Industrialized Development Models of Agricultural Scientific and Technological Achievements

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Abstract   Industrialization of agricultural scientific and technological achievements has become an extremely important part in agricultural structural adjustment and agricultural economic development. Basic models for industrialization of China’s agricultural scientific and technological achievements should be; (i) integrating scientific and technological development and production relying on large enterprises; (ii) integrating scientific research and development with agricultural scientific and technological achievements and scientific research institutions as support; (iii) spindle type transformation; (vi) agricultural scientific and technological demonstration area; (v) technology extension network.

Key words   Agricultural scientific and technological achievements, Industrialization, Development model

At present, China’s agricultural productivity and rural social economic development are extremely not balanced. In addition to influence of traditional planned economy management system, China’s agricultural production technology system will inevitably be a multi-level system. For a certain area, due to distinctive regional difference and seasonal production, all sectors within agriculture are varied. In this situation, traditional agricultural technology coexists with modern agricultural technology. In view of complexity and diversity of technological structure, China’s agricultural scientific and technological achievements industrialization must accord with local situations, and it is required to actively explore suitable model favorable for benign cycle of agricultural scientific research production. According to practice in recent years, we can sum industrialization models of agricultural scientific and technological achievements into following models.

1 The model of integrating scientific and technological development and production relying on large enterprises

The largest characteristic of this model is taking large enterprise as a party demanding agricultural scientific and technological achievements. Ways of agricultural scientific and technological achievements being introduced to large enterprises are various. Thus, this model is manifested in different forms. In accordance with ownership of property right, this model can be divided into following types.

1.1 Monopolizing property right of agricultural scientific and technological achievements   The relationship between buyer and seller of transfer of agricultural scientific and technological achievements is purely market relationship. As buyers, large enterprises will be influenced and restricted by the market when buying scientific and technological achievements, while as suppliers or sellers of scientific and technological achievements, scientific research institutions will also face market choice. This transformation model is clear in property right and convenient for management. However, due to lack of effective benefit return mechanism, incentive and restrictive mechanism, it is easy to lead to separation of supply and demand parties in market action. In addition, although market transaction is completed, there is no effective technical support and guarantee at production stage, so suppliers can not completely evaluate market potential and expected profit of the corresponding achievement. Therefore, such model will damage benefits of suppliers and naturally lack strength and power for long-term conversion of agricultural scientific and technological achievements in the later period. This model is popular at the market, but due to its instability and lack of risk sharing and benefit mechanism, we believe that it is only a supplemental model. For example, Linqu County Fruit Company successfully cultivated high quality detoxification fruit seedlings, realized annual production capacity of 4 million seedlings, and invested more than 2 million USD to build China Northern Fruit Laboratory Application Station, to conduct technological development of fresh keeping, cold storage and processing of fruit products. Through technology extension, it has established more than 40000 mu high quality fruit production base, developed more than 10 large fruit fine and deep processing enterprises, and preliminarily established the production pattern of integrating agriculture, industry and trade with science and technology as guide.

1.2 Sharing property right of agricultural scientific and technological achievements   The most distinctive characteristic of this model is that suppliers and demanders of agricultural scientific and technological achievements participate in industrialization process of scientific and technological achievements in certain form. According to difference of enterprises in the establishment pattern, it can be roughly divided into following threes models.

(i) Cooperative production model. Large enterprises badly need

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Received; February 13, 2015   Accepted; April 16, 2015
Supported by Project of Business Management Cultivation Discipline in Southwest University Rongchang Campus
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agricultural scientific and technological achievements. Through negotiation and signing agreement, it is able to regulate rights and obligations of both parties. Suppliers also can be benefited from transferring scientific and technological achievements. (ii) Jointly establishing limited liability companies. Since conversion of agricultural scientific and technological achievements needs large sum of funds and is faced with high risks, suppliers and demanders of agricultural scientific and technological achievements need making clear that suppliers provide technological achievements, human capital, technological support and certain amount of funds, while demanders need providing major funds, management, place and facilities through agreement. Suppliers and demanders jointly make plan for such high technological enterprises (companies). Returns will be allocated in accordance with their agreement. Routine management is often carried out by receivers with authorization of suppliers, and suppliers mainly complete management of enterprises through supervision mechanism and personnel appointment and removal system. (iii) Establishing joint-stock agricultural scientific and technological enterprises. Major difference of this model with the above two models lies in the fact that funds for combining agricultural scientific and technological achievements with industrial economy are raised through project evaluation, risk determination, and feasibility study. This model conforms to the principle of optimum input of cost because it can bring into full play advantages of modern financial market and investment means, effectively evade market risk and industrial risk, successfully apply agricultural scientific and technological achievements into production practice, realize integration of science and technology with economy and value of scientific and technological achievements. Although the cost of financing is relatively high, as multiplier of economic benefit, science and technology have much higher output than input. The above models have superior advantages and many successful cases in China, and accordingly will become major models for industrialization of agricultural scientific and technological achievements. For example, Chongqing Keguang Seed Co., Ltd is a scientific and technological enterprise jointly established by Chongqing Scientific Research Institute and a company. It has extended fine seed about 666700 tons and created social and economic benefits for 500 million yuan.

2 The model of integrating scientific research and development with agricultural scientific and technological achievements and scientific research institutions as support

This model is also called autonomous conversion model or autonomous scientific and technological development model. It is characterized by the fact that agricultural scientific and technological achievements are not transferred, property right of agricultural scientific and technological achievements is still possessed by suppliers, agricultural scientific and technological achievements are developed and industrialized through autonomous development of scientific research institutions, and all benefits are possessed by scientific research institutions through autonomous management, self-development, and assuming sole responsibility for their profits or losses. This model operates with scientific research institutions as major entities. It is suitable for scientific research institutions with high application of agricultural scientific and technological achievements. Besides, it is favorable for reform and system innovation of China’s scientific research system, and favorable for agricultural scientific research system getting rid of influence of planned economy and really manifesting requirement of market economy. When selecting topics, scientific research institutions should orient towards market demand, focus on studying market prospect and commercial feasibility of research achievements, and develop materialized achievements conforming to demands of consumers and suitable for sales, so as to realize benign cycle of "scientific research - development - extension - market benefit - scientific research" operation mechanism. In addition, scientific research institutions provide technological consultation, transfer and contract through establishing economic entities, to realize industrialization of scientific and technological achievements. A large number of typical cases also emerge in our country, in which the conversion of achievements is realized with scientific research institutions as major entities. For example, the Cucumber Research Institute of Tianjin Academy of Agricultural Sciences walks out a road of industrial system integrating scientific research, breeding, processing and sales, with an annual net income of 10 million yuan. Another example is the Vegetable Research Institute of Hu-nan Academy of Agricultural Sciences, which is engaged in the scientific research on key problem tackling of hybrid pepper and meanwhile develops the existing scientific research achievements with the result that Xiangyan pepper is not only extended all over the country, but also successfully planted experimentally in regions such as Vietnam, Thailand, Japan and South Korea, etc., with an accumulative net profits of 90 million yuan in 10 years and the highest annual per capital net profit of 0.4 million yuan, thus successfully walking out a road of scientific and technological achievements industrialization.

3 "Spindle type" achievement transformation model

This model means establishing an economic carrier of "scientific and technological achievement + company + farm household". It is mainly to develop a company specialized in the local leading industry by the introduction of domestic and foreign agricultural high-tech achievements as well as famous and excellent new products around rural native specialities and in combination with local regional advantages and radiate to the surrounding rural areas centered on a demonstration base established by the company so as to gradually produce high-quality characteristic products by means of high-quality species and advanced planting management technology and sell these product to domestic and foreign markets after uniform processing or deep processing with the result of realizing the value increase of scientific and technological achievements, and also incorporate fame households into a large-scale socialized
production system featured with specialized labor division and coordination. This model looks like a "spindle" because the agricultural scientific and technological achievements come from domestic and foreign countries and are also sold to domestic and foreign markets. It can realize the transformation of conventional agriculture quite well. A typical case is the "Dajiang model" appearing in recently years. Dajiang (Group) Stock Co., Ltd., which is located in Songjiang Country in the suburbs of Shanghai city, becomes the largest modern agriculture and animal husbandry enterprise group in our country through 10 years of hard work in exploitation and development, with the registered capital increasing form original 6 million USD to present 494.35 million yuan. Aiming at and following up the world first-class level, introducing the advanced technology, equipment and excellent species from foreign countries on a selective basis and combining with the domestic and local actual conditions for digestion and innovation, Dajiang Group establishes a continuous operating system integrating feed production, breed chicken breeding, meat chicken raising, slaughtering and processing as well as domestic sale and export and, by uniting with the village, builds 21 modern large chicken farms and 7 feed factories. "Dajiang" has already become a famous feed production base, improved species breeding base, non-staple food production base and export and foreign exchange earning base in our country. It produces 1.2 million tons of feed, 3.5 million sets of parent breed chickens, 100 millions of commercial young meat chickens, 50 millions of meat chickens and 90 thousand tons of chicken meat (including 35 thousand tons for export) annually. In 1994, its annual sales amount reached 2.035 billion yuan, with its pretax profit up to 26.1 billion yuan and its foreign exchange earning up to 62.24 million USD. "Dajiang model" takes "Dajiang" subsidiary enterprises as its core and continuously establishes and develops a batch of associated enterprises with multiple economic sectors and multiple operation modes, thus forming a combined enterprise group. It connects with farm households through these enterprises and makes farmers directly combine with the domestic and foreign high-tech technological achievements, thus transforming the structure of species and technology at the fastest speed, producing high-quality and high-value products and making the domestic and foreign agricultural products successfully enter into domestic and foreign markets through advanced processing and packing. In a word, this model overcomes the shortcomings of villages in the aspect of land, fund, technology, etc., and brings the advantages of ample labor force and flexible household management in the villages of our country into full play. Moreover, farm household can directly contact the advanced foreign methods for agricultural science and technology and operation and management, which is of great help to integrating China’s agriculture with international community and realizing the modernization of conventional agriculture. In eastern coastal regions where the rural productivity is comparatively developed, this can yet be regarded as a good road for the transformation of agricultural scientific and technological achievements.

4 Agricultural scientific and technological demonstration area

This model is mainly a transformation model that is driven by the government act and organized and coordinated by the local government for marking certain regions in the suburbs of large and medium cities and open coastal cities with relatively strong agricultural scientific research strength, concentrated qualified agricultural technical personnel and developed economy so as to form development bases, pilot testing bases and production bases for agricultural high and new technology through concentrated input and concentrated development of agricultural high and new technology, drive the accelerated transformation of agricultural high-tech scientific and technological achievements and realize the commercialization, industrialization and internationalization of agricultural scientific and technological achievements.

4.1 Establishing high agricultural scientific and technological park model

This model is suitable for suburban developed areas, relies on central cities, and takes intellectual resources of colleges and scientific research organizations. Agricultural education, scientific research and local production institutions establish economic entities, create optimum environment with the aid of favorable conditions of central cities, preferential policies of new high technology industrial zones, attract enterprises and financial circles to cooperate, provide mature new high technologies and products, and become secondary development and pilot base of agricultural scientific and technological achievements. Modern agricultural scientific and technological park is a new organizational form in the process of accelerating development of agricultural modernization. For example, in the Eighth Five-Year Plan and Ninth Five-Year Plan, all areas took building or modern agricultural scientific and technological park as major work, so the development of modern agricultural scientific and technological park is vigorous. According to preliminary survey and statistics of Department of Science and Education of the Ministry of Agriculture, the total number of new high agricultural scientific and technological parks and modern agricultural model parks has reached 405, including one national level new high agricultural technological industrial demonstration zone (Yangling New High Agricultural Technological Industrial Demonstration Zone), 42 provincial level new high agricultural technological development zones, and 362 prefecture level new high agricultural technological development zones. For example, Jinan City of Shandong Province takes new high agricultural technological development zone as connection with agriculture, science and technology and education, and important base for training farmers. It invested 3.5 million yuan in building 3000 m² scientific and technological training center, and selected a town in every county (city and district) as training demonstration base. Shandong Dengcheng New High Agricultural Scientific and Technological Demonstration Zone invested 8.6 million yuan in building 2080 m² tissue culture Center and 20 hectare flower tissue culture development base, and signed greenhouse flower planting contract with 150 farmer households through provi-
4.2 Integrated agriculture, science and technology, and education demonstration model

With support of government sectors and famous agricultural colleges and universities or agricultural scientific research institutions, it is recommended to build an agricultural technology service system integrating demonstration of agricultural scientific and technological project, direct sales of means of agricultural production, and issue of agricultural information. Suzhou Future Farming and Forestry World is a large agricultural science and technology exposition park independently controlled by foreign capital and a teaching and scientific research base of Nanjing Agricultural University, with registered capital of 100 million yuan, covering an area of 200 hectare, and Nanjing Agricultural University as general counsel of agricultural technologies. At present, Nanjing Agricultural University has gathered forces of all disciplines to form expert team and reside in the park for participating in the construction. An indoor exhibition hall with an area of 4000 m² is under construction. American and Speedling Incorporated and New Zealand Xcell Breeding Services Ltd have entered the park. As a comprehensive permanent agricultural technology market, Suzhou Future Farming and Forestry World has obtained great support of many departments including the Ministry of Agriculture.

4.3 Establishing comprehensive agricultural development trial zone

Hunan Mapoling Agricultural Scientific and Technological Extension Park is established with support of the Ministry of Finance in 1988. It takes full advantage of production experimental facilities and base, carries out pilot test and extension model production, and provides model production for leaders and cadres, which plays an extremely important role in accelerating extension and application of agricultural scientific and technological achievements. Firstly, agricultural scientific and technological achievement extension is carried out in achievement research and development institutions. This can further improve agricultural scientific and technological achievements and promote improvement of agricultural scientific and technological achievements. Secondly, is agricultural scientific and technological achievement extension. It is recommended to take advantage of existing production conditions and foundation of scientific research institutions, which is favorable for reducing cost of achievement extension and also favorable for improving extension quality. Thirdly, provincial level comprehensive agricultural scientific research institutions provide unselfish scientific and technological services, set up trust of farmers, promote farmers to voluntarily accept model achievements. Fourthly, in the process of achievement extension, it is able to fully find out demands of farmers for agricultural scientific and technological achievements and promote establishment of scientific and technological projects, which is favorable for increasing transformation and application rate of agricultural scientific and technological achievements.

5 Technology extension network model

The technology extension network model is also called government promoted transformation model. It is mainly aiming at agricultural scientific and technological achievements with high social benefits, low economic benefits and high difficulty of transformation. Government provides support and guidance with the aid of public resources and administrative forces, promote combination with agricultural production activities, to realize value of agricultural scientific and technological achievements. This model is suitable for those agricultural scientific and technological achievements difficult for transformation, such as crop cultivation technologies, transformation of medium and low yield field. Government can implement comprehensive agricultural development projects. This model has realized high social benefits with agricultural technology extension network at all levels as foundation. Rural economic system reform launched in the beginning of the 1980s is not adapted to demands of individual and household operation for services. After disintegration of original four level agricultural science and technology extension network, about 65% agricultural counties have established agricultural extension centers, built or expanded agricultural extension station, gradually established basic functional organizations with counties as centers. The new extension system plays a great role in overall coordination and formulating policies and regulations.