Assessment on Innovation Capability of Science & Technology Park in Agriculture Sector

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Abstract: The purpose of establishing Agricultural Science and Technology Parks is to promote the modernization of agriculture in China through clustering capital, technology and R&D resources. On the basis of analyzing the actuality and long term factors that restrict its innovation capability, the thesis discusses the models and methods can be used to promote the Park’s innovation capability.

Key word: Agricultural science and technology park, innovation, capability, model

1. Introduction

In 1990’s, with the development and continuous improvement of productivity of agriculture, China’s grain supply became self-sufficient or even surplus in good years historically, but due to the irrational industry structure, low efficiency as a whole and the weak international competitiveness, agriculture industry has become the bottleneck of China’s economy progress. As a new method to develop and transfer agriculture technology, state owned agricultural science and technology parks were set up consequently. It has become an important way to promote the application of R&D results, solve the rural issues and boost sustainable development.

With the direction of government and widely participation of society and based on advanced technology and oriented by the market, the parks achieved a lot in taking advantage of local strengths and technology and regime innovation. Now there have been 36 parks and they’ve been located rationally and of considerable size. Meanwhile, as these parks are still new and growing, several problems are revealed in their developments, e.g. some of them are not well planed and local specialties are not considered sufficiently, which resulted in lacking of features and repeat investment, low efficiency and weak competitiveness; paying more attention to importing foreign equipment than digesting of technology and attracting personnel; insufficient R&D capability and operation and management experience disable the parks to bring prosperity to local farmers. These problems undermine the function and development of the parks. Besides lack of directive theory and operational specification, state owned Agriculture Science and Technology Park has no precedent in the world, the methods and mechanisms of it are far from developed, which makes the parks unable to achieve their full potential and innovative capability and therefore slows down the realization of socialism new rural.

It is of significant meaning to diagnose the bottlenecks of innovative capability of agriculture science and Technology Park and find practical solutions.

1.1 Actuality of Agriculture Science and Technology Parks

1.1.1 The achievements of the parks:
The agricultural science and technology parks did a good job in technology integration, demonstration and promotion and accelerate a great number of applications of technology. They brought about a new production method that is more intensive, of larger scale and market oriented, and greatly increased the scale and efficiency of agriculture production in China as well as the competitiveness of the products. They also introduced a whole new pluralistic investment and financing system. From 2002 to the end of 2005, the accumulated investment reached 27.8 billion RMB, government investment accounted 12.3%, business investment accounted 70.6%, and 17.1% left was the investment by the parks. The businesses have become the largest investor and a number of large agriculture technology companies have been established (with more than 1 million RMB yearly sales and sound governance). There are 540 large companies (19.95% of all companies) in 36 parks around the country; and 15789 science popularization
lectures and informal discussions were organized that were participated by 1.4 million person-times during the same period.[1]

1.1.2 Difficulties in technology innovation:

**Flaws in financing system slow down the Investment**: There were only 540 companies’ yearly sales exceeded 1 million in 36 park indicated that the companies’ scale and profitability were still low. The percentages of all kinds of investment were relatively stable but increased slowly, even dropped for some year (see graph 1). Take SUNQIAO agricultural park in Shanghai for instance, the companies in the park are subsidiaries of the park. For outsiders it is absolutely an independent system. Though it helps the management and coordination and decision making process, it is not suitable for establishing a socialized investment environment and attracting wide participation, as well as getting support from financial institutes and forming multi-channel, multi-layer pluralistic investment and financing system.

![Investment of Agricultural Parks](image)

**Graph 1** Source: Agricultural Science and Technology Park 2005 Report, Ministry of Science and Technology of the People’s Republic of China

**Technology development and promotion ability declines**: During the period of 2002-2005, the number of new project as well as new developed technology and imported variety declined regularly. Indicated that the one of the parks’ most important function - to promote new technology and new variety, which is significant to local agricultural companies, influential cultivation families and demo premises as well as development and prosperity of rural area, has declined. Some of the reasons are the small size of the companies and insufficient innovativeness and their future development is affected. (see graph 2).

**Underdeveloped Feature industry and low cluster efficiency**: In the process of importing project, technology and varieties, most parks focus more on local advantages and specialties rather than regional features. After studying agriculture parks in Beijing, Shanghai and Tianjin, we found that industry of regional feature and advantages were still underdeveloped. Even some parks that have developed more than 200 products such as vegetables, fruits, egg and pork that are of specifications of green food and aquatic products, mushrooms, flowers and microbe compound preparations of high quality, they can not identify their feature and advantage industry as well. The low level of cluster, weak clustered innovation capability and no cluster stimulating mechanism make it hard for the parks to be the leading force of the industry and to stimulate clustering, which is important to improve their profitability and future developments. On the other hand, this means the parks can still do a lot of things in optimizing industry structure, industry upgrading and industrializing.
Beneficial policy that promote technology transfer needed: The main task and goal of agriculture development in China now is to encourage R&D input and improve transfer efficiency of R&D results, as well as innovative promotion mechanism. Though many attempts have been made by the parks to find their own way to promote application of new technologies, the related policy support of local governments is not enough. Examples are: no detailed attraction policy and measures are specified in the governments’ beneficial policy; no materialized promotion policies on agriculture promotion, etc. Governments of all hierarchies should pay more attention to the carrying out of these agriculture promotion policies and measures.

Insufficient self-innovative capability: In the past 20 years, agricultural parks imported a great number of foreign technologies, and this benefits China’s agriculture as a whole. Compared with the foreign counterpart, the main weaknesses for the parks are lack of core technology and low added value for domestic developed products. In general, to compete with more competitive foreign counterparts, it is urgent for them to improve technology innovation capabilities and strengthen the management of core technology and intellective properties at present. It is of both theoretical and realistic significance to study the innovative capability, identify the driving factors of technology innovation and establish the innovation motivation model.

2. Driving factors and models of technology innovation capability

2.1 Driving factors of technology innovation capability

Continuous technology innovation is not only propeller the prosperity of economy; it is also the foundation of the surviving and development of enterprises. Innovation theory was first mentioned in “Economy Development Theory” by American economist Joseph A. Chumpeter in 1912. He thought innovation was a variable in production function; the emergence of new idea and method was to introduce a whole combination of producing factor and conditions into the production process and brought about changes in technology system. Innovations include: new developed product, new technology, new material, new market and new management method. Afterwards, many economists put innovation in many different ways, like invention-technology innovation theory by American economist E.J. Mansfield; technology innovation-new product or technology theory by English Science and technology policy expert C. Freeman and technology innovation-new market exploration theory by...
Japan expert Moriya Regular, etc. According to the corporation core competence theory by C.K. Prahalad and Gary Hamel, the core competence of a corporation is not separated technologies or skills but an aggregation of them with management, which is a combination of a set of complementary skills and knowledge. Meyer and J.M. Utterback thought, the core competence of a company was the unique capability that penetrated every step of the whole value chain \([2]\). Michael Porter \([3]\) from Harvard Business School structured the diamond model for competitive advantage of countries analysis that is applicable for regional analysis. Diagnosing the five decisive forces of the competitiveness of an industry provides us clues for analyzing technology innovation drivers.

### 2.2 Models of technology innovation capability

There two linear models for technology innovation, technology driving model and market pulling model. Chumpeter put it this way in his technology driving model, the main power of innovation comes from achievements of basic science and technology inventions. It was them that motivate innovative businesses to organize themselves to apply these inventions, and therefore satisfy existed or newly created needs in the market. The founder of market pulling model - J.Schmookler believed that innovations were motivated by markets. In the model, innovations are initiated by market needs for new technology and products. Innovative economist Dosi defined Technological Paradigm in his article - “Technological paradigms and technological trajectories” \([4]\) as a road map to solve specific technology and economy problem based on highly selective principle of natural science and special rules of trying to obtain new knowledge and prevent proliferation of it. The Technological Trajectories refers to the interactions and tradeoffs between economy and technology. The trajectory is formed by a series of technological attempts and experience accumulations.

### 3. Innovation capability modeling of agricultural parks

#### 3.1A model of agricultural parks’ innovation capability

According to analysis, the main problems of agricultural parks can be summarized as: no pluralistic investment and financing system, low company clustering level, underdeveloped feature industry, weak application ability and insufficient policy support. As the competitiveness of the parks are determined by innovation capability, we can solve the problems by two steps: to identify the determinants of innovations and then set up the innovative model and technological trajectory of our own, so that we can be less dependent to imported technologies. Graph 3 shows a two-dimension promotion model of technological innovation capability for agricultural parks. The model forms a system structure combined interacting factors like government, technology, market, venture capital and organization structure, culture, motivation mechanism and entrepreneur spirit of companies.

![Graph 3 Innovation Model of Agricultural Science and Technology Park](image-url)
3.2 Analysis on determinants of innovative capability of the parks

According to the above model, we can promote the innovative capability of the agricultural parks by upgrading both the inner and outer environments and increasing the coordination of all the determinants within the model. Evolutionary theory believes superior species eliminates inferiors in a given environment [5]. Likewise, the innovative capability of these parks depends on outer environment as well. A better environment can stimulate the innovativeness and expand the development prospect and form a self-strengthen circle. The determinants of the outer environment includes: government policy, technology development, market need and competitiveness and venture capital.

An appropriate outer environment is prerequisite for innovation and intrinsic motivation is a necessity. The determinants of the inner environment includes: organizational structure, profitability, entrepreneur, culture and motivation mechanism of the companies.

3.2.1 The government is the paramount determinant

Because of the significant external economy of technology innovations, the government should take the role of catalyst. Innovations in a specific industry can be beneficial to other industry as well. An outer environment with only market and technology is not enough for innovation, the encouraging policy and supportive measure from the government is needed.

The government’s function in propel innovation is emphasized long ago. For instance, United States congress approved “Federal agriculture improvement and reform act” in 1996, and “The Farm Security and Rural Investment Act” in 2002, which increased the R&D investment significantly on the basis of the former act. In European Union, Common Agricultural Policy (CAP) was adopted, whose basic target was to promote agricultural productivity, assure farmer’s fair income and stabilize the supply and price of farm products. The 4th, 5th and 6th research and development frame plans set up the research basis for sustainable development of agriculture, and the researching areas include: agriculture, fishery, forestry and quality and safety of food. All these greatly increased the agricultural innovativeness in these countries. Governments draft laws and regulations to stimulate innovation in enterprises as well, measures generally applied by governments include: government direct investment, tax holiday to new products and R&D expenses and favorite loan policy.

In China, national science and technology projects, 863 plan and 973 plan are all researching projects focus on agriculture modernization, new rural industry, rural community development. The achievements of these projects in areas as species protection, seed selection and abundant harvest engineering etc prosper the agricultural research in China greatly.

3.2.2 Enterprise is the main practitioner

Enterprises are the main practitioner of technology innovation and college and researching institutes are foundation of innovation. Regional R&D can provide mature and industrialized technology for enterprises in the parks. And with the support of servicing organizations of market, information, logistics, results of R&D can proliferate and be applied around the country. With more technology innovation emerge, more competitive enterprises will be attracted and clustered to take a part in regional technology innovation.

3.2.3 Coordinating factors

The technology development level and market potential is the original stimulation of technology innovation in enterprises as well as the basis for governments to draft encouraging policy. The interest of enterprise is the core driver for internal innovation; it is influential to other factors as entrepreneur spirit, motivation mechanism, organizational structure and culture. First, when an enterprise can benefit from innovation and become more competitive, entrepreneur spirit will be stimulated, and motivation mechanism inside the enterprise will be adjusted accordingly as well as the organizational structure. Second, the valuation and behavior of employees can be guided by the innovative efforts of the enterprise searching for competitive advantages. For example, the spiritual and material rewards can not only motivate the employees but also plant innovative idea in their mind and form new organizational culture.

Venture capital is the catalyst of transformation of R&D results and high-tech enterprises. In their
early stage, enterprises in the park face difficulties in getting financing support from commercial banks and capital markets because of the high risk and long investment period due to their small scale and present financial status. Venture capital became an important funds source for the innovative actions of the parks.

In summary, the coordination mechanism positions the enterprises in the center because they face the market directly and afford the responsibility of creating values. They should pay more attention to the applicability of technologies other than technologies themselves. Governments and market are propellers of specifications, technology system and intellectual property forming. College and institutes are in the upstream of the innovation process; they care more about the process of inventions. They will work together with enterprises to set up the platform of technology innovation and create value to the society through independent innovations.

4. Conclusion

As a new approach for agriculture development, technology innovation alone is not enough for state owned agriculture science and technology park; the innovative regime is essential as well. What we need here is a regional innovation system. To obtain the capability of sustainable development, we should not only strengthen the interrelation and interaction among the inner factors of the park, but also combine the motivational mechanism of innovation and external conditions actively, focus on the interaction and clustering of innovative factors. Insufficient interaction and exchange of these factors will result in humble innovation capability. Generally speaking, well structured innovation system with well performed functions is beneficial for the sustainable development of agricultural science and technology parks in China.

Reference

[1] Agricultural Science and Technology Park 2005 Report, Ministry of Science and Technology of the People’s Republic of China, p56~70