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A WIN-WIN COOPERATION OF AGRICULTURAL RESEARCH BETWEEN CHINA AND BELARUS

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China is currently experiencing a transition period for its agriculture development. Innovation in science and technology will play a crucial role in achieving the modernization of agriculture in China. Over the last decades, agriculture in China has primarily been of extensive style with an undiversified conformation. There has been a poorish correlation among the primary, secondary and tertiary industries, the three-industry, resulting in a less developed agro-processing industry and shortened industry chain. Jilin province is a typical ecotype area of agriculture in northeast China and an epitome of the northern agriculture. Belarus has well developed machinery, food and potato industries. These are ideal complements to the agricultural economics in northeast China. Thus, induction of talents and the advanced technologies in food processing industries from Belarus would be a wise choice to overcome the shortage in agro-products processing industries, so as to promote the coordinated development of the three-industry in China. Jilin Academy of Agricultural Sciences (JAAS) has a prestige history of some 100 years. Scientists there have contributed greatly to both national and regional agriculture with their remarkable achievements in cereal breeding, pomology, edible fungus, vegetables, and animal husbandry. Together with the broad market potential for farm products processing industry in China, these have provided Belarus with a great opportunity of collaboration with China. This article overviews the agriculture and agricultural related science and technology in Jilin. Further, a comparative analysis was conducted aiming at clarification of the advantages in agricultural sciences between Jilin and Belarus. Finally, the feasibility and future perspectives of the collaboration between the two parties are also discussed.

Keywords: Jilin province of China; Belarus; agriculture; science and technology; collaboration.

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ВЗАИМНОЕ СОТРУДНИЧЕСТВО КИТАЯ И БЕЛАРУСИ В ОБЛАСТИ СЕЛЬСКОХОЗЯЙСТВЕННЫХ ИССЛЕДОВАНИЙ

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В настоящее время в Китае наблюдается переходный период в развитии сельского хозяйства. При модернизации сельского хозяйства Китая огромную роль будут играть инновации в науке и технологиях. За последние десятилетия сельское хозяйство Китая было экстенсивным, практически не было взаимодействия между различными отраслями (первичной, вторичной, третичной), в результате чего сельскохозяйственная перерабатывающая промышленность оказалась слабо развитой. Провинция Цзилинь – это адаптированная к определенной окружающей среде зона сельского хозяйства на северо-востоке Китая и типичный пример ведения сельского хозяйства на севере. В Беларуси хорошо развито машиностроение, пищевая промышленность и картофелеводство, что является идеальным для сельскохозяйственной экономики северо-востока Китая. Таким образом, знания и современные технологии в области перерабатывающей промышленности Беларуси могли бы стать разумным решением для устранения всех недостатков перерабатывающей промышленности Китая и способствовать развитию третичной отрасли экономики. История Академии сельскохозяйственных наук провинции Цзилинь насчитывает около 100 лет. Ученые Академии вносят огромный вклад в развитие сельского хозяйства как на национальном, так и на региональном уровне и имеют большие достижения в области селекции зерновых, овощеводства, плодоводства, животноводства. Благодаря огромному рыночному потенциалу для перерабатывающей промышленности сельскохозяйственной продукции в Китае у Беларуси имеются все возможности для сотрудничества с этой страной. В статье представлен обзор сельского хозяйства и сельскохозяйственной науки и технологий провинции Цзилинь. Кроме того, проведен сравнительный анализ, для того чтобы определить основные преимущества сельскохозяйственной науки провинции Цзилинь и Беларуси, рассматриваются перспективы будущего сотрудничества между двумя странами.

Ключевые слова: Китайская провинция Цзилинь, Беларусь, сельское хозяйство, наука и технологии, сотрудничество.

Today's economy in China is facing the challenge of resources and environment constraints, and production cost raise up. This urges the improvement in science & technology innovation and transformation in agricultural development mode. In particular, the "One zone one road" strategy from the new central government offers a great opportunity to make use of the markets and resources from domestic China and abroad. This has largely promoted international cooperation and communication in China agriculture. Belarus is an important nation of the Silk Road economic zone. Its advanced machinery manufacturing and farm product industries make it a strong complement for China. In current specific period of agricultural development mode transformation in China, a profitable collaboration potential will offer mutual benefits and win-win outputs to both nations.

1. An overview of Agriculture in Jilin

China is an agricultural nation. The principal contradiction in agricultural development has over the last decades been changed into the conformational contradiction from insufficient total production of the grain. Market-oriented agriculture is the basic direction of the future agriculture in China. An intensive and environment friendly modern agriculture not only requires an optimized production chain of strong science and technology support, but also considers ecological priority and transformation in development pattern with coordination between planting and cultivation, and integrative development of the three-industry.

Jilin province is an agriculturerich province. It is located in one of the 3 most famous fertile lands in the world and, also the center of the golden corn zone in the world. Jilin is the key commodity grain production base, the "hometown of soybean" and the main production area of the high quality *Japonica* rice in China. It has been taken for many years the top ranking position in-per-unit area yield of grain, the commodity rate of grain and the per capital occupancy of grain in China. Over the last decades Jilin has made a significant contribution in ensuring national food security.

Now, Jilin province is experiencing a new period of transformation from traditional agriculture into advanced agriculture. The agricultural development starts to relying mainly on science and technology innovation, instead of previous extensive agriculture that depends extensively on input of resource elements. It is believed that advanced agriculture is an integration of elements like land, water and energy saving, environment friendly, efficient and sustainable.

2. The effects of the agricultural S&T on modern agriculture development in China

At present, the rural population of China accounts for 43.9 % of the national population of 1.36 billion. The number of farming employes accounts for 39.8 % of the rural. According to the fundamental realities of the country, agricultural modernization is essential for realization of the modernization in China. Like industrial development, modern agriculture depends on also the support from modern sciences and technologies. Conduction of a modern agriculture system requires transformation of the agricultural developing mode, as well as improvement of traditional agriculture with modern sciences and technologies. Although, science and technology is prerequisite to ensure national food security, it is necessary to break through the constraints of resources and environment, and also the decision-making ability to promote construction of modern agriculture. JAAS is one of the agricultural research institutions of reputed expertise in agricultural sciences and technologies development in the northeast area.

2.1. Historical contribution of JAAS in agricultural S&T

JAAS plays a key and leading role in breeding and cultivation of crops such as maize, rice, soybean, sorghum and other major food crops in China. Maize, soybean and rice breeding technologies take great advantage over other crops. The success in breeding of "Jijing" series rice varieties eliminated the dependence of Jilin rice breeding on Japanese rice germplasm, with a world record of accumulative planting area of more than 3.33 million hectares. The 1st hybrid soybean was bred in JAAS and obtained the patents of China, Japan and USA. The cultivation technique of spring maize ranks to the top in China for the multiple-year high yield record under natural rainfall condition. Advanced corn borer bio-controlling technology is used to 2.33 million hectares field each every which makes a great contribution to regional corn production.

Technique improvements have also been made on cold land pomology, vegetable and edible fungus research. A high quality variety library of cold land fruit trees of Northeast China was established in JAAS. JAAS is also the 1st one to conduct the asparagus and sweet potato research in Jilin province.

In addition, biotechnology research and technology development are reputed in the nation for its advanced R&D capability in crop biotech breeding and plant bioreactor. The 1st national center for GM maize and soybean R&D was affiliated at JAAS holding many important national projects in crop biotech breeding. Over 100 years history, animal husbandry research in JAAS has played a critical role in China. The hybrid Red steppe is the 1st cattle breed in China. Songliao black swine is the 1st lean-meat type with black color female line in northeast China. Subo merino sheep is the national released new breed can produce the super fine-fleece. Animal Respiration Calorimetric Device was made independently in JAAS filling the domestic gap.

2.2. S&T innovation of different ecological areas in Jilin

Agricultural modernization depends on S&T innovation. Based on the 42 national affiliated research centers of JAAS, the resource superiorities and agriculture production reality, diverse types of S&T innovation are conducted throughout 3 ecological areas of Jilin. In the east of Jilin, Changbai mountain area has well protected natural resources including more than 1000 species of wild animals and 2700 species of wild plants. There are opportunities to develop special local products and the Chinese herbal medicine. In the middle part of Jilin, which is the major grain production area, genetic breeding and cultivation of maize, rice, soybean and other crops are encouraged. For instance, the main breeding interests for maize are in early mature, dwarf, close planting, suitable for machine harvest. Whilst rice breeding interests lie in direct seeding with high quality and better taste. Develop hybrid soybean breeding research and maize-soybean intercrop varieties to improve the optimization of agricultural structure in Jilin, enhance breeding varieties of edible and processing soybean in order to realize the goal of national soybean self-sufficiency above 50 %. Development of high yield technologies with water-nutrition-chemical control, resources efficiency and environmental friendly. The west part of Jilin is an interlaced zone of farming and livestock, mainly focusing on semi-barn feeding and water saving agriculture research. The industry of silage corn, alfalfa planting and sheep, cattle breeding for meat and milk use purpose will be a better start to drive moderately large-scale livestock and poultry breeding. Jilin is just located in the world famous black soil belt with an area of 1.1 million hectares black soil. JAAS has been working on the monitoring research of the black soil for more than 30 years, mainly focusing on protective cultivation, commercial organic fertilizer, grain-bean rotation, straw retain to the land and many other newly used technologies.

2.3. Modern agriculture development promoted by the commercialized S&T achievements

In recent years, there are approximately 150 technologies of JAAS which are applied to agriculture and can increase the social benefit of 5 billion RMB every year. In order to accelerate the breeding process and strengthen the core competitiveness of the varieties, 2 R&D union groups have been set up for maize and rice according to the commercialized breeding mode. Rice research of JAAS leads the industry of *Japonica* rice breeding in China, president XI Jin-ping highly praised the taste and quality of Jilin rice during the NPC&CPPCC. Jijing511 won the “China fine taste rice award” in 2015 and the silver prize of “China-Japan fine taste award” in 2016 making “Jilin rice” known to outside China. *Trichogramma* and *Beauveria bassiana* are developed for bio-control of Asian corn borer. The technique application area of *Trichogramma* and *Beauveria bassiana* reached to 2 million hectares and 330 thousand hectares which save 900 million kg of grain losses every year. “Broad-narrow row farming techniques” applies to >330 thousand hectares every year.

3. Contrastive analysis of agriculture between Jilin and Belarus

3.1. Natural resources overview of Jilin and Belarus

Jilin province is located in the center of northeast Asia and is the central region of northeast China with a total area of 18.74 square kilometers and 7.03 square kilometers of arable land. Jilin is part of the temperate continental monsoon climate, the annual frost-free season is about 100–160 days and the average annual rainfall is 400–600 mm. The natural environment is suitable for agricultural production. In 2015, the planting area of the food crops was 5.08 million hectares and the total grain output was 36.47 million tons in our province. The per unit area yield of grain keeps the first in China for many years.

Belarus is located in the center of Europe with a total area of 207.6 thousand square kilometers. The agriculture and animal husbandry are better developed in Belarus. It is also the main flax producing

area in the world. The cereal, economic crops and forage crops are the major crops in Belarus, among which potato is one of the important parts of agro-products. Animal husbandry mainly focuses on meat, egg and milk production. Most of the dairy products in Belarus are used for export.

3.2. Agricultural S&T overview of Jilin and Belarus

There are 18 agricultural independent research organizations in Jilin province. JAAS is the only one specialized agricultural research firm subordinate of Jilin provincial government, which has the comprehensive priority with applied research and applied basic research. Throughout its 100-year changes, JAAS currently employs the total of 1197 staff members, including 870 research scientist: 170 with Ph. D. degree and 350 with master degree. There are 19 research institutes of scientific orientations covering from plant and animal science & breeding, biotechnology, plant protection, germplasm resources, pomology, agro-products processing through agro-economics and ecology etc. JAAS has contributed both nationally and regionally to science and technology of agriculture with its remarkable achievements.

The developed agriculture, universities specific for scientific and technological talents training, mechanical manufacturing technology such as tractor and agricultural implement of Belarus have been in a world leading level. After 170 years research history, the Agricultural Science Department of National Academy of Science of Belarus is the specialized organization for agricultural research, providing germplasm resources for nationwide and making outstanding contribution to cultivation, animal husbandry and veterinary, agricultural mechanization and food production.

3.3. Broad collaboration potential of agricultural S&T between Jilin and Belarus

The natural conditions between Jilin and Belarus are very similar, what makes a strong possibility for portability and complementarity of the scientific and technological achievements from both sides. Many scientific and technological outputs in Belarus can be transformed into the broad market of China. Jilin can also offer germplasm resources and the integrated cultivation technologies of crops and animals to meet the demand of agricultural development in Belarus. There are strategic cooperation agreements between the Chinese and Belarus governments which will create favorable conditions for collaboration between two countries.

3.3.1. The «bring in» strategy of Agricultural Research

China has already entered an aging society, the aging population will reach 248 million by 2020 and aging level will reach 17.17 %. The elderly population will be over 400 million in 2050. After the implementation of the second child policy in 2015, the population of infants will increase rapidly. It is expected that it will increase more than 2 million newborns every year. In order to meet the rapid increased needs of the population, Jilin starts to pay more attention to the functional food research which was almost a blank in the past. The launch of national staple food strategy of potato in 2016 predicts that more than 50 % of potato will be used as staple food in 2020 which require to pay further attention to potato research. The Food processing machinery and equipment production level of China is relatively backward. The biological control technology on direct edible agricultural products such as vegetables and fruit still needs to be improved.

The elderly health food and infant functional food research and development of Belarus is in a world leading level. There are senior researchers and advanced functional food production technologies, processes and equipment. It will be a shortcut and great opportunity for China if the academicians working on functional food research and the related technologies, processes and equipment can be introduced to China from Belarus to meet the needs of high-end market in China. Potatoes are the important agricultural products and there are more than 100 varieties in Belarus. The manufacturing technology of agricultural machinery, food processing machinery in Belarus has been leading in the world. The application of bio-control technology especially on direct edible agricultural products is widely used. Through the collaboration, potato resources, agricultural machinery and manufacturing technology, food processing machinery and bio-control technology Belarus will successfully introduced to China and rapidly promote the modern agriculture development here.

3.3.2. The “step abroad” strategy of Agricultural Research

The market potential of fruit, vegetables and edible fungus in Belarus is tremendous which needs a large number of import every year. Pig and chicken breeding are competitive industries compared

to other livestock breeding in Belarus. Although the production of livestock is increasing in the recent years, it is still unable to meet the growing demand.

The cold tolerant fruit tree resources in Jilin province can represent the north part of China. There are more than 1300 fruit tree resources in the nursery which is a national affiliated center established in JAAS. During the collaboration, JAAS would like to make a joint use of the resources and technologies with Belarus. The animal husbandry study in Jilin is famous in China. Many breeds such as the hybrid Red steppe, Yan scalper, mutton sheep and local chicken can provide technical support for the animal husbandry development in Belarus. The edible fungus production in Jilin such as oyster mushroom, pleurotus eryngii, black agaric, champignon, lucid ganoderma and toadstool industry can be imported to the market of Belarus.

4. Future prospects of the complementary collaboration

Under the national strategic concept of “one belt and one road”, the agricultural technology cooperation between Jilin and Belarus specific in agricultural machinery, breeding, functional food, cold tolerant fruit tree, biotechnology areas will be an assist to make a breakthrough in our modern agriculture establishment. To develop joint overseas bases for each other, Belarus can make full use of the broad market resources in Jilin and transform the advanced agricultural scientific and technological achievements. Meanwhile, new crop varieties, high quality fruit and vegetable resources and new type fertilizer of Jilin can be applied in Belarus. The win-win cooperation of agro-technology between China and Belarus will be achieved through the complementary advantages of the two countries.

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