Analysis of enterprise relationships in food industry cluster based on niche theory

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***Abstract*—** *In recent years, the Chinese government and local governments in China at all levels actively promote the construction of food industry cluster Demonstration Park. Many problems accompanied with the continuous development of industrial clusters, such as the proliferation of homogeneous enterprises and products, the lack of organic links and symbiosis relationship among enterprises, resource depletion and environmental degradation, triggering niche overlap and vicious competition. All these phenomenon leads to industry cluster an acute shortage power of competitive and innovation. In this paper, we take the livestock and poultry industry cluster as the research object, use niche theory to analyze enterprise niche inclusion, overlap and separation relationships. As well as through the neutral theory in the equilibrium state to explain the cluster of enterprises in the competition, cooperation and symbiotic relationship.*

Keywords*— *Niche Theory, Food Industry Cluster, Neutral Theory, Competition, Cooperation.

I. INTRODUCTION

Food industry cluster is composed with plenty of units, which lies in a specific geographical scope and in a particular way to rally around close neighboring communities, including government agencies, intermediary organizations, and research institutions, small and medium-sized enterprises producing food and related products and other social economic groups. In the industrial cluster, the enterprises can share the professional infrastructure, labor market and service. Relations among these units are complicated, such as complementary, cooperation, and even competing. For the important of food safety, Chinese government pays much attention to food industry development. "The 13th Five-Year Plan" of food industry and "No.1 File of 2017" clearly proposed to accelerate food industry cluster, to promote the food industry to be intensive, large-scale, so as to form a rational layout, resource conservation, modern food industry cluster. The government encourages food enterprises to strengthen cooperation and actively extend to the upstream and downstream, from the establishment of raw materials from the production of all aspects to the end of the whole industry chain. Promote the effective convergence of all aspects, to speed up the integration between the industrial chain integration, to achieve complementary advantages, information sharing, and coordinating development.

Under the guidance of government policy, most local government in China actively promotes the demonstration of food industry cluster or food park construction. And many large-scale, high levels modern food Industry Parks have been founded, such as Shandong Laiyang Food Industry Park, Chongqing Qijiang Food Industry Park, Chuzhou Green Food Industry Park and so on. At the same time, some districts are greed during food industry cluster construction, and there are some errors in their investment philosophy, leading to too much homogeneous enterprises within the cluster, and serious product homogeneity. And the lack of organic links and symbiotic relationship among enterprises within a food park, leading to depletion of resources and industrial environment deterioration, causing niche overlap and vicious competition and other issues. In particular, with the development of modern livestock production technology, animal husbandry, slaughtering, processing and logistics and other aspects is gradual getting intensive, large-scale. The fecal discharge and environmental pollution problems are becoming more and more serious, which has become a serious challenge to build a new socialist countryside and realize the coordinated development of economy and environment. In some districts, the food industry cluster has emerged the phenomena of lack of competition and excessive competition coexist, which caused the industrial cluster competitive power and innovation power is seriously inadequate, cooperation mechanism greatly reduced.

Therefore, in the food industry cluster development and upgrading process, too much competition occurs in horizontal enterprises, and lack of cooperation among vertical enterprises. In the process of industrial operation, the regionalism, incompleteness and imbalance of the competition among enterprises and the inequality of the subject status are the key problems in the development of food industry cluster.

Food industry cluster is a life-like organic whole, it has the life characteristics from emerge, development, maturity, and even to recession or other evolution. And all these behaviors are not only impacted or constrained by the environment, but also have some feedback on the environment. So the food industry cluster has obvious Ecological characteristics. Our research is

to regard the food industry cluster as a natural biological community, by using niche theory, we will analyze the niche of each unit, so as to make every enterprise in the cluster can find its own position, and all enterprises within a food park can form a "food industry ecological community". We will take the food industry park lifecycle as research object, and carry out study from its original status of less competition to the intermediate status of excessive competition and to the final status of coexistence. We will integrate niche theory to build industrial clusters collaborative evolution and sustainable development model.

II. COOPERATION AND COMPETITION AMONG ENTERPRISES IN FOOD INDUSTRY CLUSTER

Because competition and cooperation occur in different ranges and different participants, they can coexist in the same industry cluster. Therefore, proper scale competitions among enterprises in one industry cluster provide both incentives and avoid excessive competition (Porter, 1998). It can be seen that the observation of competition and cooperation in industrial clusters is based on two different perspectives of homogeneous enterprises and heterogeneous enterprises.

The competition among leading large enterprises in one industry cluster shows the greatest impact and the most obvious performance of the cluster, especially in the cluster supply chain enterprises. So, competition among leading large enterprises can be very intuitive to reflect the strong competition among them, and its heterogeneous enterprises in the cluster of mutual cooperation among the close cooperation. Because the core enterprise appears in industry cluster, especially co-existence of multiple core enterprises, the industry cluster forms a cluster supply chain, which is driven by core enterprises and a large number of collaborative enterprises co-exist parallel organization.

As shown in Fig. 1, livestock and poultry industry is the group that builds around the adjacent neighborhood residents in a specific geographical scope, including government departments, intermediary organizations, scientific research institutions, large-scale production of livestock and related products related to small and medium enterprises in a specific way. The focus of this paper is mainly on the core of animal husbandry and food industry cluster, which are shown as ①, ②, ③part in the Fig. 1. The animal husbandry food enterprises in this article is represented by Ai (i=1, 2, ---). Farmers or agricultural cooperatives, who provide raw materials for processing is represented by Bi (i=1, 2, ---), and Logistics and transport enterprises are represented by Ci (i=1, 2, ---). Besides that, government agencies and food development center, inspection and testing and certification center, checking each process of product, internationally renowned third-party testing and certification bodies, to carry out international testing and certification services, universities, research institutions, associations, trade finance and intermediary organizations, providing product innovation and enterprise financing to provide support and help, and display trading center, innovation incubator center, brand operations center, cooperation and exchange center, human resources center around the cluster, providing technical and service support, all of these mentioned units are represented by Di (i=1, 2, ---).

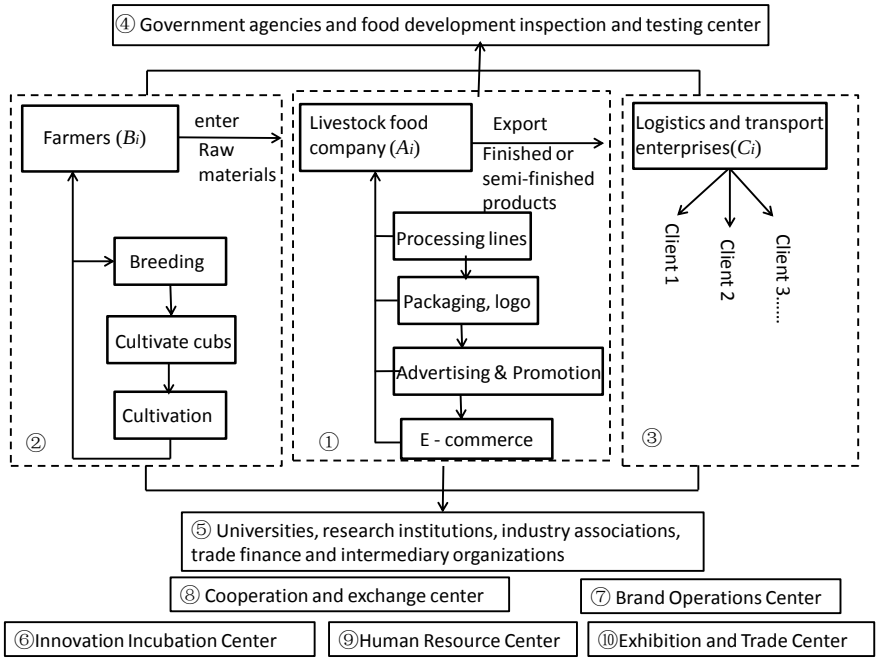

FIGURE 1: SCHEMATIC DIAGRAM OF LIVESTOCK FOOD INDUSTRY CLUSTER

With the continuous development of China's food industry cluster over the past decades, combined with the above research shows that in a relatively mature food industry cluster, there will be one or more core enterprises drive the development of other enterprises within the cluster. The following analysis is for the livestock and poultry industry cluster has two or more core enterprises situation. At the same time, due to animal husbandry food with preservation, durability characteristics, its requirements are extremely high for logistics and transportation industry. Considering the highest correlation between the two, mainly take logistics enterprises as an example.

According to existing research, the competition in the animal husbandry and food cluster can be divided into three kinds: ① competition between core enterprises; ②competition between core enterprises and related enterprises; ③Competition among related enterprises (mainly small and medium enterprises). Corresponding cooperation can also be divided into three kinds: ①cooperation between the core enterprises; ②core business and related business cooperation; ③related enterprises (mainly refers to the small and medium enterprises) competition.

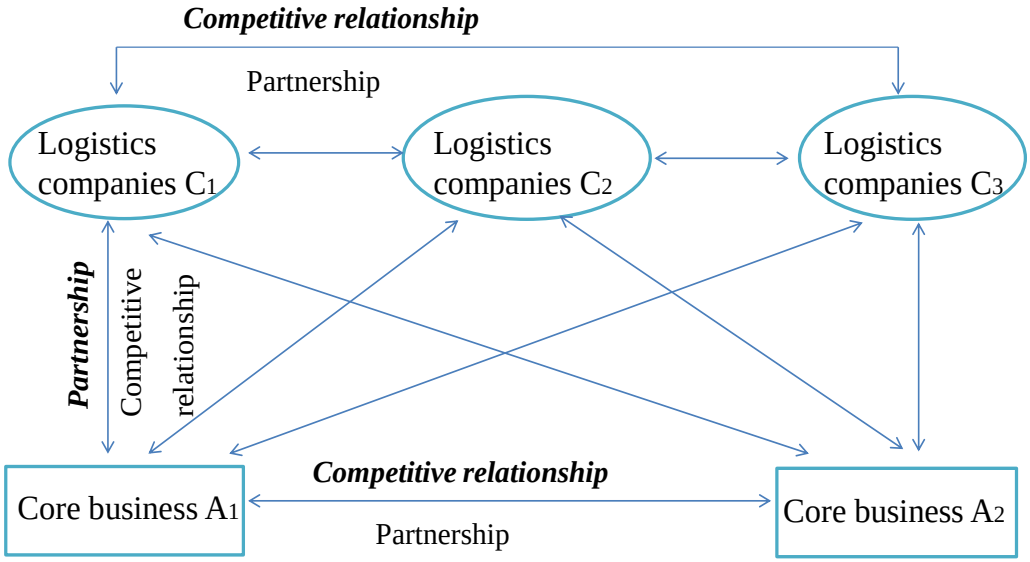

FIGURE 2: COMPETITION AND COOPERATION AMONG ENTERPRISES

Fig. 2 shows that a variety of enterprises among the competition and cooperation diagram in a livestock and poultry industry cluster, the core business A1, A2, logistics enterprises C1, C2, C3. It can be seen that competition and cooperation exist at the same time, however there might have a leading role between the two (the bold font means the dominant role of the two relations).

In food industry cluster, the interaction among enterprises is more obvious, and becomes a staggered network structure. This can be seen easily from Fig. 2 that the competition is dominated by the core enterprises A1 and A2, and between the enterprises C1 and C2 (or C1 and C2, C2 and C3, C3 and C1). Mainly due to the geographical distance is close between the core industries in the industrial clusters, more widely access to other information channels, the spread faster news, basically rely on the same geographical market, therefore the market share, product type, business publicity, management, culture and above than the general competition of enterprises are more comparable. At the same time, the two do not rule out cooperation, such as animal husbandry fresh food enterprises share cold storage, but this is a few cases. However as to cooperation, it clearly exists obviously between the core business and related enterprises, such as the core business A1 and logistics enterprises C1. The main relationship between competition and cooperation in industrial clusters can be summarized as the competition of homogeneous enterprises is greater than that of cooperation, and the cooperation of heterogeneous enterprises is greater than that of competition.

It is necessary for enterprises to give full play to their own core competitiveness, especially the core competitiveness built by a lot of money and manpower, with some other business obtained from the relevant enterprises through outsourcing and other means, making the whole production process more efficient. That is why the core business and related enterprises reached a long-term cooperation consensus. But in practice, not every food cluster in the competing relations are the same as the

theoretical analysis, there are still some situations cannot be ignored, especially obvious vicious competition and lack of competition.

As shown in Fig. 2,when enterprise A1, A2 are seeking logistics cooperation, if core companies in a food cluster is lack of competition (the core business is in a downturn and the demand for related businesses is reduced), it will lead to logistics enterprises C1, C2, C3 in a state of excessive competition. This is what the core business wants to see. In this case, it becomes the "core business market", means that the dominant power is in the hands of the core business, and related enterprises over-competition can give the core business A1, A2 bring lower transaction costs, but not conducive to the logistics enterprises C1, C2, C3 long-term development; If there is an excessive competition between the core business A1 and A2 (core business development is rapid, strong demand for related business), the logistics enterprises C1, C2, C3 have more opportunities to observe cooperation conditions offered by A1 and A2, and choose the most optimized to cooperate. In this case, it becomes the "relevant business market", means that the dominant power is in the hands of the related enterprises. Such a situation can give logistics enterprises C1, C2, C3 bring more benefits, and the core business is certainly to be affected to varying degrees in excessive competition.

No matter it is competition or cooperation, each business wants to hold its own advantage position in the cluster development process. Its development trend can be summarized as homogeneous competition is greater than cooperation; heterogeneous cooperation is greater than competition. Just like the species of the community of species, through the "survival of the fittest, discomfort eliminated" natural choice, each business is on its own ecosystem, to achieve their own and the overall niche balance, forming a stable development Community. Enterprises are just like biological individuals. To analyze the more complex relationship between enterprises is one of the main purposes of this study with niche theory.

III. NICHE ANALYSIS OF ENTERPRISE RELATIONSHIP IN ANIMAL HUSBANDRY FOOD INDUSTRY CLUSTER

Niche theory is an important theoretical concept of modern ecology. Johnson (1910) was the first person who used the word "niche". And then Grinnell (1917), Elton (1927), Hutchinson (1957), Odum (1959), Pianka (1983) and other famous scholars have been committed to the niche analysis and explore. The niche theory can be summarized into three main points: position, function and the relation of species. One of the most critical points is that species in each species spatial position to a stable adaptation. In addition it also has the function of and contact with other species. In the course of the study, scholars have given them specific numerical indicators such as niche breadth, niche overlap, niche size, and niche dimensions.

With the continuous application of niche theory in the enterprise economy, a number of domestic scholars have formed their own niche theory. Enterprise niche is the part of resources and space that can be obtained and utilized by the enterprise in the whole ecological resource space. It is an enterprise and even an industry, in the enterprise ecological environment has a definite position. The niche of the enterprise in the industry is the sign of the competitive strength of the enterprise in the industry (Liang Jiahua, GeZhenzhong, et al., 2002). It is the specific market position, location and function status of an enterprise associated with other enterprises (Lin Xiao, 2003). In the enterprise niche, enterprise in a certain market environment occupies a certain position and plays a role similar to the concept of "market orientation". But it has more ecological connotations than "market positioning" (Xu Fang, Li Jianhua, 2005).Enterprise niche refers to the relative position and function of enterprise in a certain period in the specific ecological environment actively and the environment and other enterprises in the process of interaction form (Yan An, DaQingli, 2005).

The niche of food cluster can be interpreted as those different types of food enterprises have their own stable position in the cluster. The position of each enterprise embodies its comprehensive strength in the industry. In daily production, food enterprises keep close contact with related enterprises in a particular cluster ecological environment, and give full play to their important functions in the cluster, and interact with each other.

By referring to the domestic and foreign scholars' research on niche theory and expanding the result, we can describe the abstract cluster enterprise relationship by the quantitative index mentioned above. Here mainly focus on three aspects. First, the competition between enterprises in the cluster can be expressed as niche overlap. Second, cooperation among enterprises within the cluster can be expressed as the compensation of niche. Third, symbiosis among enterprises in the cluster can be expressed as the equilibrium of neutral theory. (The third point will be analyzed in the next section.)

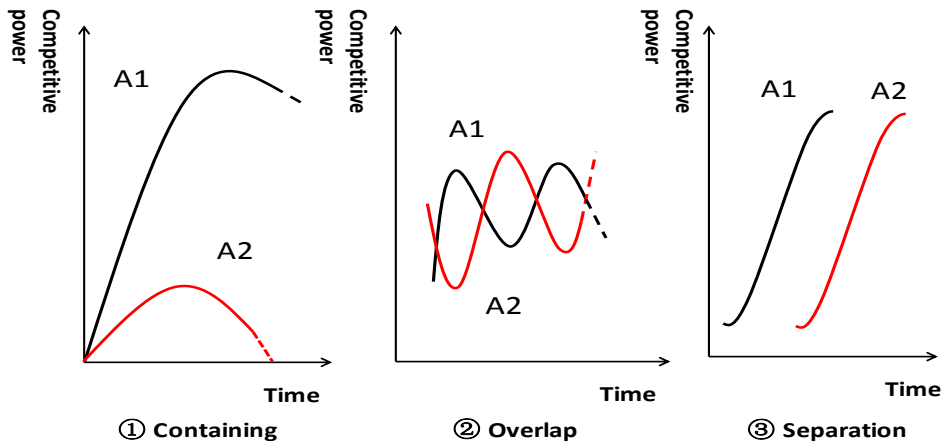

FIGURE 3: SKETCH MAP OF NICHE TYPES

Since the research object is defined as the food industry cluster, the breadth of enterprise niche can be understood as the total demand for the market resources of food enterprises. This indirectly reflects the competitive level of the food enterprises in the competition. If the resources of a food enterprise are more abundant, the niche wider, and the more generalization of the ecological niche, that's means the greater the possibilities of niche overlap. On the contrary, the niche of a food enterprise is narrower, and its niche is more specialized, which shows that the niche overlap is less likely. The above law can be divided into three types as shown in Fig. 3.

Fig. 3 shows the Enterprises A1 and A2 in the animal husbandry and food industry. The above three types indicate respectively.①containing: With the passage of time, the survival of the fittest, the enterprise A1 gradually gain higher competitiveness, gradually eliminate the enterprise A2. (It can be viewed as a special case of overlap, or indirectly as a result of the lack of competition in the enterprise A2.) ②Overlap: This situation shows that competition exists among enterprises, and enterprises A1 and A2 rise alternately in competition.③Separation: it shows that cooperation or symbiosis exists between enterprise A1 and A2. The two ecological niches are parallel, increasing and decreasing, and depend on each other.

However, in the actual situation, we should not ignore the environmental factors of the enterprise, and the related objects should also be considered. Here, we establish a multidimensional coordinate for analysis. In this paper assumes that there is three kinds of main food industry cluster study: the first category is the logistics oriented enterprises, set the X axis. Second is the resource oriented farmers, set to the Y axis. Third is for animal husbandry food enterprises, and it is as a production and processing oriented food enterprises, set to the Z axis.

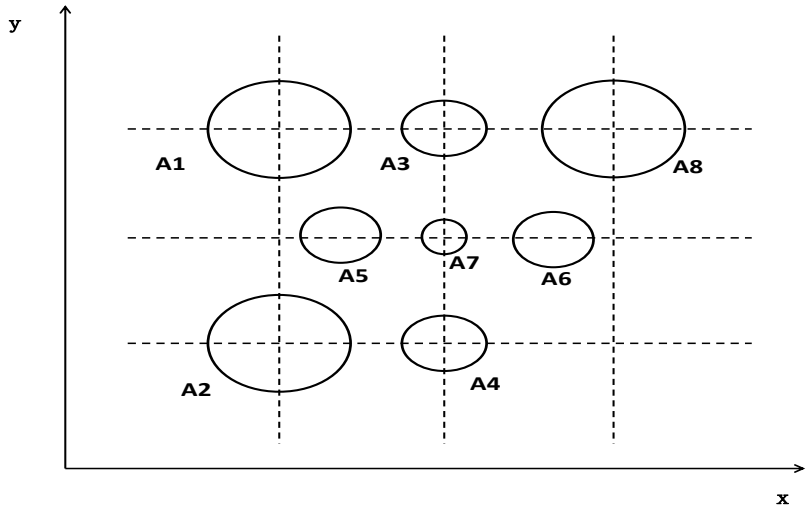

FIGURE 4: SCHEMATIC DIAGRAM OF ENTERPRISE'S TWO-DIMENSIONAL NICHE

Fig. 4 shows the niche of a livestock food industry in a two-dimensional perspective at different related objects. According to the graph above, we can see the direction of the X axis in terms of enterprise A2 and A4, enterprise A1, A3 and A8, and

enterprise A5, A7 and A6 have the same ecological niche. In the direction of the Y axis, enterprise A1 and A2, enterprise A3, A7 and A4 have the same ecological niche. That is to say, there are differences in niche in different dimensions, so we cannot ignore the angle of view of related objects in the process of research. In order to more intuitively reflect the phenomenon of niche overlap, each research enterprise can build a three-dimensional coordinate. Here, for example, the enterprise A1 and A2 of the above diagram, build the following 3D coordinates.

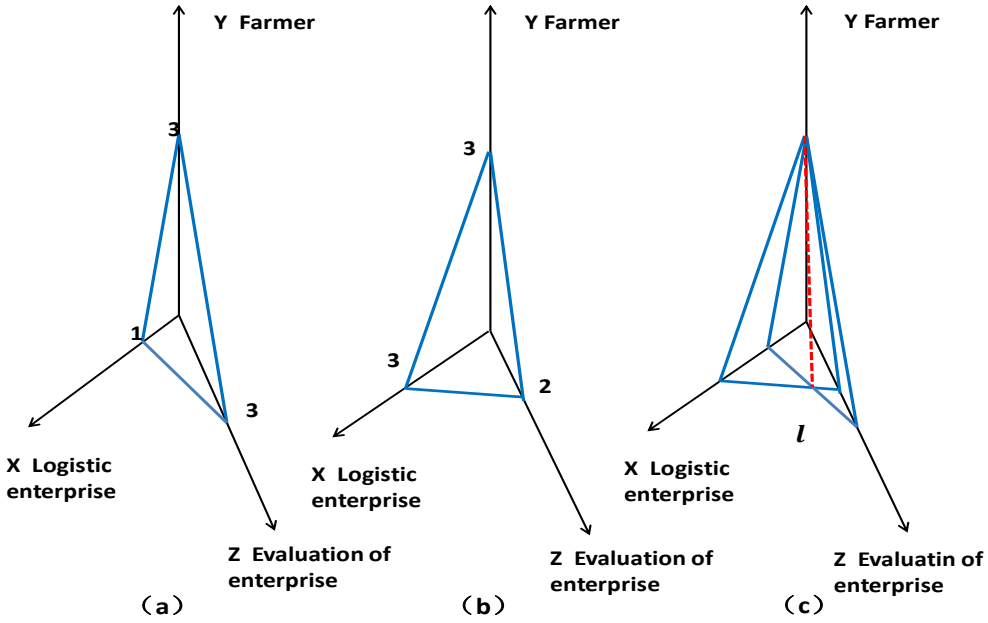

FIGURE 5: ENTERPRISE THREE-DIMENSIONAL NICHE

In Fig. 5, enterprise A1 and A2 have the same niche in the Y axis, i.e. A1 and A2 for farmers is very similar supplier. There must be a high competition between A2 and A1.Both in the Y axis is assumed to be 3. On the X axis, enterprise A1 and A2 have different ecological niche, assuming the A1 in X axis is 1, A2 is 3.The Z axis represents the enterprise's own evaluation (Of course, this evaluation needs to be adjusted after a deep understanding of the enterprises). It is assumed that A1 is 3, A2 is 2.The enterprise A1 and A2 are established in the three-dimensional space of ∆ 133 and ∆ 332.As shown in Fig. 3-C, Put the two triangles in the same coordinate system and intersect at the line l.

This shows that an enterprise and other enterprises in the axis intersect the more line and points, the more it overlaps with other enterprises in the niche, the wider the niche and the more decentralized the enterprise. On the contrary, the more specialized the enterprise is. Similarly, farmers' competitiveness evaluation of enterprises will also affect the competitiveness of farmers, because farmers will want to cooperate with more competitive enterprises. But the enterprises that are competitive with farmers are not necessarily competitive in logistics enterprises. Therefore, the competitiveness of enterprises can also lead to competition in their partner industry.

IV. EQUILIBRIUM STATE OF ENTERPRISE RELATIONS IN ANIMAL HUSBANDRY FOOD INDUSTRY CLUSTER

Niche theory shows that the difference of niche is the key to the existence of species diversity in a community after the natural selection of survival of the fittest. However, the neutral theory is the opposite of the hypothesis of niche theory. The neutral theory holds that the difference between species does not matter to the construction of ecological communities, that is to say, ecological equivalence of species. It is assumed that all individuals in the community are functionally equivalent, and in addition the number of communities is saturated in extent.

This theory of the main assumptions applied to food industry cluster can be summarized as follows: (1) each part of cluster are equivalent. That's means the Enterprises have same statistical properties, such as production, processing, and transportation efficiency. They will not change with the enterprise's changing. (2) Cluster is a saturated cluster. That is to say, once a food enterprise or other related enterprise goes bankrupt, then the cluster will be accompanied by another new random individual to come. In order to better understand the changes of the above two basic assumptions, the performance and change of enterprises and related enterprises in the neutral theory can be observed in the examples in the last section.

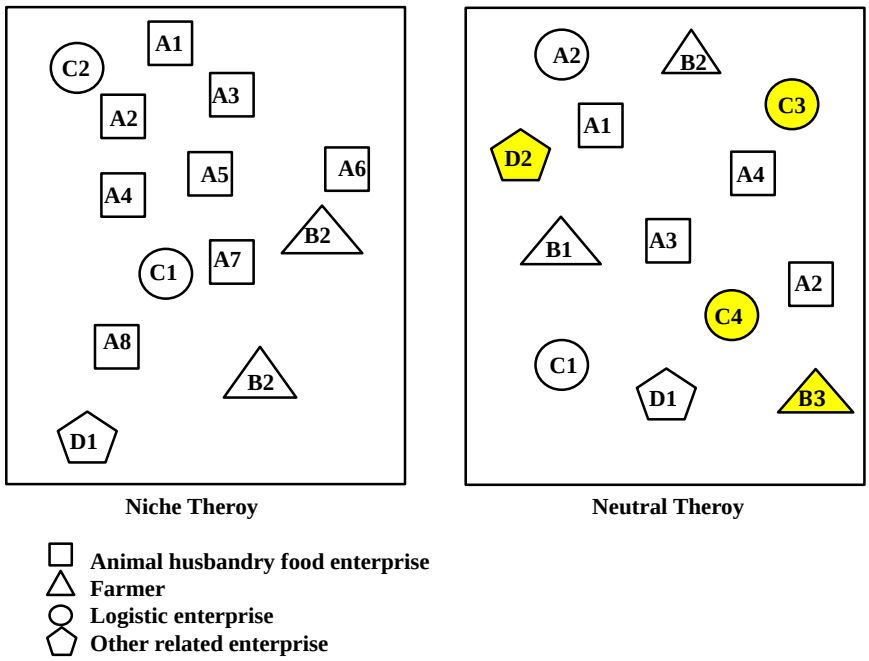

FIGURE 6: CHANGE OF NEUTRAL THEORY IN ANIMAL HUSBANDRY FOOD INDUSTRY ENTERPRISES

The diagram shows a clear change from niche theory to neutral theory. Apart from the reduction of 8 animal food industry enterprises to 4, the remaining 2 farmers increased to 3, logistic enterprises increased from 1 to 4, and 1 other related enterprises increased to 2.In the original niche, the homogeneous competition among the enterprises of animal husbandry and food industry led to the disappearance of some vulnerable enterprises. At the same time, the retained enterprises have driven the development of their cooperative enterprises.

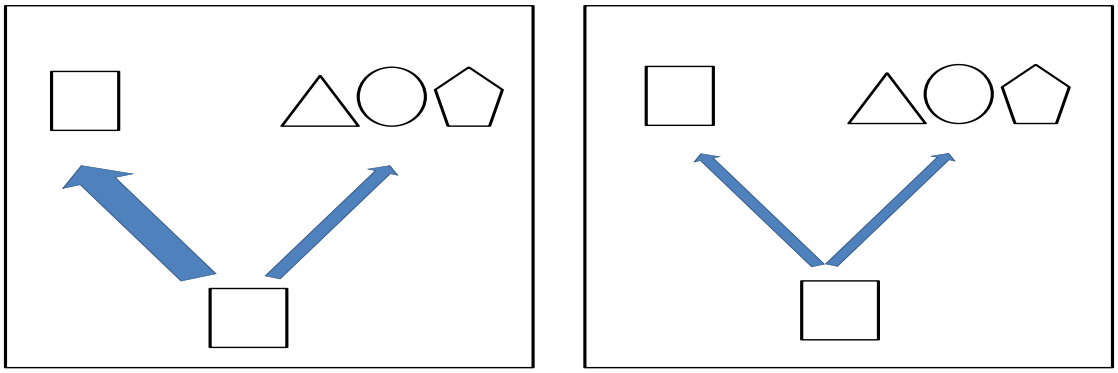

FIGURE 7: COMPETITION BETWEEN ANIMAL HUSBANDRY FOOD ENTERPRISES OF NEUTRAL THEORY

As shown in Fig.7, the size of the arrow represents the extent to which the animal husbandry food industry is more competitive with other enterprises, and the thicker the arrows, the more intense the competition. In niche theory, homogeneous enterprises inhibit each other's development to a greater extent than those of heterogeneous enterprises, mainly because cooperation between heterogeneous enterprises is greater than competition. But in neutral theory there is no extent of size and depth because each enterprise is equivalent. This law can also be represented by rates and quantity diagrams in Fig.8. Among them, l_1 andl_3 indicate the relationship between the quantity of animal husbandry food industry and the rate of development. l_2 andl_4 respectively indicate the relationship between the number of farmers, logistics enterprises and other related enterprises along with the development rate. Generally speaking, when a homogeneous population develops rapidly, it will restrain self-development and reduce the quantity. Conversely, when the homogeneous population develops slowly, its self-inhibition will decrease and the quantity will increase. Therefore, we believe that the neutral theory emphasizes a balanced state on the basis of niche theory. It is an ideal condition for enterprises in mature industrial clusters to achieve symbiotic balance through competition.

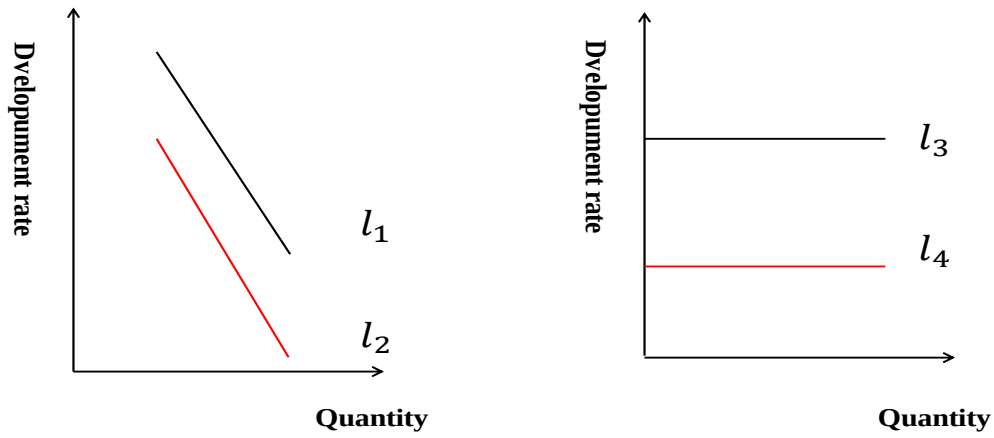

FIGURE 8: NUMBER OF ENTERPRISES OF FOOD INDUSTRY WITH THE DEVELOPMENT RATE CHANGES

V. CONCLUSION

In the research assume that the food industry cluster is a crisscross network structure, enterprises in the cluster are homogeneous, heterogeneous or complementary, reflects the relations of competition, cooperation and symbiosis among enterprises in the cluster.

Due to the particularity requirements for food safety, its operation from environment, raw material, collaboration, inspection or quarantine institutions to any participant are extremely strict, this requires enterprises, farmers, and specialized agencies set up sound relations. Our research regard the food industry cluster as a natural biological community, and to make every enterprise in the cluster find its own position, and form a "ecological community". The research aim is to build collaborative evolution and sustainable development model for food industry cluster, from the perspective of ecology.

Through the analysis of the above can be found, in animal husbandry food industry cluster, homogeneous enterprises located in the state of niche overlap, there will be a shift to the fierce competition in the spiral phase, also be a result of natural selection. In addition, with the development of the competition, the cluster tends to be balanced. In the process of equilibrium, the inhibition of competition between homogeneous enterprises is greater than that of heterogeneous enterprises, i.e. the general trend of "homogeneous competition and heterogeneous cooperation".

When the equilibrium state comes, the cluster is in a state of saturation. The demise of old businesses will be replaced by new ones. The ecological niche difference between enterprises is also played down. Each enterprise is the equivalent individual in the cluster. The speed and quantity of the enterprise will not change again. That's what we call equilibrium -- symbiosis.

Symbiosis is a special situation in a cooperative relationship and a closer relationship than cooperation. It can be simply understood as co-existence. That is to say, the symbiotic enterprise is an intimate long-term strategic cooperative partnership, which is dependent on each other and is interdependent, and the ecological niche overlap is low. The low overlap of enterprise niche will avoid the confrontation between enterprises in the cluster because they produce the same products and compete for the same market and source. Ecological niche resource complementary or ecological niche separation can promote the relationship between enterprises to seek their respective development resources. At the same time, the daily operation of the communist party will reduce the transaction cost of enterprises and improve the efficiency of production and operation. For a business, it's good to have a symbiotic relationship, and it's not good. Once a party has a major problem such as financial or even bankruptcy, the other party is bound to get involved. As businesses become more dependent on each other, once the symbiotic object goes bankrupt, the business can be severely damaged or even bankrupt.

Although the competition itself has led to cooperation, it is not what we want to see whether it is excessive competition or lack of competition. What people want is a balanced development in the cluster, when the market itself does not have a role to play, with the help of government intervention. So the other main purpose of this study is to provide a manageable, maneuverable policy recommendation series to the government level. Subsequent research will be based on the theoretical framework of this paper, and the empirical research will be carried out in detail in various animal husbandry food industry clusters, such as fresh meat, frozen meat, eggs and milk.

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