Comparison and Selection of Organization Modes in Edible Fungus Industry of Shandong Province

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Abstract China is the largest producer and exporter of edible fungus in the world, and Shandong is the largest producer of edible fungus in China. This study is intended to select suitable organization mode for edible fungus industry of Shandong Province. On the basis of types and characteristics of existing edible fungus production modes in China, it is concluded that Shandong Province should take following measures: (1) giving priority to development of integrated organization mode; (2) steadily promoting park and factory mode in economically developed regions; (3) developing circular agriculture in regions with solid foundation of agriculture and animal husbandry. Finally, it puts forward following recommendations: (1) speeding up construction of standardization and information platform for edible fungus industry; (2) improving quality of personnel engaged in edible fungus industry; (3) bringing into play driving effect of leading enterprises; (4) developing and introducing deep processing enterprises.

Key words Edible fungus, Industry, Organization mode

China is the largest producer and exporter of edible fungus in the world. Domestic scholars have made extensive researches on development of the edible fungus industry, while most researches focus on industrial organization modes. Relying on the development of edible fungus industry in certain region, the scholars have made exploration and innovation in industrial organization. In combination with different regions and research perspectives, Shandong Province has established many organization modes of edible fungus industry, such as company + farmer household, standardization mode, factory mode[1] and circular agriculture mode. Some scholars compared different organization modes and discussed selection of organization modes for edible fungus industry on the basis of actual situations of the study area[3]. Since the research perspective is varied, no unified understanding has been reached on organization mode of edible fungus industry.

Shandong Province has solid agricultural foundation and edible fungus industry develops rapidly. In 2011, the total output of edible fungus in Shandong Province reached 3.152 million tons, with output value up to 18.33 billion yuan. At present, Shandong Province has become the largest province producing edible fungus in China. Shenxian, Xintai, Zoucheng, and Mouping become the first batch of edible fungus producing counties, and their industrial development has made significant achievements. In the aspect of integrated development, the "Company + Farmer household" mode of Shenxian County has made marked progress. In the aspect of factory mode, there are near 100 edible fungus factories in Shandong Province with investment amount above 10 million yuan. In the aspect of park construction, Shandong Province has established more than 10 modern edible fungus parks in recent years. With promotion of government and drive of market demand, the industrial level of edible fungus is significantly improved and developed toward deep processing.

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1 Comparison of organization modes of edible fungus industry

In the long term development process, China's edible fungus industry has formed characteristic organization modes, as listed in Table 1.

1.1 Integrated mode

1.1.1 Major forms of the integrated mode. The integration is the process of several mutually independent entities of property right gradually combining together to a single entity in a certain way. In the integration process of edible fungus industry, the integrated mode is manifested in different organization forms, such as "Company + Farmer household", "Company + Farmer household + Wholesale market", "Company + Cooperative + Farmer household", and "Company + Base + Farmer household", *etc*[4-5]. In "Company + Farmer household" mode: in the production of edible fungus, a company invests in construction of mushroom houses, provides fine seeds and support and guidance for farmers in technology and management, and edible fungi produced are purchased by the company; In "Company + Farmer household + Wholesale market" mode: a company provides fine seeds and technological support, and wholesale market sells edible fungus produced by farmer households, to realize integrated production, supply and marketing; In "Company + Cooperative + Farmer household": a cooperative provides fund and technological support for farmers, and a company provides fine seeds and technological guidance, such mode provides certain fund for farmer households and reduces access threshold of farmer households; In "Company + Base + Farmer household" mode: it stresses standardization of production

and promotion of the base, convenient for building brand of edible fungus.

1.1.2 Characteristics of integrated mode. Compared with production of general agricultural products, edible fungus industry has harsh production condition and high technological content. Therefore, the integrated mode is of great significance to development of the edible fungus industry.

(1) The integrated mode attaches importance to extension of the industrial chain, which is favorable for sharing risks in all links. For example, in "Company + Farmer household" mode, a company provides fine seeds and technological and management guidance for farmer households, and purchases the fungus produced by farmer households at contract price, so farmers need not worry about difficulty in selling products or losses brought about by large fluctuation of price. With the aid of technology and market leading power of the company, it is able to reduce production and market risks of farmer households.

(2) The integrated mode is favorable for improving quality of edible fungus. At present, frequent occurrence of quality safety of edible fungus and residues of pesticide and chemical fertilizer are mainly due to lack of effective organizational management and external supervision. In the integrated mode, the company can monitor production of farmer households, and restrict standardized production of farmer households through leading function of product procurement on quality, to improve quality of edible fungus.

(3) The integrated mode is helpful for solving the fund deficiency problem of mushroom farmers in the production. Most organization forms of the integrated mode have significant function to solve the fund deficiency problem. For example, in "Company + Farmer households" mode, the company can provide fund for farmer households to build production facilities or sell some means of production on credit; in "Company + Cooperative + Farmer household" mode, fund of the cooperative can be used for edible fungus production of farmer households. With the aid of external funds, mushroom farmers can use fewer funds to conduct larger scale production.

Table 1 Comparison of organization modes of edible fungus industry

Organization modes	Major forms	Advantages	Disadvantages
Integrated mode	"Company + Farmer household", "Company + Farmer household + Wholesale market", "Company + Cooperative + Farmer household", and "Company + Base + Farmer household"	(1) Reducing risks of mushroom farmers; (2) Rapidly expanding industrial scale; (3) Helpful for improving quality of edible fungus.	(1) Excessive dependence on contract easily leads to moral hazard; (2) It is difficult to realize real fairness in allocation of benefits in all links.
Factory mode	Advanced greenhouse provided with mechanized and automatic management equipment and mushroom farmers as daily management personnel	(1) Breaking the seasonal limit of edible fungus planting; (2) Possible to control natural conditions of edible fungus growth; (3) Improving quality.	(1) Investment scale is large; (2) Personnel quality needs high; (3) It is difficult to rapidly expand the scale.
Pagoda honeycomb briquette mode	Line management type technological innovation organization with guidance of government and participation of post experts	(1) Bringing into full play functions of innovation team; (2) Helpful for scientific and technological extension.	(1) Many levels and difficult management; (2) Relatively mature innovation team required.
Circular agriculture mode	Agricultural waste → Production of edible fungus → Fertilizer and energy conversion of waste → Agricultural production	(1) Protecting ecological environment; (2) Increasing resource utilization efficiency.	(1) High technological requirement; (2) Difficult to achieve scale due to limit of cost and technology.
Park mode	Putting production, processing, logistic and marketing enterprises together in a special park	(1) High radiation and driving function; (2) Easy to cultivate leading enterprises; (3) Low transaction cost.	(1) Large investment scale; (2) Great dependence on government.

The integrated mode is widely suitable in the whole country. However, the implementation of this mode needs perfect credit mechanism as guarantee. For example, in "Company + Farmer household" mode, purchase relationship is established between company and farmer household in the form of contract. This can reduce operating risk of farmer households, but the company and farmer households will face moral risk of breach of contract. This needs perfect credit mechanism as guarantee, to make the delinquent party receive due punishment and the aggrieved party receive proper compensation. In addition, in this mode, the company generally holds the strong position, which squeezes profit of other links in the industrial chain, consequently leading to unfair allocation of profit.

1.2 Factory mode

1.2.1 Factory mode of edible fungus industry. This mode adopts new production technology, necessary facilities and suitable varieties and corresponding cultivation technology, in the hope of bringing the edible fungus industry to be an intensive industry with high input and high output[6]. It stresses mechanization, large scale and automation of edible fungus production. Through construction of production facilities, this mode can break seasonal limit of edible fungus production and realize constant production of edible fungus, to satisfy constant demand of edible fungus market.

1.2.2 Characteristics of the factory mode. The factory mode uses advanced edible fungus production factory building and controls natural environment (such as temperature, humidity and sunshine) of edible fungus production through people, to realize standardized production and management of edible fungus. Since the production process is controllable, it is favorable for improving quality of edible fungus products and strengthening competitive power of edible fungus industry.

This mode can deal with the uneven allocation of benefits of

entities in the integrated mode. In the integrated mode, due to subordinate to different entities, there are potential benefit conflicts between farmer households and cooperative, company and cooperative or base, generally leading to disintegration of the integrated mode. In the factory mode, since all links belong to the same entity, there is no problem of benefit allocation. In addition, industrial benefits can be adjusted in all links, which improves ability of enterprises to resist market risks.

The factory mode needs harsh conditions. As a result, it is difficult to rapidly expand the production scale. On the one hand, the factory mode needs huge fund input, including fund for construction of standardized factory building and control facilities. On the other hand, the factory mode needs advanced technology and management means, and has high requirement for quality of personnel engaged in this industry. Therefore, this mode is suitable for field with manure technology and area with high level of economic development.

1.3 Pagoda honeycomb briquette mode

1.3.1 System structure of the pagoda honeycomb briquette mode. This mode is a high efficient cooperative mode consisting of state modern edible fungus industrial technological system, provincial innovation team, county's industrial base, relevant enterprises and farmer households. Generally, in the modern edible fungus industrial technological system, the lower level is always larger than the upper level, like a pagoda, whose top is the designer and commander of the system; the second level is chief scientists of state modern edible fungus industrial technological system; the third level is executors of state system functional laboratory, post experts and agricultural department at the state level, and commanders at provincial level; the fourth level is innovation team; the fifth level is agricultural technological service personnel in county's industrial base; the sixth level is vast mushroom farmers and relevant enterprises[7]. The pagoda honeycomb briquette mode emphasizes integrating scientific and technological forces under the guidance of government, advocates establishment of local innovation team to bring into play its function in local sci-tech innovation, and post experts make innovation in respective fields according to classification of edible fungus.

1.3.2 Characteristics of the pagoda honeycomb briquette mode. This mode adopts system of division of responsibility to realize connection of levels. It takes the edible fungus as the main line, establishes perfect technological system in the whole country, divides labor for experts according to different products, and focuses on researches to realize technological innovation. Besides, this mode stresses overall arrangement, which is favorable for building rapid technological service and extension system. However, this mode needs participation of government, to realize coordination of all levels. Since this involves a wide range, it is difficult to realize. Since this mode is an organization form pertinent to technological innovation, its implementation needs strong scientific research force, and the development level of edible fungus industry should be high. This mode stresses technological innovation, so it is highly complementary to other organization modes.

1.4 Circular agriculture mode

1.4.1 Basic principle of the circular agriculture mode. With increase in people's environmental awareness, the environment – friendly industry is gradually receiving policy support. The circular agriculture mode is a high-efficient circular mode using wastes of agriculture and animal husbandry for edible fungus breeding[8]. It uses agricultural waste, such as wheat straws and chicken manure, to breed edible fungus. Fungus dregs can be used to make marsh gas for energy, and also can be used as quality fertilizer or animal feed, so it increases the resource utilization efficiency. Through setting proper edible fungus matching ratio, it is able to increase conversion ratio of agricultural wastes. The edible fungus circular agriculture mode is a part of circular economy.

1.4.2 Characteristics of the circular agriculture mode. Raw materials of edible fungus can be obtained through processing of wastes such as crop straws and animal manure, thus the production of edible fungus can effectively use resources to protect ecological environment. The circular agriculture mode can further expand such function. It takes used raw materials as fertilizer or production energy, so it can strengthen intensification of agricultural production, which is helpful for realization of characteristic and high-efficient agricultural production. The realization of circular agriculture mode needs higher technological support. No matter the conversion of agricultural waste to raw material, or production waste of edible fungus to fertilizer and energy, it needs advanced technology, while the improvement of technology is the precondition of increase in conversion ratio of agricultural resource utilization. The circular agriculture mode is the development direction of edible fungus industry. But due to limitation of cost and technology, it is difficult to realize large scale application. At present stage, such mode is suitable for areas with higher development level of traditional agriculture and animal husbandry.

1.5 Park mode

1.5.1 Organization form of the park mode. In the park mode, all enterprises and service industry relevant to edible fungus industry are centralized in a park[4]. Relevant enterprises include edible fungus breeding, planting, processing and sales enterprises. Service industry includes technical guidance and innovation, market information consultation, and services necessary for other basic production. The edible fungus park can regionally arrange enterprises in the edible fungus industrial chain, to realize the scale merit of edible fungus production through setting up industrial clusters.

1.5.2 Characteristics of the park mode. In this mode, enterprises relevant to edible fungus production are gathered into a park, and information, technology and personnel are also centralized in a park, which is not only favorable for research and development and conversion of edible fungus technology, but also reduces transaction cost of links of the industrial chain. Besides, in the construction of edible fungus park, government should make certain support policy to facilitate building characteristic brands and

leading enterprises of edible fungus, promoting development of surrounding regions, and expanding the scale of edible fungus industry. The realization of park mode needs more investment, and it has high dependence on government policy, so the primary condition is government support. The park mode focuses on centralization of the edible fungus production, so it is complementary to the integrated mode of extending the industrial chain. Since the construction fund is large, this mode is suitable for implementation in regions with higher industrial level.

2 Selection of organization modes in edible fungus industry of Shandong Province

2.1 Giving priority to development of the integrated mode Relying on the company and integrating existing edible fungus production individuals, the integrated mode can reduce production and market risks of mushroom farmers and rapidly expand the industrial scale. Such mode features small investment, low access threshold, and rapid effect, so it should enjoy priority development. The development of edible fungus industry in Shandong Province should take the integrated mode of Shenxian County as the sign post, combine local economic development level and current development situation of edible fungus industry, choose "Company + Farmer household", "Company + Base + Farmer household" or "Company + Base + Cooperative + Farmer household", and use these organizations to make the entire industrial chain share risks and benefits, to jointly promote development of the edible fungus industry.

2.2 Steadily promoting park and factory mode in economically developed regions The park and factory mode needs high input and high technology, management and personnel requirement, so both modes are suitable for economic developed regions. Shandong Province is a large province but not a strong province of edible fungus production, mainly because of backward park and factory construction. Except existing parks, Shandong Province may develop edible fungus industrial parks in economically developed regions, and gather relevant edible fungus enterprises. In addition, there are many varieties but few fine ones of edible fungus in Shandong Province, but foreign exchange earning is relatively low. With economic globalization, the requirement for quality of agricultural products is increasing. The factory production mode is just favorable for realizing standardization construction and improving quality of edible fungus production. Therefore, it is feasible to steadily promote the factory mode in economically developed regions.

2.3 Developing circular agriculture in regions with solid foundation of agriculture and animal husbandry The circular agriculture mode needs better agricultural and animal husbandry foundation. In qualified regions, it is proposed to use crop straws or animal manure as raw materials for production of edible fungus. The production waste can be used as fertilizer or fermented to become marsh gas, then returned to farmland, consequently forming a regional ecological cycle. For example, Taian City, as a tourism city, has high requirement for environment. At the same time, there are also mountain regions, hilly regions and plain areas, so the common development of crop cultivation and animal husbandry can provide rich raw materials, it should properly adopt circular agriculture to produce edible fungus and build characteristic high efficient agriculture.

In sum, various organization modes of the edible fungus industry have respective applicable conditions. With change of these conditions, the organization mode should also change. The "Company + Farmer household" mode in Shenxian County, for instance, has promoted development of local agaricus bisporus. And Shenxian County has obtained huge economic benefits. At present, Shenxian County is exploring a multiple innovative integrated mode. Besides, park construction and factory production already have basic conditions and are steadily implementing. Therefore, it should bring into play advantages and complementary functions of respective mode in accordance with local objective conditions, to improve industrial development level of edible fungus production.

3 Policy recommendations for speeding up development of edible fungus industry in Shandong Province

3.1 Speeding up construction of standardization and information platform for edible fungus industry Edible fungus is a type of green and high efficient agricultural product. It not competes for grain with human, not competes for land with grain, not competes for fertility with land, and not competes for season with farmers. Thus the edible fungus industry should receive close attention of Shandong provincial government. In addition, the development of edible fungus industry also needs great support of government in policies, environment and infrastructure. Firstly, government should improve the industrial standard system for edible fungus industry as soon as possible, formulate standards for preproduction, production and postproduction process of edible fungus production, establish a standard system from production place, cultivation process, product to purchase, processing, package, storage, transportation and marketing, to ensure healthy development of edible fungus industry. Secondly, government should promote construction of information platform for edible fungus production, to keep edible fungus at stable price level, and reduce market risks of farmers and enterprises due to information asymmetry.

3.2 Improving quality of personnel engaged in edible fungus industry The edible fungus production needs adequate personnel support. Talent can provide guarantee for park construction and factory production. Thus, talent is a foundation for realizing standardized production of edible fungus and improving quality of edible fungus. Shandong Province should attach importance to introduction and cultivation of talents. Apart from providing training services for edible fungus production farmers, government should also increase effort in technological extension, and invite experts from colleges and universities or research institutes to popularize planting technology and management ways of edible fungus.

3.3 Bringing into play driving effect of leading enterprises

It is recommended to bring into play driving effect of leading enterprises to build regional brands. The park construction and integrated construction need promotion of leading enterprises, and enthusiasm of farmers for planting edible fungus also needs drive of leading enterprises. Government should lay stress on cultivation of leading enterprises, take leading enterprises as support, bring into play scale advantage of the integrated mode, and drive farmers' edible fungus production. Also, government may take leading enterprises as guide, bring into play advantages of factory and park modes, set up local edible fungus brands, and improve standardized production level of edible fungus.

3.4 Developing and introducing deep processing enterprises

Industrialized development of edible fungus has become an inevitable trend, while deep processing enterprises, as extension of the industrial chain, not only can alleviate fluctuation in supply and demand of edible fungus market, but also can increase profit margin of edible fungus industry. Through guaranteeing higher profit level of the edible fungus industry, it is possible to attract more enterprises to enter the edible fungus production industry and promote sound and sustainable development of edible fungus industry.

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policy support for use of the regional brand, assist industry association and strategic alliance enterprises in formulating qualitystandards of *Carya Cathayensis*, use standards and security system of regional brand; on the other hand, they strictly crack down on workshop production of *Carya Cathayensis* and selling of counterfeit or inferior products, and implement GB/T19000 - ISO9000 standards to maintain the market image of the regional brand Lin'an *Carya Cathayensis*.

4.4 Formation of corporate alliance The leading enterprises are major market contributors for a larger and stronger industry. Success in corporate alliance - based regional brand operation mode of Lin'an *Carya Cathayensis* depends on cooperation attitude and practices of leading enterprises to some great extent. The government shall enhance its guiding role to facilitate alliance of enterprises connected through capital upon the principle of investment income. It shall be fully noted by leading enterprises that the regional brand is a kind of rare brand resources with great value. Successful operation of such resource can bring enormous profits. Therefore, the leading enterprises shall cooperate with each other and joint efforts to develop, expand and strengthen the featured industry of Lin'an *Carya Cathayensis* and establish robust regional brand, creating economic benefits impossibly generated by a single enterprise.

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