On Agricultural Scientific Research Institutions Supporting and Serving Technological Innovation Entities

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Abstract This paper firstly analyzed current situation of agricultural technological innovation system in China and obstacles restricting agricultural enterprises to become technological innovation entities. It discussed exploration and practice of Chinese Academy of Tropical Agricultural Sciences in supporting and serving technological innovation entities. Finally, it came up with ideas and approaches for supporting and serving technological innovation entities in the new trend, to provide a new idea and practice for agricultural scientific research institute supporting and serving technological innovation entities.

Key words Public welfare agricultural scientific research institutes, Enterprises, Technological innovation, Entities

Opinions of Central Committee and State Council about Deepening Reform of Scientific and Technological System and Accelerating Construction of National Innovation System[1] ([2012]. 06) set forth accelerating national innovation construction, fully implementing *National Mid- and Long-term Plan for Science and Technology Development*, bringing into full play leading function of science and technology to economic and social development, and taking the entity status of enterprises in technological innovation as primary objective of the reform of scientific and technological system reform in the twelfth five-year plan period, giving prominence to functions of innovation entities, strengthening close cooperation between industry, universities and research, promoting open and share of scientific and technological resources and cooperation of various innovation entities, to improve overall performance of national innovation system. *The Instructions of Central Committee and State Council for Promoting Reform of Institutions by Classification*[2] ([2011]. 05) set forth promoting reform of institutions by classifications according to requirements of separating government from institutions, institutions from enterprises, and management from running. It is important to study how public welfare agricultural scientific research institutions support and serve innovation entities.

1 Current situation of agricultural technological innovation system in China

From the level, the agricultural sci-tech innovation system in China mainly includes central level (scientific research institutions, agricultural colleges and universities, central government-owned enterprises), ministerial and provincial level (scientific research institutions, agricultural colleges and universities, agricultural enterprises), city and county level scientific research institutions; from undertaking entities, it mainly include scientific research institutions, agricultural colleges and universities, agricultural enterprises, extension system[3]. Agricultural knowledge innovation is mainly undertaken by Chinese Academy of Sciences, three institutions subordinate to the Ministry of Agriculture, and agricultural universities, and technological innovation is mainly undertaken by provincial, city and county level institutes of agricultural sciences, three institutions subordinate to the Ministry of Agriculture, and agricultural enterprises. Elements of sci-tech innovation mainly include scientific research personnel, innovation platform and project. In China, agricultural sci-tech innovation talents are mainly distributed in scientific research institutions and colleges and universities, enterprises seriously lack innovation personnel. Government guiding innovation platforms, such as key laboratory and engineering center, are relied on scientific research institutions and higher learning institutions. Only in recent years, some research and development centers or engineering centers are set up with support of government. From the flow direction of financial funds for technological innovation projects, they are mainly undertaken by agricultural scientific research institutions and higher learning institutions, and few are undertaken by enterprises, directly leading to disconnection of agricultural scientific researches and low innovation efficiency and innovation benefit.

2 Obstacles restricting agricultural enterprises to become technological innovation entities

Due to land operation system, China's agricultural operation is decentralized, growth of agricultural enterprises is late, and industrial concentration is low, and enterprises are weak. These restrict functions of enterprises as innovation entities, which are manifested in following three aspects: (i) lack of innovation elements, Enterprises face great pressure of engaging high quality research and development personnel. For a long time, financial funds for innovation projects are subsidized for agricultural scientific research institutions and higher learning institutions, while enterprises are weak in competition[4]. (ii) Lack of innovation motiva-

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tion. Agriculture has distinct public welfare feature. Except modern seed industry, the intellectual property right is difficult to protect. The ratio of research and development input to output benefit is asymmetric, directly leading to enterprises having no enthusiasm to make investment in scientific and technological innovation. (iii) Agricultural centralization is low, leading to weak enterprises and low input ability[5].

3 Supporting and serving technological innovation entities is historical mission in the new trend

Opinions of Central Committee and State Council about Deepening Reform of Scientific and Technological System and Accelerating Construction of National Innovation System set forth establishing enterprise leading industrial technology research and development and innovation system, speeding up the technological innovation system with enterprise as entities, market as direction, and close cooperation of industry, universities and research institutions, bringing into full play functions of enterprises in technological innovation decision making, research and development input, and scientific research organization and achievement conversion, ask scientific research institutions and higher learning universities to provide support and services for enterprises and promote flow of technologies and talents to enterprises. Public welfare scientific research institutions should stick to the direction of social public welfare services, explore new scientific and technological innovation mechanism suitable for agriculture, strengthen openness and sharing of scientific and technological resources, and establish reasonable operation mechanism for scientific research institutions and enterprises[1]. In sum, supporting and serving technological innovation entities is not only requirement for reform of institutions and construction of national innovation system, but also historical mission in the new trend. Public welfare agricultural scientific research institutions should adjust major points and direction of scientific research, open up sci-tech resources, promote personnel flow, innovate upon cooperation system of scientific research institutions and enterprises, and make efforts to make them to become agricultural technological innovation entities.

4 Approaches and ideas for supporting and serving technological innovation entities

4.1 Strengthening gathering of technological innovation elements Firstly, it is required to ensure orderly flow of sci-tech personnel. Scientific research institutions and enterprises may attract sci-tech personnel through signing agreements. Secondly, it is required to support enterprises to set up research and development center, or cooperate with enterprises to build key laboratories, engineering centers, and other high level sci-tech platform. Thirdly, it is required to support enterprises to declare projects, or cooperate with other enterprises to declare financial fund sci-tech projects, and provide consultation services for project declaration and implementation. Fourthly, it is required to establish fundamental scientific research resource sharing platform, mainly including germplasm resources, basic research achievements, scientific research basic data, and scientific and technological information[6].

4.2 Enhancing participation and voice of enterprises in longitudinal projects Firstly, it is required to ask enterprises about key technical problems, including key scientific research subjects and project guidance, to set innovation projects and objectives pertinently. Secondly, it is required to attract technical personnel of enterprises to participate in longitudinal projects, including encouraging enterprises to undertake subproject and participate in project research relying on advantage of directly connecting industries. Thirdly, for projects with distinctive characteristics of achievement converting funds and new high technology industrialization, enterprises should take the lead to provide technological support, to ensure pertinence and actual effect of scientific and technological achievements[7].

4.3 Bringing into play entity function of enterprises in transformation of scientific and technological achievements It is recommended to give full play advantages of enterprises in funds, management and market information, and increase achievement transformation efficiency and benefit relying on major channels to implement achievement transformation. Firstly, it is recommended to develop public technological market, raise ability and level of sci-tech intermediary services, and connect supply and demands of achievements. Secondly, it is recommended to improve practical effect of scientific and technological achievements relying on scientific research institutions. Thirdly, it is recommended to reduce risks of enterprises in applying achievements, promote scientific research institutions and enterprises to establish achievement transformation benefit sharing and responsibility sharing mechanism through buying shares in the form of technology or technological auction[8]. Fourthly, it is recommended to bring into full play comprehensive means of achievement transformation guiding funds and financial insurance, to reduce costs and risks of enterprises in transforming and applying achievements.

5 Exploration and practice of CATAS in supporting and serving technological innovation entities

5.1 Implementing sci-tech innovation ability improvement action, optimizing and adjusting key scientific research points and direction, and laying solid foundation for self-development It is recommended to energetically implement talent-based and science and technology based development strategy, and rapidly raise the sci-tech innovation ability focusing on the strategic objective of one center and five bases, taking talent team construction as the core, discipline construction as the main thread, industry technological demand as motive force, sci-tech platform construction as prop, key projects as gripper, and institutional innovation as means. By 2017, it is expected to solve a good many strategic sci-tech problems concerning overall situation of modernization of China's tropical agriculture, take the lead in some major fields, cultivate a high level sci-tech innovation team, build high

level sci-tech innovation platform and achievement transformation bases, and really bring into play functions of leader of tropical agriculture sci-tech innovation, pacesetter of achievement transformation, and incubator of sci-tech talents[9]. These mainly include following projects.

5.1.1 "Ten-Hundred-Thousand" talent project. It is recommended to put forth effort on cultivating leader talents and sci-tech backbone talents of key fields and posts, including 10 academicians, chief expert of industrial technology system or famous scientists and discipline leaders, 100 influential chairmen or persons responsible for key projects in tropical agriculture, and 1000 competitive sci-tech backbones.

5.1.2 "Ten-Hundred-Thousand" sci-tech project. It is recommended to build tropical agriculture sci-tech innovation system, speed up resource integration, establish whole industry chain innovation system, and obtain 100 projects of national 973 plan, 863 plan, national sci-tech support plan, and key project of national natural science, obtain 1000 provincial and ministerial level projects, make internationally advanced and domestic leading original achievements, and obtain 5 – 10 national level sci-tech achievement awards.

5.1.3 "235" guarantee project. It is recommended to raise 20 million yuan talent incentive funds, strive for obtaining special fund 300 million yuan, capital construction fund 500 million yuan, and make considerable improvement in scientific research conditions of the whole academy by 2017.

5.2 Strengthening comprehensive in-depth cooperation with enterprises and promoting deep integration of science and technology with industrial development It is recommended to bring into full play new force function of enterprises in participating in scientific research projects and organizing achievement transformation, really establish "scientific research project and industrial guidance", set up platform and mechanism for enterprise cooperation, scientific research implementation and enterprise participation, enterprise evaluation, achievement transformation and application, and enterprise as major part.

5.2.1 Comprehensively introducing scientific research enterprises. It is recommended to actively adapt to requirement of national scientific research project reform and introduce enterprises to participate in longitudinal scientific research projects. For 973 and 863 fundamental research projects, it is recommended to listen to opinions of enterprises and focus on solving key scientific problems restricting industrial development; for special projects of public welfare industries, it is recommended to attract enterprises to participate and focus on solving key problems restricting industrial development; for industrial projects of agricultural sci-tech achievement transformation and new high technological industrialization, it is recommended to strengthen industrialization direction in cooperation with enterprises.

5.2.2 Bringing into play mainstay function of enterprises in achievement transformation. Firstly, it is proposed to enhance achievement curing and recommendation, set achievement transformation and sci-tech extension posts according to 10% of whole scientific and technological personnel in the academy. Public welfare category I department should be arranged with 15% full-time achievement transformation personnel and 30% part-time achievement transformation personnel; public welfare category II department should be arranged with 30% full-time achievement transformation personnel and 60% part-time achievement transformation personnel. Personnel for the above posts mainly undertake achievement curing, secondary development and technological transformation work. Secondly, it is recommended to carry out achievement transformation work relying on main channels of enterprises, and promote transformation and application of scientific and technological achievements through buying shares in the form of technology or technological auction.

5.2.3 Introducing social enterprises to make shareholding system transformation of existing enterprises. It is recommended to explore new ways, such as organization holding shares, buying shares in the form of technology, and voluntary share holding, speed up scientific and technological achievement transformation and independent intellectual property right achievement transfer, and enjoy related policies of encouraging enterprise innovation. It is recommended to encourage institutes (stations) to make reform of existing development entities, engineering technological research center, agricultural product processing technology research and development center, fine seed and seedling breeding base, combining resource advantage and development foundation, in accordance with modern enterprise codes and requirements, and establish independent business entity administration structural system. For enterprises with excellent operation, high assets, and promising development prospect, it is recommended to raise competitiveness and build scientific and technological development leading enterprises.

5.3 Innovating upon academy and enterprise cooperation mechanism and building benefit community

5.3.1 Establishing council system. It is recommended to establish modern academy and institute system, improve public welfare agricultural scientific research institute administration structure, and implement the council system composed by major parties at interest. Firstly, it is recommended to continue to implement the national tropical agriculture sci-tech cooperation network. Under the leadership of Department of Science and Education of the Ministry of Agriculture, it is required to attract agricultural leading enterprises, local agricultural administrative competent authorities, agricultural higher colleges and universities, agricultural technology extension system, and new rural operating entities to improve the council structure, and carry out cooperative innovation and extension. Secondly, it is recommended to improve academy and institute two level council system, engage superior competent authorities, regional leading enterprises, local agricultural administrative department, farmers' specialized cooperative organization, and related industrial associations to participate in the council, assist in formulating academy and institute development plan, determine

key research fields and disciplines, and come up with major scientific research programs and key technologies, and improve pertinence and actual effect of scientific research activities.

5.3.2 Supporting enterprises to establish technology center. It is recommended to implement *Opinions of the Ministry of Agriculture about Promoting Enterprises to Carry out Agricultural Scientific and Technological Innovation* ([2012] 2), to support enterprises to set up high level research and development department. Firstly, enterprises take the lead and CATAS participates, to set up industrial technology alliance. Secondly, it is recommended to unite enterprises to set up national or ministerial and provincial level engineering technological research centers, engineering centers, engineering laboratories, and key laboratories. Thirdly, it is recommended to build scientific and technological resource opening and sharing mechanism. All ministerial and provincial agricultural laboratories, engineering (technological) centers, inspection (detection) centers, scientific research test (demonstration) base, germplasm resource banks (nurseries), and agricultural database should be open to agriculture-related enterprises.

5.3.3 Energetically promoting customized scientific research activities. It is recommended to take full advantage of achievement resources of longitudinal scientific research projects and long-term scientific and technological fundamental work, and carry out customized horizontal client projects. Besides, it is recommended to improve project cooperative mechanism, to really manifest cooperative undertaking of project establishment, enterprises participating in scientific research process, timely evaluating study value, and adjusting and optimizing key project direction. Achievements should be evaluated mainly by enterprises or third party organizations and value will be determined in the form of auction. And achievement transformation is carried out mainly relying on cooperative enterprises, and to obtain benefit in the way of buying shares with non-patent technologies. Finally, it is recommended to establish benign cycle of "project establishment - study - transformation - project establishment again", explore rapid channel for transformation of scientific and technological achievements, and to promote close integration of science and technology with industries and enterprises[11].

5.3.4 Building technological transfer center. It is recommended to innovate upon system and mechanism, and build CATAS technological transfer center. It is recommended to rely on scientific and technological achievement resources and human resources of CATAS, carry out technological transaction information services, integrated technological development, technology curing and technology solution, achievement evaluation and patent evaluation, technological property right transaction, consultation service, and technology investing and financing services through opening, cooperation and resource integration with market demand as attraction. It is recommended to set up enterprise-oriented technological transfer public service platform, explore knowledge transfer, and technology transfer, to promote industries to develop new modes, promote excellent technological achievements to move to rural areas, improve ability of serving social and economic development, and create excellent social and economic benefits.

5.3.5 Exploring reform of achievement disposal and income right, to stimulate enthusiasm of achievement transformation. With *Amendment of the Law of Promoting the Transformation of Scientific and Technological Achievements* as guidance, it is recommended to actively explore use right, disposal right and income right reform of scientific and technological achievements, allow organizations to carry out achievement transformation work relying on main channels of enterprises, and promote transformation and application of scientific and technological achievements through buying shares in the form of technology or technological auction, so as to overcome problems of inadequate and unsmooth scientific and technological achievements, promote close connection of innovation and transformation, and boost transformation of scientific and technological achievements to actual productivity. In the period of the Thirteenth Five-Year Plan, CATAS selects 9 project teams to implement reform pilots, explores key scientific and technological achievements with promising application prospect, set ups scientific and technological enterprises, and strengthens technological curing and engineering development, to increase technological achievement transformation efficiency and benefit, and to stimulate team members to make greater contribution to scientific and technological innovation.

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