World Food Prize Youth Leadership Camp

Industry-University-Research-Application Model Serving Rural Poverty Alleviation and Revitalization: a Case Study on the Shunping Fruit Experiment and Demonstration Station

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Abstract: China is in a major transitional period of effectively connecting poverty alleviation and rural revitalization, and it is urgent to effectively integrate industry, university, research and application, and carry out collaborative innovation to meet the needs of social transformation. Universities should fully play their leading role in scientific research, engage in deep cooperation with enterprises, and serve rural revitalization through scientific research output, which is a sustainable development path. Taking Shunping Fruit Experimental Demonstration Station of Hebei Agricultural University as the research object, this paper analyzes its "Six Ones"development model, the "Five Chains in One"support and security system, and the scientific and technological means in the apple planting process, in order to have a beneficial impact on the solution of food problems worldwide.

Keywords: industry-university-research-application model; Shunping Fruit Experimental Demonstration Station; "Six Ones"development model；"Five Chains in One" support and security system

1 Introduction

By the end of 2020, China's comprehensive construction of a moderately prosperous society has achieved decisive achievements, and the task of poverty alleviation has been completed. How to consolidate the achievements of poverty alleviation, prevent poverty return, and ensure that rural residents continue to increase their income and become wealthy has become an urgent problem to be solved in rural areas of China. Taking a new development path that combines industry, university, research and application led by universities in rural areas is conducive to further consolidating the achievements of poverty alleviation and comprehensively promoting rural revitalization and accelerating agricultural and rural modernization. This paper mainly analyzes the connotation, mode and practical effect of the combination of industry, university, research and application, and studies the role of Shunping Fruit Experimental Demonstration Station established by Hebei Agricultural University in the industry, university, research and application mode and its great role in rural revitalization through investigation and literature analysis.

2 Analysis of the Connotation of Poverty Alleviation Model in the Science and Technology Industry of Universities Based on the Industry-University-Research-Application Model

2.1 Analysis of the Industry-University-Research-Application Model

Universities represent the combination of science and technology, talents and renovation and play a key role in the industry-university-research-application model[2]. Deeply promoting collaborative innovation among industry, university, research, and application is of special significance in the new era. Industry refers to industries or enterprises, university refers to schools, research refers to research institutions, and application refers to the market, representing social needs. The

collaborative innovation model of industry, university, research and application is based on market demand, organically combining enterprises, universities, and scientific research institutions, with output as the guide, and aims to meet market needs. In recent years, the model of industry, university, research and application has played a significant role in the process of rural targeted poverty alleviation[1]. The model of industry, university, research and application of rural targeted poverty alleviation can be understood as a poverty alleviation model that takes the needs of poor areas as the starting point, focuses on improving the knowledge, technology, productivity, income, etc. of the poor population, organically combines the advantages of talent, discipline, technology and other resources of universities, enterprises, and research institutes to help rural agriculture with science, technology, industry, and farmers with intellectual and spiritual support. Vigorously promoting the combination of “industry, university, research and application” and “agriculture, rural areas, and farmers development”, integrating agricultural related resources, and promoting diversified and collaborative efforts to promote rural development, agricultural progress, and improve farmers' lives are effective models for achieving rural revitalization.

2.2 Introduction to the Shunping County and Shunping Fruit Experiment and Demonstration Station

Shunping County, Hebei Province, is located at the eastern foot of the Taihang Mountains. The northwest of the county extends into the Taihang Mountains, and the southeast is the alluvial plain. It is the transition zone from the Taihang Mountains to the North China Plain. The terrain is high in the northwest and low in the southeast. The types of landforms can be divided from northwest to southeast into medium to low mountain landforms, hilly landforms, and plain landforms(as shown in Fig.1and Fig.2). Due to insufficient arable land, inconvenient transportation, backward infrastructure and other reasons, the county has been in a state of poverty for a long time. It belongs to the extremely poor Yanshan Taihang Mountain area, and has become an important aim for poverty alleviation in Hebei Province. Although some mountainous areas in Shunping County have good ecological resources, due to the limitations of traditional conservative thinking and development level, the farmers there do not know enough about the value of ecological resources, and fail to effectively develop and utilize the surrounding ecological environment to increase income. At the same time, the soil organic matter in Shunping County is rich, highly permeable, with large temperature difference between day and night, fresh air, clear water. The average annual temperature is 12.7 ℃ , and the average annual precipitation is 521.9mm. The coldest month is January, with an average temperature of minus 4.5 ℃. The hottest month is July, with an average temperature of 26.5 ℃. There is adequate illumination, with 2532 hours of illumination throughout the year and 2030.4 hours during crop growth, accounting for 80% of the total illumination throughout the year.The annual frost free period is 198 days. It has a unique regional microclimate. The climate characteristics of Shunping County are very beneficial to the growth and production of fruits, and the quality of the fruits produced is of high

quality. However, farmers failed to make significant breakthroughs in fruit tree planting due to their lack of understanding of scientific planting techniques and marketing strategies. In recent years, relying on scientific and technological support, Shunping County has increased apple planting and production. With the scientific and technological support and assistance of Hebei Agricultural University, an important agricultural university in Hebei Province, it has set up a fruit experiment and demonstration station. Supported by scientific and technological innovation, the fruit experiment and demonstration station is highly integrated with local characteristic industries, which has greatly promoted the agricultural development in surrounding areas and created a combination of industry, universtiy, research and application. It is a new development road to help Shunping County get rid of poverty and achieve rural revitalization. This new model of agricultural colleges helping rural development is of great significance to consolidate the achievements of poverty alleviation and achieve rural revitalization.

Fig.1.Low Mountains and Hills

Fig.2. Piedmont Plain

Landform of Dabei Township, Shunping County

3 Analysis of the Practice of the Targeted Poverty Alleviation Model Used by Shunping Fruit Experiment and Demonstration Station

The main bodies of the four aspects of industry, university, research and application in the process of Targeted Poverty Alleviation in Shunping County are as follows: "Industry" refers to Shun'an lvsheng Agricultural Science and Technology Development Co., Ltd., which was founded in 2014, with a planned area of 12200 mu. The core area of the park covers an area of 3520 mu, mainly planting Fuji apples, cherries, walnuts, grapes, etc; “University” refers to Hebei Agricultural University, a major agricultural university in Hebei Province; “Research” refers to the Shunping Fruit Experiment and Demonstration Station of Hebei Agricultural University established in the park of Shun’an Lvsheng Agricultural Science and Technology Development Co., Ltd. by Hebei Agricultural University. It is a scientific and technological innovation and experiment station that applies the scientific and technological achievements of Hebei Agricultural University to enterprises. The laboratory and related supporting facilities have been established in the experiment station, which ensures the formation of a standardized system for the whole process of apple industry. The station is the core of production, university, research and application; “Application”refers to the target of poverty alleviation, namely farmers.(Fig. 3)

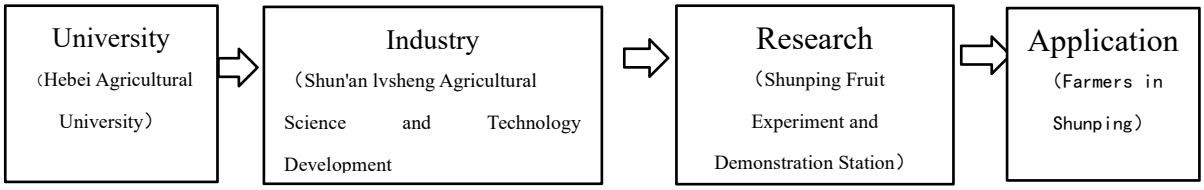

Fig.3.The Demonstration of the Model of Industry-University-Research-Application

The industry-university-research-application model has established a structure with technology as the core, universities, enterprises, research institutions, and farmers closely connected, industrial development as the link, and achieving precise poverty alleviation for farmers as the goal. (Fig.4)

Shun'an lvsheng Agricultural Science and Technology Development Co., Ltd			
Establishment Time	Planning Area	Main Fruit	Auxiliary fruit
2014	12200 Mu	Fuji Apple	Cherries, walnuts, grapes

Fig.4.Shun'an lvsheng Agricultural Science and Technology Development Co., Ltd

3.1 Forming a “Six Ones” Development Model Led by Characteristic Industries

After years of hard exploration by the expert team, Shunping County's industry-university-research-application model has created a “six ones” model which is identifying a characteristic leading industry, allocating a special fund, identifying an enterprise or park as an industry undertaking platform, establishing an expert team, establishing a scientific research and development promotion center, and cultivating a batch of agricultural talents(Fig.5). Hebei Agricultural University and the Shunping County government worked together, and finally chose Fuji Apple which has a good industrial foundation and a wide range of stimulating and leading role, as the leading industry according to the characteristics of the mountain area and the industrial base of the local conditions. The government has set up a special fund to encourage schools to carry out projects to tackle key problems in order to solve the problem of industrial development in Taihang Mountains. Led by the government and jointly determined by the university, Shun’an lvsheng Agricultural Science and Technology Development Co., Ltd has been established as the undertaking platform to carry out industry-university-research-application research. An expert team has been established according to the needs of industrial development, and have now developed into a team of nearly 50 experts covering four professional fields: cultivation, plant protection, agricultural machinery and equipment, and agricultural management. The Shunping Fruit Experiment and Demonstration Station established by the expert team has become a technology research and development and promotion center. The “Six Ones” industrial development model is centered around industries, and led by universities to build a comprehensive industrial development support system, and ultimately promotes industrial revitalization through in-depth collaboration between industry, university, and research, achieving benefits for the main body and stimulating the development of the surrounding areas[3].

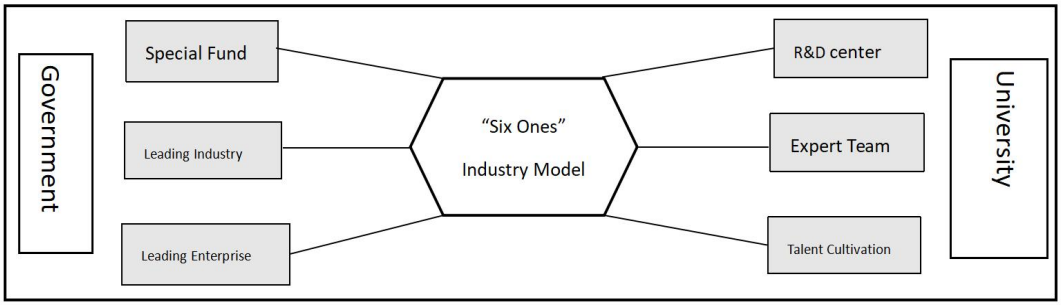

Fig.5. "Six Ones" Industry Model

3.2 Establishing a Support and Guarantee System for the Integration of the Five Chains

The industry-university-research-application model forms the five chains of talent, discipline, innovation and service around the industrial chain, and promotes the "five chains in one". The Shunping Fruit Experiment and Demonstration Station takes theFuji Apple as the main focus to extend the fruit industry chain, provide talent reserves for sustainable industrial development through innovative talent chains, enhance the level of discipline construction and teaching work through agricultural discipline chains, and do a good job in increasing production and efficiency through technological innovation chains, making the technical service chain a booster for improving farmers' scientific farming quality. Specifically, it focuses on the entire industry chain of apple production, sorting, warehousing, processing, packaging, logistics, etc., and cultivates technicians and "technology+management" type administrators through on-site classification, in order to reserve talent chains. The interdisciplinary integration is promoted and the agricultural discipline chain is improved by means of strengthening the construction of disciplines and specialties, and a strong disciplinary support system is formed by connecting the discipline chain with the industrial chain. The modernization of planting technology and business management are promoted in the park through technological innovation and innovative management methods. A scientific and technological support group of "experts+graduate students" has been formed to improve the technical level of farmers' scientific management and scientific farming through "nanny style" service and "apprentice style" guidance. This "five chain integration" development model has constructed a relatively stable linkage mechanism, providing strong support for the development of the apple industry.

3.3 Enhancing the Technological Content of Apple Planting Process

The Shunping Fruit Experiment and Demonstration Station promotes a modern apple cultivation model centered on short rootstocks and dense planting, demonstrating modern apple cultivation techniques such as ridging cultivation, ground cloth covering, drip irrigation, orchard grass planting, and mechanized operations with the goal of saving labor, effort, and efficiency. Based on the modern apple cultivation mode and technical configuration, the demonstration station uses the methane tank biological fermentation technology to innocuously treat and liquefy the

solid organic matter, and integrates it into the drip irrigation system of the park through multistage filtration to realize the green and efficient application of manure. The fallen fruits and grass fragments in the orchard can be used to feed sheep, and sheep manure can be fermented to become high-quality fruit tree green manure. The modern apple cultivation technology system has been further improved and a model for the upgrading of apple fertilization technology has been provided in our province and even across the country. Fruit quality and safety tracking systems, bucket rain sensors, automatic weather intelligence stations, and intelligent pest detection and reporting lights can be seen everywhere in the park.(Fig.6——Fig.11)

Fig.6. Fuji Apple Planted with Low Anvil

Fig.7. Methane Production Plant

Fig.8. Soil Sensor

Fig.9. Intelligent Insect Warning Light

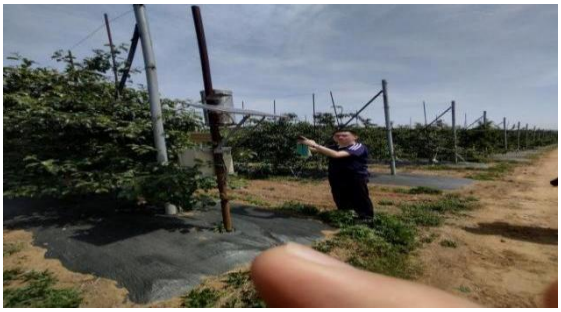

Fig.10. Automatic Meteorological Station

Fig.11. Robot Automatic Lawn Mower

In the past two years, the park has mainly strengthened the weak spots in the industrial chain by building a 1000-ton refrigerated warehouse, adding a fresh fruit sorting and packaging line with a daily sorting capacity of 40 tons, equipping the park with an apple fresh slicing processing line and an apple chip production line for apple

deep processing, and completing a comprehensive processing line for fresh apple pressing, juice fermentation, and apple brandy production. In this way, the industrial chain is transformed into a value chain, and the apple fruit can be utilized to the largest extent. From simple planting and breeding to deep processing, the park promotes industrial clusters, creates job opportunities, and reduces market risks caused by a single industrial link. The optimization technology system from warehousing, sorting, processing, and market circulation is being reconstructed step by step. (Fig.12)

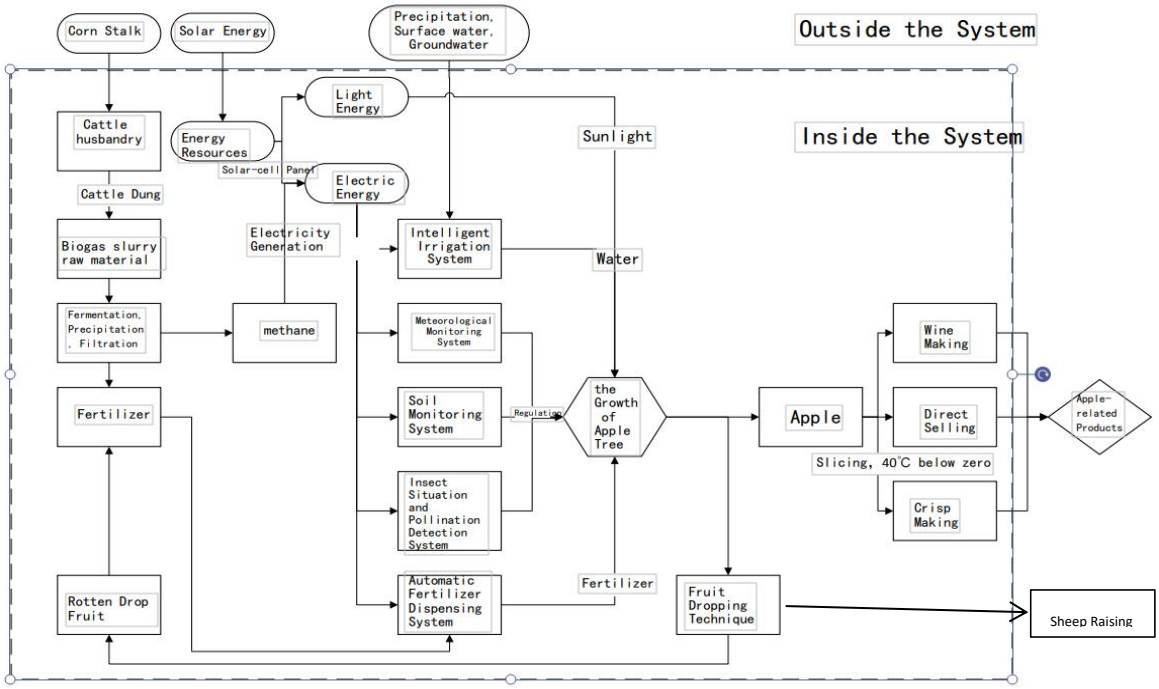

Fig.12.Shunping Fruit Experiment and Demonstration station Apple Growth Flow Chart

4 The Practical Effectiveness of the Industry-University-Research-Application Model at Shunping Fruit Experiment and Demonstration Station

The industry-university-research-application model at Shunping Fruit Experiment and Demonstration Station has always been centered around the main line of industry, exploring the path of integration of industry, university, research and application, to create characteristic industrial clusters, and develop modern agricultural industry models. Since the cooperation with Shunping County in 2013, Hebei Agricultural University has planned a 12200 mu comprehensive modern agricultural industrial park dominated by Fuji apples, forming an industrial layout dominated by apples and supplemented by walnuts, grapes, cherries, etc. On this basis, Hebei Agricultural University further plays the supporting and leading role of science and technology in industrial poverty alleviation, and promotes industrial upgrading and transformation with scientific and technological research and development, and ensured the formation of a standardized system for the whole process of apple industry including pre-production, mid-production and post-production with scientific and technological research and development. At the same time, a special fruit tourism line has been established in the park. An integration of the first, second and third

industries, integrating industry, university and research, and application with a clear division of labor in demonstration areas, production and processing areas and leisure and tourism areas, has been basically formed, and the function of serving scientific research has been realized.

At present, the 850-mu apple orchard in the core park of the fruit experiment and demonstration station produces over 1250 kilograms apples per mu, with a production value exceeding 10 million yuan, and has developed and grown into a leading enterprise. At the same time, the experimental station has become a "base" for scientific research, teaching, and practice in universities. The main benefits of Shunping Fruit Experiment and Demonstration Station to the local area are that it has stimulated a group of large growers, engaged a group of farmers for employment, and the inspiration function of the experiment station has been played. With the guidance and assistance of experts and professors, local farmers' apple tree planting has become more scientific and standardized. The demonstration station has benefited 3500 mu of orchards in the surrounding area, successively driven 8 impoverished villages and more than 1700 households out of poverty, benefited more than 6500 farmers and achieved an per capita income increase of over 3000 yuan. (Fig.13)

Results of Shunping Fruit Experiment and Demonstration station				
OutputValue Realized	Villages Lifted out of Poverty	Households Lifted out of Poverty	Number of people Lifted out of Poverty	Number of people Lifted out of Poverty
10000000 RMB	8	1700	6500	3000

Fig.13.Results of Shunping Fruit Experiment and Demonstration station

5 Enlightenment of Serving Rural Revitalization Based on the Industry-University-Research-Application Model

The 2021 Global Food Crisis Report jointly released by the Food and Agriculture Organization of the United Nations, the Food Programme, and the European Union shows that in 55 countries and regions, at least 155 million people fell into crisis level or more severe food insecurity in 2020 with an increase of about 20 million people compared to the previous year. The report solemnly warns of a worrying trend: since the first release of the report in 2017, the problem of severe food insecurity has been escalating. The main factors that currently affect the world food market and prices are manifested in five aspects: climate, arable land, technology, population, and government. The World Food Programme believes that one of the main reasons for the instability of world food supply and demand and the large fluctuations in food prices is that science and technology are not widely used in agricultural production, especially in Africa and other developing countries and regions. The lack of modern agricultural science and technology equipment, technology and talent, and low agricultural productivity have led to frequent food crises in these regions. Learning from the development model of the Shunping apple industry is suggested. The experience include choosing a leading industry according

to local conditions, setting up an agricultural industrial park as a platform to undertake the industry-university-research-application cooperation, setting up a compound expert team to conduct the research.[4] Thus the chosen industry is driven with the industry-university-research-application model, and the surrounding areas are influenced.

In the future, institutions of higher learning will inevitably assume an important mission in serving the major strategy of rural revitalization, and strengthening the collaborative innovation of industry, university, research and application will become an inevitable path. The industry-university-research-application model of Shunping Fruit Experiment and Demonstration Station established by Hebei Agricultural University can provide useful reference for rural revitalization in China and the successful solution of food problems worldwide.

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