and co-financed by farmers, cooperatives or United societies that have the intention to provide agricultural development facilities for participants in order to promote their horizontal development. To bring one or more participants to the industrial scale of a grassroots union or merger. The establishment of the platform is based on the participation of individuals with voluntary participation in the platform Farmers, co-operatives or unions are not restricted to the participation of all three parties, but at least one party.

Set up self-employed farmers as "A", cooperatives as "B", Union for "C", According to the selection of participation by the three parties, seven kinds of participation combinations can be obtained. The following is an example of the first combination to illustrate the development trend after the establishment of the distribution center:

![Diagram](image)

Figure 1. Development of Individual Farmers in Distribution Centers.

The yellow circle numbered 1 in the figure represents the farmers (one or more) who have just begun to live in the center, when the size of the distribution center is equal to the production scale of farmer 1. After a period of development, farmers make use of the resources of the distribution
center to expand their own industry. Farmers 2 and 3 realize that entering the center can bring higher income to themselves, so they join in. Similarly, cooperative 4 also proposes to join in the situation in which the participants have developed well. The economic benefits brought about by the scale effect ultimately urge all farmers, cooperatives and unions in this region to cooperate with each other and form the grass-roots joint cooperative.

**Game Mechanism of Platform Construction**

The participants of the platform can be divided into three main bodies according to the point of interest: government, producer and third party.

Assume that the construction cost is a one-time cost that can be used to raise funds for the whole society; investment allocation, in which the investor will get the return on the investment within a few years of the platform’s operation; and the distribution of the benefits of the product, several years before the operation of the platform, which requires repayment of the investment amount, at this time, the producer income can be the central purchase price, and the value-added income after the product processing is used to repay, the operating cost is borne by the platform, and after no debt, the producer income is distributed according to the profit and the output. There is no correlation between producer investment and its own scale of production; the investor Can participate in the investment of multiple centers; the products of each producer can enter only one center; the size of the center is related to the scope of its services; the investment of each center is independent; the third party investment does not affect the price of the center business.

**Government's Interest Function**

Government advocacy is the key to promote the establishment of the whole platform, but whether the benefits after the platform construction can solve the existing problems of agricultural development has certain risks, and the government can choose whether to cooperate or not according to the evaluation.

(1) benefit function under cooperative strategy

\[
X_0 = \sum_{i=1}^{n} \left[ f(I_{i0}) - I_{i0} \right] (1 - \alpha_{i0}) + S_0 + \beta_0 \sum_{i=1}^{n} \sum_{j=1}^{m} r_{ij} \left( T_{ij} - P_{ij} \right) ;
\]

(1)

(2) benefit function under non-cooperative strategy

\[
X'_0 = S_0 + \sum_{i=1}^{n} FI_{i0} ;
\]

(2)

**Producer's Interest Function**

Producer refers to the main supply of agricultural products for the logistics center, mainly composed of farmers, cooperatives and United societies. Each producer can choose whether to enter the platform or not, but the construction of the platform has certain requirements on the total scale of producer production.

(1) benefit function under cooperative strategy

\[
X_{ij} = \left[ f(I_{ij}) - I_{ij} \right] (1 - \alpha_{ij}) - r_{ij} T_{ij} + f(q_{ij}) + \beta_0 \sum_{i=1}^{n} \sum_{j=1}^{m} r_{ij} \left( T_{ij} - P_{ij} \right) ;
\]

(3)

(2) benefit function under non-cooperative strategy

\[
X'_{ij} = p q_{ij} + FI_{ij} ;
\]

(4)

**Interest Functions of Third Parties**

Third parties refer to all interested parties except governments and producers, which can be individuals, enterprises, organizations, etc.

\[
X_n = \mu \left[ f(I_n) - I_n (1 - \alpha_n) + \beta_0 \sum_{i=1}^{n} \sum_{j=1}^{m} r_{ij} \left( T_{ij} - P_{ij} \right) \right] + (1 - \mu) FI_n .
\]

(5)
Cooperative Game Model

The core of the alliance is to balance the interests of the participants, both individual rationality and collective rationality.

1) Individual rationality

The necessary condition for the participants to join the alliance is that the gain in the alliance is not lower than that in the case of non-cooperation.

\[ X_0 \geq X_0 \Rightarrow \sum_{i=1}^{n} [f(I_{i0}) - I_{i0}](1 - \alpha_{i0}) + S_0 + \beta_0 \sum_{i=1}^{n} \sum_{j=1}^{m} r_{ij}(T_{ij} - P_{ij}) \geq S_0 + \sum_{i=1}^{n} F_{i0} \]

Formula (6) is based on formula (1) and formula (2), which is based on the interests of individual rationality of the government, which is the prerequisite for the government not to dissolve the alliance.

\[ X_{ij} \geq X_{ij} \Rightarrow f(I_{ij}) - I_{ij}(1 - \alpha_{ij}) - r_{ij}T_{ij} + f(q_{ij}) + \beta_0 \sum_{i=1}^{n} \sum_{j=1}^{m} r_{ij}(T_{ij} - P_{ij}) \geq p_{ij} + F_{ij} ; \]

Formula (7) is based on formula (3) and formula (4), which is based on the benefit constraint of individual rationality of producer, which is the basic condition for producer to participate in alliance.

2) Collective rationality

The platform is the node that connects the producer and the investor. It is not a company or enterprise. In theory, there should be no extra profit, that is, the product income should belong to the investor and producer. Thus, the sum of the benefits received by the participants is equal to the total income of the product.

\[ V(S) = X_0 + \sum_{i} \sum_{j} X_{ij} + \sum_{i} X_i ; \]

\[ Q = \sum_{i} \sum_{j} q_{ij} , \quad y \text{ represents time, then } V(S) = \sum_{y} PQ . \]

The complete distribution of the benefits obtained by the alliance is the basic condition for the fair and reasonable distribution of the benefits. Since the platform returns to investors in the first few years of its operations, collective rationality constraints can be translated into a balance of investment returns in previous years:

\[ \sum_{i} [f(I_i) - I_i](1 - \alpha_i) = T \left( PQ - \sum_{i} C_i \right) - \sum_{i} p_i Q . \]

3) Game equilibrium model of alliance cooperation

\[ V(S) = \sum_{i=1}^{n} [f(I_{i0}) - I_{i0}](1 - \alpha_{i0}) + S_0 + \beta_0 \sum_{i=1}^{n} \sum_{j=1}^{m} r_{ij}(T_{ij} - P_{ij}) \]

\[ + \sum_{i} \sum_{j} \left[ f(I_{ij}) - I_{ij}(1 - \alpha_{ij}) - r_{ij}T_{ij} + f(q_{ij}) + \beta_0 \sum_{i=1}^{n} \sum_{j=1}^{m} r_{ij}(T_{ij} - P_{ij}) \right] \]

\[ + \sum_{i} \sum_{v} \left[ \mu \left[ f(I_{iv}) - I_{iv}(1 - \alpha_{iv}) + \beta_0 \sum_{i=1}^{n} \sum_{j=1}^{m} r_{ij}(T_{ij} - P_{ij}) \right] + (1 - \mu)F_{iv} \right] \]

(10)
\[
\begin{align*}
\sum_{i=1}^{n} [f(I_{i,j})-I_{i,j}](1-\alpha_{i,j}) &+ \beta_{i,j} \sum_{j=1}^{n} r_{j} (T_{j} - P_{j}) \geq \sum_{i=1}^{n} FI_{i,j} \\
[f(I_{i,j})-I_{i,j}](1-\alpha_{i,j}) - r_{j} T_{j} + f(q_{j}) + \beta_{j} \sum_{i=1}^{n} r_{i} (T_{i} - P_{i}) &\geq pq_{j} + FI_{j}
\end{align*}
\]

S.T.
\[
\sum_{i=1}^{n} [f(I_{i,j})-I_{i,j}](1-\alpha_{i,j}) = T \left( PQ - \sum_{i=1}^{n} C_{i} \right) - \sum_{k} p_{k} Q
\]
\[0 \leq t \leq 5\]
\[I_{i,j}, S_{i,j}, T_{i,j}, P_{i,j}, FI_{i,j}, q_{j}, C, > 0\]
\[\alpha_{i,j}, w_{i,j}, \beta_{i,j}, \alpha_{i,j}, \beta_{i,j} \in [0,1]\]

Conclusion

This paper puts forward an idea of agricultural development, which is based on historical development and natural laws. At present, the present situation of the scattered distribution of agriculture in China can no longer bring new impetus to development, while the integration of resources can inject new vitality into the development of agriculture, stimulate agricultural production, and stabilize the basic livelihood guarantee system. This paper only provides a new way for the development of agriculture, hoping that more people will pay attention to the agricultural industry.

Reference