DOI 10.15302/J-SSCAE-2019.04.009

China–Africa Cooperation in Edible Fungus Industry Technology

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Abstract: The backwardness in agricultural technology has seriously hindered agriculture in Africa. As a responsible nation with a long history of farming and culture, China can develop a win–win cooperation with Africa through export of its practical production technologies. Since enterprises are the main bodies for China's agriculture to "go global", this paper takes Jilin Province Overseas Agricultural Investment and Development Group Limited Company as an example. The competitive edible fungus industry in China and Africa's own resources and market advantages make it possible for China's edible fungus industry technology to expand its market to Africa. To promote this cooperation in edible fungus industry technology, suggestions are proposed, including selecting leading varieties suited to local conditions, controlling the production scale expansion speed, strengthening the training of technical personnel, and making full use of preferential national policies.
Keywords: edible fungi; China–Africa cooperation; the Belt and Road; agricultural corporation

1 Introduction

Africa is the most densely populated region of developing countries and occupies a pivotal position on the international stage. Due to poverty, hunger, disease, ethnic conflicts, and other factors, the level of social development and overall economic development in Africa is relatively low and backward. The most undeveloped countries in the world are part of Africa [1]. In fact, Africa's land area is 20.4%, of which 48% is forest and grassland. At the same time, there are 1.2 billion people, abundant natural resources, and human resources in Africa, which form a unique environment for agriculture, and a huge potential for the development of modern agriculture. However, due to the low level of agricultural technology, agricultural development in Africa has been increasingly difficult, and African countries, such as Zambia, are suffering from a lack of food security [2]. The rapid development of agriculture through the introduction of advanced production technology is not only a common aspiration among African countries, but also directly relates to the achievement of "Vision 2063" for Africa.

As early as the 1950s, China began agricultural cooperation with Africa in the form of aid [3]. As China is an ancient nation with a long history of farming and culture, through long-term historical practices, the Chinese have created and inherited farming techniques that are in line with their own farming conditions, capturing years of experience and lessons in agricultural production. From this perspective, the trajectory of Chinese agriculture production could serve as an important reference path for the development of African agriculture [4]. By introducing practical Chinese agricultural technology into Africa, combined with rich, local natural resources,

Received date: May 30, 2019; **Revised date:** June 10, 2019
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Funding program: CAE Advisory Project "Research on the Development Strategy of China's Agricultural International Cooperation under the Belt and Road Initiative" (2016-XZ-19)
Chinese version: Strategic Study of CAE 2019, 21 (4): 105–110
Cited item: Li Fenni et al. China-Africa Cooperation in Edible Fungus Industry Technology. *Strategic Study of CAE*, https://doi.org/10.15302/J-SSCAE-2019.04.009

China can effectively promote African agricultural construction and China–Africa agricultural cooperation as well as address the current world food security situation [5], satisfy the needs of jointly building a global food production base [6], reflecting its responsible image by fulfilling the obligation of a major power [7], and demonstrate China's international influence.

The proposal and implementation of the Belt and Road initiative provide a rare historical opportunity for China to carry out agricultural cooperation with the countries along the route. Africa is one of the key areas designated for China's foreign cooperation. This is a worthy initiative considering that China and Africa already have in place extensive cooperation in agriculture to promote Africa's economic and social development. The modes of China–Africa agricultural cooperation include aid, trade, investment, and so on [3]. Among them, enterprises are the main means for China's agriculture to "go global" [8]. Jilin Province Overseas Agricultural Investment and Development Group Co., Ltd. has the first and largest factory producing edible fungus annually in Zambia. Taking the Jilin Province Overseas Agricultural Investment and Development Group Co., Ltd. as an example, this paper analyzes the necessity and possibility of the expansion of China's edible fungus industry to Africa, the current situation and effect of edible fungus enterprises in Africa, and the proposed path and suggestions to promote the China–Africa alliance in the edible fungus industry technology.

2 The necessity and possibility of expanding China's edible fungus industry to Africa

2.1 The competitive edible fungus industry in China

China has a long history of edible fungus cultivation and was one of the earliest countries to recognize and utilize edible fungus [9]. After a long period of cultivation, there are more than 2 000 species of wild edible fungus in China, more than 100 species of domesticated cultivated edible fungus, and about 60 kinds of commercial edible fungus. As a country, China has the richest strain resources and the most cultivated species of edible fungus in the world [10]. Since the 1990s, in particular, by relying on unique conditions and strong policy support, the edible fungus industry in China has developed rapidly with China becoming the largest producer and exporter of edible fungus in the world [11]. According to the statistics of the China Edible Fungus Association, the output of edible fungus in China reached 37.12 million tonnes in 2017, with a value of 272.2 billion yuan. The edible fungus industry has become the fourth largest planting industry after grains, vegetables, and fruits. At the same time, with characteristics as nutritional and safe, edible fungus has not only become one of the mainstays of agricultural products for export earnings [12], but also one of the important products that are making up for other agricultural product deficits in China [13]. According to national customs data, China exported 0.548 million tonnes of edible fungus products and earned 3.17 billion US dollars in 2016. Thus, the edible fungus industry has become an important foreign exchange industry in China's agricultural sector. Clearly, China has mature edible fungus production technology, rich planting experience, and strong industrial strength.

2.2 Reflecting a responsible image as a large country

The lack of food has been the major obstacle to economic and social development in Africa. Africa suffers from severe food shortage and insufficient supply [14]. As edible fungus is rich in protein, minerals, and vitamins and other nutrients, it not only can be used as a substitute for other foods [15], thereby alleviating pressure on the local food supply and effectively improving the nutrition in Africa, but can also solve the problem of labor employment and play a role in poverty alleviation and prosperity. Therefore, Africa is the largest potential market for the foreign trade of edible fungus in China [16]. Notably, edible fungus is a fresh and perishable agricultural product, and the distance between Africa and China is significant. Hence, it is difficult to maintain fresh edible fungus in the trade process, generating relatively high transportation costs. The economic value of edible fungus is relatively high, which means there are certain requirements regarding the ability to pay. In the context of the low economic circumstances in Africa, transporting edible fungus to the African market directly over the long distance is hard to achieve. As it is often said, "It is better to teach people to fish than to give them fish." With the impetus of the Belt and Road initiative, adjusting the idea of African cooperation and exporting China's edible fungus industry technology into Africa directly can conform not only to the trend of world economic integration, but also contribute to economic and social development promotion and the improvement of people's livelihoods in Africa, ultimately, reflecting China's positive image as a "responsible, big country."

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2.3 Africa's own resources and market advantages

Since 2009, Africa has been China's largest trading partner [1]. There are more than 50 countries and regions in Africa and Zambia, in south-central Africa, was the first country to establish diplomatic relations with China [17]. Therefore, there are certain advantages in providing agricultural assistance to Zambia by relying on edible fungus technology industry [18].

In terms of the natural environment, Zambia has a land area of 7.5×10^5 km^2 (equivalent to three provinces in Northeast China). In Zambia, the arable land accounts for 57%, reflecting that it is rich in land resources. Zambia also has a tropical climate. Moreover, as most regions are located on the plateau with altitudes of 1000 to 1500 m and the annual average temperature is 18 °C to 20 °C, the cool climate and low humidity are ideal for growing edible fungus. Zambia has a dense river network, with about 45% of the groundwater resources in southern Africa, reflecting that Zambia is rich in water resources, and creating superior agricultural production conditions. Byproducts, such as corncobs, cottonseed hulls, sawdust, and cassava stalks produced through the growth of local crops, provide sufficient and low-cost materials for the production of edible fungus. Zambia has a population of 14 million people, which means that labor costs are low. In other words, Zambia has the advantages of labor, hydrology, land, climate, raw materials, and other resources for the development of a large-scale edible fungus industry.

In terms of its economic environment, Zambia is positioned well geographically. Tanzania borders Zambia on the northeast, Malawi borders it on the east, Mozambique borders it on the southeast, Zimbabwe, Botswana and Namibia border it on the south, Angola borders it on the west and the Democratic Republic of the Congo borders it on the north. Its unique geographical positioning makes it conducive for Zambia to export edible fungus to these surrounding countries, which can, thereby, stimulate economic development, increase foreign exchange, and form a radiation effect in the surrounding countries. Additionally, edible fungus is rich in nutrients and unique in taste, as well as extremely popular among local residents, becoming a traditional dish in Zambia and other African countries. However, there is no complete edible fungus industry system in Zambia and its eight neighboring countries. Thus, this provides a good market development environment for Chinese edible fungus enterprises to enter Zambia.

3 The social and economic effect of edible fungus enterprises in Zambia

3.1 Promoting the development of modern agriculture

The rapid development of domestic edible fungus production technology, especially factory-based production, has attracted increasing private, industrial, commercial, and foreign capital to the edible fungus industry. Although the entry of such capital has led to the transformation and upgrading of the industry, these funds usually lack technological support and simply copy production workshops and models. However, in the case of limited market expansion, the rapid increase in the number of edible fungus enterprises has not only led to fierce market competition, but has also caused serious, ineffective loss, creating a negative impact on the sustainable development of the edible fungus industry. Overseas investments by edible fungus enterprises that enter Africa not only avoid the disordered competition with other domestic edible fungus enterprises, alleviating the competitive pressures in the domestic edible fungus market, but also promote the production capacity of the edible fungus industry, the export of production technology, and the development of modern agriculture in Zambia and other importing countries.

3.2 Increasing local employment opportunities and resident income

Agriculture is the leading industry in Zambia. More than 60% of the four million workers are engaged in agricultural production activities. Although Zambia has sufficient natural resources and a good production environment, its backward agricultural production model and infrastructure have limited the arable land and caused the rural labor force to be insufficiently employed. About 50% of the labor force in Zambia is unemployed or semi-employed. The edible fungus industry is a typical labor-intensive industry. There are many production steps with low technical demand that are easily grasped. These include mixing and bagging, which still need to be done manually. Under the advantage of low labor costs in Zambia, the Jilin Province Overseas Agricultural Investment and Development Group Co., Ltd. combined scientific demonstration of planting cultivation technology with traditional, farmer cultivation methods. This not only attracted a large number of surplus rural laborers to participate in the production, processing, and cultivation of edible fungus, but also ultimately, solved

the employment and resettlement problem of the rural surplus labor, thereby satisfying the requirements from Zambian farmers to increase their income, regional development, and prosperity. To date, Jilin Province Overseas Agricultural Investment and Development Group Co., Ltd. has invested more than 25 million dollars in Zambia, built multiple projects, such as an edible fungus factory, an agricultural industry demonstration park, and so on, and employed more than 100 local workers. With the continuous expansion of the edible fungus factories and investment scale, the effects of providing employment opportunities and stimulating local economic development will be further highlighted.

3.3 Promoting and popularizing the concept of recycling agriculture

The edible fungus industry that transforms agricultural waste into delicious and nutritious food is a typical recycling economy model, which not only reduces pollution damage to the ecological environment, but also improves the comprehensive utilization of agricultural waste and brings significant social and economic benefits. Based on these effects, the Jilin Province Overseas Agricultural Investment and Development Group Co., Ltd. follows the concept of recycling agriculture. The agricultural byproducts, such as sugarcane bagasse, corncobs, cottonseed hull, wood chips, and cassava stalks, can be used as the fungus bags for cultivating edible fungus directly. The discarded edible fungus residue can be used as fertilizer to return to the field, for planting corn, soybean, and other crops, feeding fish and poultry, and increasing soil fertility. In brief, edible fungus enterprises, like the Jilin Province Overseas Agricultural Investment and Development Group Co., Ltd., are recycling materials and energy in the industrial park. These efforts not only spread the culture of Chinese agricultural and recycling agriculture development, but also become an important embodiment of the "green development and shared development" concept in the Belt and Road initiative.

3.4 Improving the physical fitness and health of local residents

Zambia is one of the economically backward countries in Africa. Its diet structure is relatively singular, which has led to a widespread lack of nutrition among residents. According to the Knoema database, 44.5% of the Zambian population suffers from malnutrition, ranking fourth in the world in terms of the proportion of malnutrition among the total population. Edible fungus has the characteristics of high protein, high amino acids, high vitamins, and low fat. A Tanzanian scholar called edible fungus "the meat for the poor." The Food and Agriculture Organization of the United Nations and the World Health Organization claim that a reasonable diet structure should include meat, vegetables, and edible fungus. Seen in this light, developing the edible fungus industry in Zambia is not only conducive to reversing the long-term lack of nutrition in Zambian, but also can help optimize the dietary structure of local residents and improve the physical fitness and health of Zambians, achieving the optimization and improvement of the human capital in Zambia.

4 Optimization measures for promoting the edible fungus industry technology output

4.1 Increasing the selection of suitable local varieties

Excellent varieties are the foundation of agricultural industry development and the key to enhancing the core competitiveness of agricultural enterprises. The edible fungus enterprises often achieve their own development through the formation of technical teams and the support of technology when operating in Africa. However, due to the geographical distance between Africa and China, there are big differences in agricultural natural resource conditions and climate environment. Therefore, it is necessary to select suitable local varieties as soon as possible, such as domesticating and developing local germplasm resources, or exporting strain resources from domestic sources. To promote product diversification, enrich local market supply, meet consumer demand for diversified products, and, ultimately, achieve long-term sustainable development of edible fungus enterprises, we need to carry out variety improvement tests, selecting the exceptional varieties with high quality, strong adaptability, and good comprehensive properties, like Agaricus bisporus, Hericium erinaceus, Straw mushroom, and other edible fungus suitable for growth in Africa on the basis of the local environment

4.2 Controlling the speed of production scale expansion

At present, the Zambian market is in a lull, and there are few Chinese edible fungus enterprises, especially factory-based production enterprises, entering Zambia. Unfortunately, factory production, which is characterized by annual, high costs, is limited by infrastructure such as electricity, water conservancy, and road conditions.

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Zambia, and other African countries, generally, lag behind in infrastructure, which affects the production of edible fungus, which needs such life support, and the effective operations of edible fungus enterprises. Therefore, in the process of expanding the industry's scale, Chinese edible fungus enterprises need to remain open minded and fully demonstrate and carefully predict the changes in production factors, while pursuing moderate and scientific expansion of their production scale.

4.3 Strengthening the cultivation of local technical talent

Different from the general planting and aquaculture industry, the edible fungus industry overall requires advanced technical methods. In particular, the modern edible fungus industry developed based on factory production is inseparable from the strong underlying technical team that prevents and copes with the production risks caused by technical problems. As Africa is far from China with different economics, social development, and natural environments, once technical problems in the production process of edible fungus arise, Chinese domestic experts can only give temporary guidance and support due to inconvenient work alignment and high cost. Therefore, reserving and training local talent is critical. Talent cultivation can be carried out as follows. First, high-end technical talent should be cultivated locally. To train successors in the improvement, development, and innovation of enterprise production technology, the existing talent in Zambian universities and research institutes with a strong cultural foundation should be encouraged and supported to further study at the universities and research institutes with strong research ability in edible fungus, like the China Agricultural University, Huazhong Agricultural University, the Jilin Agricultural University, and so on, to improve their professional skills and business capabilities. Second, a general technical backbone should be established. This means selecting talent with a good professional foundation from existing international students and training them directionally, so that they can become the backbone technical force in the future development of the enterprise. Third, general technical experts should be cultivated. This means increasing the technical training for local front-line workers, so that they can operate in accordance with the production technical specifications.

4.4 Making full use of relevant national preferential policies

The entry of Chinese edible fungus enterprises into Africa is not only an important manifestation of China's "going out" strategy and the realization of international development, but also an important form of implementing the Belt and Road initiative. The management of edible fungus enterprises in Africa needs to be integrated with the full support of the Chinese government. Therefore, edible fungus enterprises, like Jilin Province Overseas Agricultural Investment and Development Group Co., Ltd., must not be left alone in the process of overseas development. Instead, such enterprises should be able to take advantage of existing relevant support policies and seize the opportunities of the Belt and Road initiative to become greater and stronger. For example, in terms of financing and raising funds, the edible fungus enterprises can use the projects of the Bank of China, the China Development Bank, and the China–Africa Development Fund to obtain financial support for operations. In terms of insurance, the edible fungus enterprises can increase contact and cooperation with companies, such as China Export Credit Insurance Corporation, and China People's Property Insurance Co., Ltd., to reduce business risks in the process of overseas development and investment.

5 Conclusion

Africa is a key area for China in foreign cooperation in the implementation of the Belt and Road initiative. However, its backwardness in agricultural technology has seriously hindered its agriculture development. As a responsible nation with a long history of farming and culture, China is supporting the development of African agriculture by exporting Chinese practical production technologies. To fulfill the responsibility of a big country and optimize its national image, based on the competitive edible fungus industry in China and Africa's own resources and market advantages, its edible fungus industry technology can become a "pacesetter" for China–Africa agricultural cooperation. As a result, China can achieve win-win cooperation with Africa.

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