Analysis and Prospects of Innovation and Extension Mode of Agricultural Research Institutes: Hybrid Foxtail Millet Entering Ethiopia

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Abstract Based on the initiative background of the Belt and Road, in order to promote the sustainability of agricultural cooperation between China and Africa, using hybrid foxtail millet as a medium, the research institutes have carried out basic research on the breeding, cultivation, and demonstration of hybrid foxtail millet in Africa in the early stage, jointed enterprises to carry out the construction of the joint research center and the construction of the industrial chain, and innovated the "scientific research units promoting agricultural "going out". The successful innovation of this mode has effectively exerted the public welfare of scientific research units and the marketability of enterprises. The organic combination of the two makes agricultural projects more healthy, sustainable and stable in African countries.

Key words Zhangjiakou Academy of Agricultural Sciences, Hybrid foxtail millet, Africa, Ethiopia, the Belt and Road

1 Introduction

In 2013, China first proposed the initiative of the "Belt and Road". By deepening cooperation and exchanges with countries along the route, it will give full play to the respective advantages, building an open and inclusive economic cooperation system, injecting new impetus into world economic growth, ultimately promoting the mutually beneficial and win-win development of China and the world economy. As an important part of the "Belt and Road Initiative", agricultural cooperation and exchanges between China and countries along the route is an important element in supporting China's agricultural globalization strategy, and it is an effective way to form a new pattern and a new order for international agricultural cooperation and global agricultural governance.

Carrying out research on innovation and extension mode of agricultural research institutes, focusing on the "Belt and Road" background, can not only provide decision-making reference for the agricultural sector to deepen the "Belt and Road" work, but also provide a scientific basis for exploring and improving China's agricultural foreign cooperation. In order to truly realize the sustainable development of hybrid foxtail millet in Ethiopia, the Zhangjiakou Academy of Agricultural Sciences uses hybrid foxtail millet as a medium to carry out the basic science and technology work of breeding, cultivation and demonstration of hybrid foxtail millet in Africa and joint ventures to carry out the construction of the African Hybrid Foxtail Millet Research Center and the construction of the hybrid foxtail millet industry chain. A new model for scientific research units to promote agriculture's "going out" has been developed innovatively. The pre-construction was led by research institutes of public interest, did not focus on short-term profitability, and focus on foundation research. In the later stage, enterprises are attracted to participate in the construction of joint research center and the construction of industrial chain. As a crop that does not cause harm to China's germplasm resources and increases the food production of Africa, hybrid foxtail millet will definitely play a bigger role in the international arena with the opportunity of the "Belt and Road".

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2 Advantages of hybrid foxtail millet's entering Ethiopia

2.1 Present situation of application of hybrid foxtail millet in China In the 1960s, the Zhangjiakou Academy of Agricultural Sciences began research on hybrid foxtail millet. After more than 30 years of research, the world's first "foxtail millet photo-thermo-sensitive male sterile line" has been discovered. This sterile line is fertile under high temperature and short daylight, and sterile under low temperature and long daylight, achieving the purpose of dual use. Since 2000, 15 hybrid foxtail millet cultivars have been cultivated, and they have been applied to large-area production. The cumulative planting area in China has exceeded 533 300 ha, and economic, social and ecological benefits are significant.

Hybrid foxtail millet is a new bright spot in China's agricultural science and technology. First, it has high yield and stability, and the average yield is 6 -9 t/ha, and the highest is 12.51 t/ha. Second, it has water-saving and drought-resistant characteristics, and the water consumption per unit area is only 1/2 -1/3 of that of maize. Third, it has high quality. The "Zhangzagu" series of hybrid foxtail millet has coupled high yield and high quality. Several hybrid cultivars such as "Zhangzagu No.13" have been rated

as national first-class high-quality foxtail millet. Fourth, it has wide adaptability. The "Zhangzagu" series of hybrid foxtail millet can not only be grown from Heilongjiang to Xinjiang. They can also be grown from Inner Mongolia to Hainan.

2.2 Match between hybrid foxtail millet and Ethiopia Agriculture is the pillar industry of Ethiopia's national economy and foreign exchange earning through exports. In 2016, Ethiopia's agricultural output accounted for 45.1% of its gross domestic product (GDP). In Ethiopia, farmers and herdsmen accounted for more than 85% of the total population. Ethiopia used to be a granary in Africa. However, in recent years, its agricultural development has faced more serious problems. First, the technology is backward and needs to be upgraded to high-tech varieties. Second, small-scale farming is the dominance, with backward technology without conditions to achieve modernization of large agricultural machinery operations. Third, due to global climate issues, the rainfall is irregular and unevenly distributed, and the water infrastructure is not sound. The extension of hybrid foxtail millet in Ethiopia can solve the above problems. Foxtail millet has been planted in the arid and semi-arid regions of northern China for more than 7 000 years, and has nurtured five thousand years of Chinese civilization. China not only has a foxtail millet planting program that adapts to large farms, but also has foxtail millet cultivation techniques adapted to small farmers. Through investigation and research, it has been concluded that China's foxtail millet can completely replace the traditional Ethiopian cuisine "injera", and it has a broad market space in the local area.

3 Extension mode of hybrid foxtail millet in Ethiopia

3.1 Carrying out test and demonstration of hybrid foxtail millet Integrating the current state of agriculture, ecological characteristics and the farming habits of local farmers in Ethiopia, comprehensive scientific research and technological development of ecological conditions adapted to local productivity conditions, including variety selection, seeding techniques, weeding techniques, fertilization techniques, pest control technology, harvesting technology, product processing technology and cereal cultivation technology should be carried out, and technicians of local farmers training center (FTC) should be cultured at demonstration sites to gradually expand the planting area.

3.2 Inputting germplasm, technology and human resources Working with Ethiopian agriculture, the "Zhangzagu" series of hybrid foxtail millet and related cultivation techniques put into promotion are led by the Zhangjiakou Academy of Agricultural Sciences, which has a core technology with independent intellectual property rights. At the same time, the Zhangjiakou Academy of Agricultural Sciences dispatches 2 – 4 professional technicians to Ethiopia for on-site management, technical training and international exchanges, tracking the whole growth period of foxtail millet, conducing technical guidance, understanding timely planting conditions and required technologies and providing guidance, thereby fully mastering the situation of hybrid foxtail millet cultivation in Ethiopia and carrying out research on cultivation techniques. In addition, hybrid foxtail millet is actively promoted to local government officials and the public, striving to find partners.

3.3 Implementation ways Focus should be paid on cooperation to maximize the use of resources, truly realizing the agricultural "going out". It can cooperate with the Ethiopian National Seed Company. Taking advantage of the cooperation opportunity, two foxtail millet varieties E7 and E10 have been successfully registered in Ethiopia, paving the way for future legalization. It can also cooperate with Green Agriculture West Africa Co., Ltd. to ensure the sustainable development of the project. It can cooperate with the Ethiopian Ministry of Agriculture and sign a cooperation agreement. Finally, it can cooperate with Chinese-funded enterprises and establish the "China-Egyptian Hybrid Foxtail Millet R&D Center" in Ethiopia to develop Chinese industries with local resources.

3.4 Service objects The service objects of hybrid foxtail millet include Ethiopian national agricultural institutions and agricultural enterprises to provide technical support to these national institutions and large enterprises, train technicians, and conduct millet research projects, thereby promoting hybrid foxtail millet varieties and related technologies from top to bottom. At present, good mutual trust has been established with the Ethiopian Ministry of Agriculture, the Southern State Government and the Ethiopian National Seed Company.

4 Experience of hybrid foxtail millet's entering Ethiopia

The Zhangjiakou Academy of Agricultural Sciences began to introduce and promote hybrid foxtail millet in Ethiopia in 2008, during which a large number of problems were encountered. The main problem is to rely directly on the research institute's own strength to directly transfer the development experience of hybrid foxtail millet in China to Ethiopia, so that the development is slow and difficult. In recent years, combined with the present situation of Ethiopia's agricultural development and local humanities, hybrid foxtail millet is bred with the all the power available. Thus, the development of hybrid foxtail millet in Ethiopia has gradually come out of the predicament.

4.1 Extensive cooperation It can work with local agencies to break down local protection barriers in the region, laying a foundation for China's hybrid foxtail millet to enter Africa. A large number of local technicians have been trained in cooperation with the Ethiopian National Seed Company, making hybrid foxtail millet cultivation more deeply rooted in people's hearts. More importantly, the registration process for hybrid foxtail millet in Ethiopia has been completed. Related work can be carried out with Chinese-funded enterprises and Chinese foreign agencies, thus saving limited resources and helping hybrid foxtail millet enter Africa. The Chinese South-South Cooperation Expert Group in Ethiopia has undertaken a large part of the research work. The Chinese Embassy in Ethiopia has spared no effect to effort to introduce help

from al walks of life. In addition, Chinese-funded enterprises are also the driving force for the development of hybrid foxtail millet in Africa. Enterprises with rich agricultural resource base and rich market operation experience have been attracted to ensure the sustainable development of the project. With the deepening of the trial and demonstration of "Zhangzagu" in Ethiopia, the Zhangjiakou Academy of Agricultural Sciences is actively looking for partners. At present, cooperation agreements have been signed with many organizations and individuals.

4.2 Building a reasonable foxtail millet industry chain In addition to the cultivation and guidance of hybrid foxtail millet, the Zhangjiakou Academy of Agricultural Sciences, in conjunction with local Chinese-funded enterprises, carry out upstream grain sales and downstream foxtail millet acquisitions. After processed into millet grain and flour, hybrid foxtail millet enters the local consumer market. The intermediate planting process relies on local people to develop the local economy. The expected effect of scientific transformation of scientific research units has been achieved, the Chinese-funded enterprises have obtained lucrative profits, and the region has also developed greatly.

4.3 Regional distribution of hybrid foxtail millet Ethiopia has federal government. In the early day, various state governments paid different attention to the promotion of hybrid foxtail millet. In view of the vastness of Ethiopia, the difference in climatic and environmental conditions, and the varying degrees of attention of local governments, the Zhangjiakou Academy of Agricultural Sciences decided to first develop hybrid foxtail millet in the southern state of Ethiopia. After three years of cultivation and promotion, the local farmers in the southern state have basically mastered the seeding technology, and they can complete a variety of agricultural technology operations more skillfully. On December 12, 2017, relevant experts from the Science and Technology Department of Hebei Province and the Hebei Academy of Agricultural and Forestry Sciences conducted a survey on the yield of planted by the Zhangjiakou Academy of Agricultural Sciences in the Arbaminch Agricultural Research Center in southern Ethiopia. The area harvested was 0.091 ha. The output measured was 485 kg, and the water content measured was 21%. By converting, the water content was as low as 13%. In December 2017, an official from the Agriculture Department of Hawassa, the capital of the southern state of Ethiopia, said that based on the three FTC sites planted in 2017, the planting area would be expanded to 30 FTCs by 2018, and promised to bear the corresponding planting costs.

4.4 Introducing small agricultural machinery and gradually increasing the yield Ethiopia's demand for agricultural products is on the rise. Agriculture has become a major source of agricultural growth. Large-scale facility agriculture and agricultural machinery are generally more difficult to promote in Africa. The Zhangjiakou Academy of Agricultural Sciences promotes hybrid foxtail millet cultivation techniques in Africa with a strong focus on the practicality of technology and the extent to which ordinary farmers can use it. For example, hand-push seed driller introduced to Ethiopia in 2013 has been welcomed by local farmers and approved by local government officials.

5 Prospects of hybrid foxtail millet's "going out"

5.1 "China-Africa Hybrid Foxtail Millet Joint Research Center" will play a leading role "China-Africa Hybrid Foxtail Millet Joint Research Center" is established by Zhangjiakou Academy of Agricultural Sciences and China Oversea Group. It will play an important role in agricultural research and promotion in Africa. The main tasks include carrying out breeding of varieties, research on seed production technology and research on seed processing technology, etc. The cultivation techniques appropriate to local productivity levels and climatic conditions, as well as foxtail millet consumption and feeding are studied. In addition, foreign-related training is conducted.

In the next five years, the center will use domestic and African resources to broaden the genetic map of foxtail millet and develop a new set of resources to provide a genetic basis for domestic foxtail millet breeding. At the same time, 1 – 2 hybrid foxtail millet varieties suitable for planting in African countries will be bred. A set of hybrid foxtail millet technology suitable for local climatic conditions and production technology conditions will be summed up. Through publicity and foreign training, varieties, cultivation techniques and other technologies will be disseminated effectively.

"China-Africa Hybrid Foxtail Millet Joint Research Center" is a platform for China to operate hybrid foxtail millet in Africa. It can not only improve the technical level of hybrid foxtail millet in Africa, attracting the attention of more Africans. It is also the advance force of China's hybrid foxtail millet "going out", effectively serving the overall diplomatic strategy of China. This is of great significance to safeguard the interests of China, maintaining China-Africa friendship and enhance China's international status.

5.2 Joint ventures will realize the industrialization of hybrid foxtail millet in Africa Research institutes, Chinese-funded enterprises and local enterprises form a hybrid foxtail millet joint company in the form of a shareholding system. The scientific research units are responsible for scientific research and innovation, and the enterprises carry out the transformation of results. The division of labor is clear, and each has its own role, so that China's hybrid foxtail millet rapidly expands to Africa. African people will also have their own breeding research and development and cultivation capabilities. Simultaneously, the breeding level of maize, beans, potatoes and other crops will be also promoted. With the development of hybrid foxtail millet industrialization, a group of related agricultural enterprises will also be born, and the living standards of African people have gradually improved. Through the implementation of this project, the food production in Africa can be truly increased, reducing the dependence of African people on food imports in international markets, thereby stabilizing international food prices and ensuring food security in China.

(To page 78)

prises or the market, and train professionals to meet the needs of the market[5].

3.3 Setting up the idea of cultivating all-around applied talents The cultivation of all-around applied talents focus on not only the cross fusion of multi-disciplinary professional knowledge, the combination of skills and abilities and the integration of thinking, but also the application of professional knowledge. That is, the multidisciplinary scientific principles are applied to the practice of social production. The major characteristics of today's society are interdiscipline, knowledge integration, and technology integration. This characteristic determines that the cultivation of all-around applied talents should not only expand the professional knowledge of talents, but also improve the comprehensive quality and application ability of talents. At the same time, we should also pay attention to the thinking training of talents, so as to establish the concept of innovation and entrepreneurship, and provide a favorable guarantee for students' follow-up employment and entrepreneurship.

4 Conclusions and discussions

In the era of economic globalization, the progress of China can not be separated from the support of scientific and technological talent, and the talent education of colleges and universities is particularly important to the development of the times. However, there is a lack of perfect teaching system in the cultivation of innovative and entrepreneurial talents, and the orientation of social demand is insufficient. This kind of question is particularly prominent in the agricultural, forestry, and normal universities. Therefore, for colleges and universities represented by agricultural, forestry and normal colleges and universities, it is necessary to be oriented by the social needs in the future reform of talent training. It is necessary to attach importance to interdisciplinary knowledge crossing and fusion, turn theory into practice, integrate knowledge and practice for the cultivation of all-around applied talents. In order to adapt to the development of the times and establish an effective mechanism for cultivating innovative and entrepreneurial talents, special innovative and entrepreneurial education should be integrated into the teaching process of various majors, and the reserve of professional talents should be improved.

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(From page 75)

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