

Innovations in Agricultural Science and Technology and Rural Development in China

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Agriculture is the basic industry on which human beings rely for their survival and reproduction. It is also a special sector where natural reproduction and economic reproduction intertwine with one another. With the property of general merchandise, agricultural products also possess the special nature seen in public social products. China is a big agricultural and developing country, with agriculture long being a major issue for its overall national economic and social development. Both CPC and the Chinese Government have always attached great importance to addressing the problems in relation to agriculture, rural areas and farmers. Historical experience indicates that the fundamental path for agricultural development is technologic progress. The key of solving the said problems lies in focusing on the construction of modern agriculture and striving to promote independent innovations in agricultural science and technology by conforming to the global trend of sci-tech development.

With a long history of agricultural production, China boasts rich traditional experience in this regard. However, its agricultural economy was highly backward for being long constrained by the feudal system. It was not until early 20th century that a handful of institutions specialized in agricultural sci-tech experiment and research began to emerge. Prior to 1949, the development of agricultural science and technology in China was so slow that the country was left far behind the developed world. After the founding of the People's Republic of China, the Chinese agricultural

scientific research undertaking started to boom under rapid development. Since the reform and opening up, in particular, and under the rational guidance of the State Council, the broad agricultural sci-tech practitioners have made remarkable achievements in China's agricultural science and technology area by making arduous, unremitting and down-to-earth efforts. The contribution ratio of sci-tech progress in agricultural development has exceeded 50%. Innovations in agricultural science and technology have become an essential driver to promote the development of agriculture and rural economy. With agricultural sci-tech innovations as an important source of technical support, China has succeeded in feeding a population accounting for 21% of the world's total by utilizing an area of farmland accounting for 9% of the world's total. The country has also achieved a historical transition from long term food shortage to the basic balance of aggregate demand and supply of major agricultural products (such as rice) (the grain production has consecutively surpassed 300 million tons, 400 million tons and 500 million tons). The total production of major animal products, including livestock, poultry and eggs, has risen to the world's first place. Innovations in agricultural science and technology have greatly contributed to the historical leap of people's life from the lack of food and clothing to moderate prosperity and to spurring the socialist modernization drive, and have provided a critical guarantee for China to build a moderately prosperous society in an all-round way.

I. Major Achievements

Over the six decades since the founding of P. R. China, substantial results have been achieved in the development of China's agricultural science and technology, as reflected by the following major aspects:

(I) The cultivation and application of high-quality breeds have substantially enhanced the supply capacity of major agricultural products such as grain.

According to incomplete statistics, over the past six decades, China has cultivated nearly 20,000 new agricultural product breeds (combination) and achieved large scale breed upgrading for five to six times. The coverage rate of refined breeds of major food crops has risen from 0.06% in 1949 to over 95% at present; the yield of grain per mu has increased from 69kg in 1949 to 330kg currently; the total output has increased from 230 billion jin (115 billion kg) to 1,057 billion jin (528.5 billion kg). Nearly 100 new quality breeds of livestock, poultry and aquatic products have been cultivated and greatly extended, and the gross production of meat, poultry, eggs and aquatic products has ranked top in the world.

1. A major breakthrough has been achieved in the research on germplasm sources. A new batch of high-yield, super high-yield, adversity-resistant and eurytopic crop breeds have been successfully cultivated and extended for application, and effectively guaranteed the supply efficiency of major agricultural products and food security.

2. The successful cultivation, extension and application of new, quality, specialized, characteristic agricultural breeds have improved people's dietary pattern and living standard, and effectively guaranteed the food safety and production development in China.

3. Remarkable achievements have been accomplished in the breeding and rapid propagation technologies for tropic crops, and

therefore, a historical breakthrough has been made in China's tropic agricultural production and technological content.

4. The extension and application of new high-yield, high-quality, multi-resistant, special animal and plant breeds have accelerated the industrialization of agricultural sci-tech achievements and catalyzed the rapid development of China's seed industry.

(II) The innovation, demonstration, extension and application of high-yield, quality, highly effective cultivation technologies and environmentally friendly technologies have enhanced the agricultural productivity and capacity for sustainable development.

While constant breakthroughs have been made in the technology of breeding quality animal and plant varieties, a large batch of high-yield, high-quality, and highly effective production technology systems of the breeding industry have undergone innovative development, extension and application. It plays a supportive role in rapidly improving the technological content and standard of China's advantage agricultural products, and in comprehensively enhancing the competitiveness of China's agricultural products in the domestic and overseas markets, and has made historical contributions to the leapfrog development of China's agricultural production.

1. The reform of farming system and the constant innovations, integrated demonstration and application of the high-yield and super high-yield technologies for agricultural products has vigorously maintained the continuous growth of agricultural production and national food security.

2. The constant innovation and development of animal nutrition as well as cultivation and breeding technologies for livestock, poultry and aquatic products have ensured the sustained expansion and increase of the production scale and efficiency of China's animal husbandry.

3. The universal application of standardized and pollution-free production technologies has played a key role in improving the quality of agricultural products and ensuring food safety.

4. The outstanding achievements accomplished in the integrated management of median- and low-yield farmland have laid a solid foundation for the constant improvement of China's comprehensive agricultural production capacity.

5. The increasing application of rural resource and environment technologies has promoted the sustainable development of agriculture.

(III) The constant breakthroughs made in major animal and plant disease prevention and control technologies have greatly enhanced the capacity to cope with biological disasters as well as the level of disease prevention and control.

Major animal and plant diseases as well as pest plagues constitute the severe biological disasters affecting the safe agricultural production in China. Since the founding of P. R. China, its agricultural sci-tech researchers have conducted substantial exploration into the relevant theories and strived to made technological breakthroughs to prevent and control major agricultural diseases and pest plagues. Key breakthroughs have

been achieved in the prevention and control of major biological disasters such as rice plant hopper, rice blast, wheat stripe rust, locust, avian influenza, foot-and-mouth disease, swine fever, New Castle disease, etc. A large number of major diseases and pest plagues are basically under control. The current loss ratio in crop diseases and pest plagues has been down to about 10%, and the case fatality rate of pigs, cattle, sheep and poultry has dropped below 8%, 2%, 4% and 18%, respectively. The capacity for agricultural biological disaster prevention and control has been greatly enhanced.

1. Major breakthroughs have been made in the theories, methods and technologies concerning the prevention and control of crop diseases and pest plagues. The capacity and level of disease and pest prevention and control have been enhanced.

2. Major progress has been achieved in the research on pesticides, and the loss of agricultural production, such as grain, has been reduced.

3. The formulation, manufacturing and extensive application of animal vaccines have ensured the healthy cultivation of livestock and poultry and the effective supply of animal products.

4. The research and development of a large batch of new veterinary medicines have effectively guaranteed the animal health.

5. Key progress has also been achieved in the research on the comprehensive prevention and control technologies for major aqua-cultural diseases, and supported the sound development of China's aquaculture.

(IV) The rapid development of agricultural machinery and agricultural product processing technologies has enhanced the labor productivity and increased the added-value of agricultural products.

The transition from traditional agriculture to modern agriculture inherently requires us to accelerate the mechanization of agricultural production, extend the industrial chain of agriculture, and enhance the agricultural labor productivity. Over the past sixty years, the scientific research on agricultural machinery in China has witnessed rapid development, with the capacity and level of the equipment of agricultural machinery being greatly enhanced. By the end of 2008, the comprehensive level of mechanization in the farming and harvest of major food crops has reached 48%. The wheat production has basically realized whole-process mechanization. The mechanized rice transplantation and harvest and the mechanization of corn harvest have been dynamically advanced, which lays an important foundation for the release and transfer of rural labor force as well as the maintenance and improvement of agricultural productivity. Over recent years, Chinese scientists have made constant breakthroughs in the intensive processing technologies of agricultural products, promoted the extension of the industrial chain of agriculture, increased the added value of agricultural products, and enhanced the benefits of agricultural development.

1. The sustained rising of the agricultural mechanization level has laid a solid material foundation for China to build its modern agriculture.

2. The vigorous development of protected agriculture has contributed to the complete solution to such problems as

inadequate gross supply and unbalanced year-round supply of vegetables, and has greatly supported the achievement of income increase and prosperity of farmers.

3. The innovation and development of agricultural product processing technologies have backed up the agricultural restructuring and enhancement of the agricultural industrialization level.

(V) The development of modern agricultural high technology has improved the competitiveness of the modern agricultural industry.

As a representative of biotechnology and information technology, the agricultural high technology has injected new impetus into the progress of agricultural science and technology, and the said technology has the leading technology and important driving force in the agricultural production. Ever since the National High-tech R&D Program (namely the "863" Program) was established, the leapfrog development has been made in the agricultural high technology, which has fostered and promoted the development of the national agricultural science and technology and obtained a series of technical bases for developing the agricultural high-tech industry. Successfully selected and cultivated a batch of new fine varieties, broke through such key technologies as the efficient safe production technology for crops, healthy breeding technology for animals, agricultural technology for water conservation, digital agriculture and agricultural information technology, resource efficient utilization technology, prevention and control technology for agricultural disaster, environmental monitoring and bioremediation technology, agricultural mechanized equipment technology, intensive processing technology for agricultural

products, biomass energy converting technology, and created such sci-tech products as engineered vaccine, bio fertilizer, biological pesticide, microbiological feed, agricultural database, agricultural information system, which accelerated the upgrading of the industrial technologies and formation of high-tech industries.

1. The genomic research has gone ahead with full stream, and continuously provided a large number of genetic resources for the genetic improvement and new variety cultivation of the animals and plants.

2. The molecular breeding technology system has been established, and a group of high-level new crop varieties have been cultivated.

3. The high technology has promoted the upgrading and updating of livestock, poultry and aquaculture technology and made outstanding contributions to earning foreign exchange through export and increasing income of farmers.

4. The research on digital agriculture and agricultural information technology has achieved significant process, which has provided the advanced technical means for the agricultural production and management.

5. The research on gene engineered vaccine has made a breakthrough, which has built a protective screen for preventing and controlling severe livestock and poultry disease in China.

6. The research on new-type reactor for animals, plants and living creatures has made outstanding achievements, and part of the products has realized industrialization.

7. The research on modern water conservation technology has made sound progress, which has made outstanding contributions to safeguarding agricultural water security.

8. The research on the efficient utilization of resources, environmental control and ecological restoration has made numerous innovative achievements, which has ensured the agricultural ecological security and promoted the sustainable development.

9. The intensive processing technology of agricultural products has made numerous innovative achievements, which has provided new technologies and channels for quality safety of agricultural products and increasing the income of farmers.

10. The invention of agricultural biomedicine has made many innovative achievements, which has laid a foundation for the development of industrialization.

11. The comprehensive biomass utilization technology has made certain progress, which has provided technical support for developing circular agriculture and building new rural area.

(VI) The agricultural basic theory and measures have continued to make breakthroughs and enhanced the capacity and aftereffects of agricultural scientific and technological development.

The agricultural fundamental research is the internal force of improving national agricultural hi-tech innovation capacity, source of knowledge and guidance of technical innovation and cradle for

cultivating agricultural innovative talents. Ever since the New China was established 60 years ago, the 30-year reform and opening-up in particular, China has continuously intensified its efforts to conduct agricultural fundamental research, launched the National "Climbing" Program, "National Basic Research Program of China (973 Program), National Natural Science Foundation, specific basic scientific research expenditures of the central scientific research institutions, etc. in succession, emphasized on supporting a batch of fundamental research topics in the "field of agriculture", and made continuous progress in the agricultural basic theory, measures and technologies. In recent years in particular, with the rapid development of world science and technology, China's agricultural scientists have continuously deepened the exploration and made periodical achievements and breakthroughs centering on the core resources of agricultural products, functional gene, primal parents, molecular improvement, utilization of heterosis, quality formation of agricultural products, agricultural disease, insects, weeds and rats, severe animal epidemic disease, bio-controlling microbes, evolution of farmland quality, external creature invasion, bio-security of the genetically modified organism (GMO), etc., which have promoted the development of China's agricultural high technologies, innovation of core techniques and cultivation of senior innovative talents and exerted a significant influence upon the international academic circles.

1. The basic research on origin of species and germplasm resource has made significant breakthrough, which has laid a theoretical basis for effectively utilizing the biological resources.

2. The agricultural heredity breeding theory and method has made substantial progress, which is conducive to breaking through the "bottleneck" of crop breeding technology.

3. The research on nutrition physiology and metabolism of animals and plants has been continuously deepened, which is conducive to the improvement of utilization efficiency of agricultural resources and quantity and quality of the agricultural products.

4. The research on the occurrence and development rules of the agricultural plant diseases and insect pests as well as the agricultural ecosystem has made remarkable progress, which is conducive to the prevention and control of severe agricultural biological disaster.

5. The fundamental research on soil evolution law and agricultural ecosystem has made rapid progress, which has provided scientific and technological support for the sustainable development of agriculture.

6. The fundamental research on biomass utilization and climate change has made preliminary progress, which is conducive to the guidance on the agricultural production and improvement of agricultural production efficiency.

7. The research on the bio-security of GMOs has made a breakthrough, which has provided a clear direction for developing modern agricultural and biotechnologies.

(VII) The agricultural scientific and technological system and its conditional equipment have been continuously improved, laying a foundation and condition for agricultural science and technology.

With 60-year construction and development, the current

comparatively complete agricultural scientific and technological innovative and application system involving different agricultural fields, various levels such as the central government, province, region, county and town and different links in R&D, promotion and application has been established, the national agricultural research system consisting of the scientific research institutions at the national, provincial and prefecture levels has been gradually established and improved, the modern agricultural and industrial technological system which takes product as the unit and industry as the main line and is composed of industrial technology R&D center and comprehensive experimental station has been established through exploration, the national agricultural technology promoting system, the grass-root agricultural technology service system in particular has been improved, and the system of high-level innovative advanced technical personnel, technical extension talents and rural practical training personnel cultivation has been built. A large number of key scientific and technical innovation bases have been established, the agricultural research conditions and equipment has been continuously improved and the system and mechanism has been consistently created, which has promoted the concentration of a large number of superior departments, subjects and outstanding talents, and laid an important foundation for the sustainable development of agricultural science and technology.

1. The agricultural scientific research, promotion and teaching departments have witnessed rapid development, and the team has been continuously expanded.

2. The scientific and technological infrastructure has been improved, and advanced instrument and equipment as well as modern facilities have reached a certain scale.

3. The agricultural science and technology has been enhanced on a daily basis, laying a foundation for its sustainable development.

II. Deficiencies and Constraints

Although the development of China's agricultural science and technology has played an effective and the first impetus role, some deficiencies and constraints also exist during the process of promoting modern agricultural development, which are mainly listed as follows:

(I) Low conversion rate of agricultural scientific research achievements

China's agricultural science and technology still falls behind the developed countries for 10-15 year in the most fields, which severely obstruct its agricultural modernization and improvement of the international competitiveness. In recent years, although the contribution rate of China's agricultural science and technology for the agricultural production has reached above 50%, the conversion ratio of China's scientific achievements made in agriculture is less than 50%, while that of the developed countries has reached more than 80%, which has a huge gap in comparison with that of the developed countries. The scientific achievements are out of line from the actual agricultural production requirements, which has resulted in the backwardness of the agricultural scientific and technical innovation.

(II) Inadequate investment in agricultural science and technology

Firstly, the total amount of national investment in agricultural science and technology is inadequate. Secondly, the investment intensity is insufficient. China's research funds for agriculture merely accounted for 3% - 4% of the total; the investment in agricultural research funds only accounted for 0.2% - 0.25% of the total agricultural output value, while the world average level is 1% and the general level of the developed countries is 2.5% - 3%. In recent years, the State has intensified its efforts to invest in science and technology; however, because the current scientific and technological funds are managed by various departments, the barrier between different departments have been severe, and the allocation ratio is unreasonable, which can hardly be utilized intensively; the instrument and equipment is purchased repeatedly with low quality and heavy waste; the key laboratories can not be shared with low degree of development, which have resulted in heavy waste of the limited scientific research resources.

(III) Shortage of talents in agricultural science and technology

The total amount of high-level talents in agricultural science and technology is inadequate and the brain drain is severe. In accordance with the statistics of the *Compilation of Statistical Data of National Agricultural Science and Technology*, in 2009, there are a total of 54,682 scientific researchers from the institutes of agricultural scientific R&D of the government departments above the regional level, with 652 doctors, accounting for 1.19%; 2,530 masters, accounting for 4.62%; and 3,238 postgraduates, accounting for 5.92%. Therefore, we can conclude that China is lack of high-level talents for agricultural scientific and technical innovation. Meanwhile, the phenomenon of brain drain is severe. In 2003, the national agricultural scientific research institutions cut

4,806 staff, 1.7 times than the additional staff. Apart from the retired personnel, the brain drain has accounted for a comparatively large percentage. The shortage of top-notch academic “generalists” and academic pacesetters has resulted in the weakness of high-tech research; and the shortage of excellent entrepreneurs who are lack of strong market sense, high-level management and capable developing capabilities has resulted in the backwardness of industrialized development of agricultural science and technology.

(IV) Imperfect agricultural scientific and technical system

The establishment of agricultural scientific research institutions and management system and operating mechanism under the planned economic system has resulted in such problems as the long-term repeatedly established institutions, outdated or outmoded subjects, separated innovative forces, low-level research repetition, achievement evaluation neglects the application value, etc., which have obstructed the innovation of agricultural science and technology. The agricultural scientific and technical system has merely a few projects with barrier between different departments in terms of macro-management, separated organizational configuration, low management efficiency, outdated subject configuration, single specialized field and trans-disciplinary comprehensiveness, the R&D direction is out of line with market demands, the operating, distribution and incentive mechanisms are backward, etc., which have made China’s agricultural scientific research cannot be closely interrelated with the economic development, the agricultural science and technology is severely out of line with the agricultural production, rural economic development and income increase of farmers, which have failed to meet the actual requirements of developing modern agriculture in China.

III. Measures and Policies

At present, China is at an important stage of combating the international financial crisis and maintaining steady and relatively rapid economic development, and development phase of building a well-off society in an all-round way and accelerating the socialist modernization. The requirements of the agricultural and rural development on the scientific and technical progress have been obviously improved, the demands for scientific and technical progress have been remarkably increased, and the dependence on the said progress has been dramatically enhanced. However, from an overall perspective of view, the overall level of China's current agricultural science and technology is still low, its independent innovative ability is still weak, the promotion and application of scientific research achievements is still comparatively weak, and contribution rate of the agricultural scientific and technical progress is still relatively low, all of which are still confronted with huge gap in comparison with that of the developed countries and requirements of China's agricultural and rural development. Accelerating the innovation and promotion of agricultural science and technology is an important and pressing strategic task of the agriculture-countryside-farmer undertaking.

(I) Vigorously enhance independent innovation capacity of agricultural science and technology

We shall take enhancing the supporting and leading role of agricultural science and technology as the core, improving the competitiveness of agricultural products as the main objectives, transfer the scientific research and tackle the key research project from taking tracing and imitation as the main part into independent

innovation, and transfer the technical promotion from focusing on promoting and applying single technology to the application of system integration techniques in the construction of modern agriculture. The agricultural scientific and technical innovation shall emphasize the major scientific and technological challenges in agriculture and core technologies, organize and implement major agricultural scientific research projects, and integrating core agricultural technologies so as to achieve a batch of breakthrough major research fruits. For example, with regard to breeding, innovate the technologies with high yielding, high-quality, drought-resistant agricultural products with the breeding for stress tolerance, and rice, wheat, corn, cotton, soy bean, rape, vegetables, etc. at the international top-class level; cultivate a batch of new breakthrough varieties of plants and animals with super high yield, superior quality and special purposes such as super rice, transgenic hybrid cotton, high-quality beef, fine wool sheep, bantam, lean hog, etc. With regard to the prevention and control of severe epidemic diseases of animals and plants, we shall strive for breakthroughs in the diagnosis, detection, monitoring and early-warning technologies in plants and pests, infectious diseases involving both people and animals, etc. as well as core techniques of rapid eradication and continuous control. Make scientific and technical innovation in the aspect of protecting agricultural resource environment, information agriculture, agricultural product processing and quality security. Expand scientific and technical innovation, break through the core technologies concerning new materials, energy and products such as biodegradable plastic film, biomass energy conversion, etc., form the high-tech products with independent intellectual property rights, cultivate new economic growth points and emerging industries so as to promote the development of modern agriculture.

(II) Further increase the investment in agricultural science and technology

The promotion of agricultural scientific research achievements can improve productivity through increasing output or reducing costs. In accordance with the research, the scientific and technical reserve increases by one percentage point, the food production can increase by 0.4 – 0.5 percentage points and the output of cash crops increases by 24%, respectively; the agricultural scientific research and promotion can also improve the quality of agricultural material input and output, and bring a new market through creating new products. We shall increase the investment in agricultural scientific research through enhancing agricultural scientific research and achievement promotion and promote scientific achievements conversion. The inadequate funds can obstruct the process of modern agriculture. Therefore, we shall substantially increase the investment in agricultural scientific research, accelerate the process of diversified agricultural scientific and technical innovation system with the government as the guidance and widespread social forces involved, and form a steady growth mechanism. We shall give full play to the specific loans of banks and foreign funds to make up for the inadequacy of the agricultural research funds.

(III) Strengthen the construction of agricultural scientific innovation personnel

We shall take the construction of agricultural scientific innovation personnel as a strategic task for the development of agricultural science and technology, assemble and cultivate a batch of strategic scientists, young and middle-aged academic leaders and innovative backbone which stand at the leading edge of the

international agricultural science and technology and promote the major scientific and technical innovation, and build a core team with international competitiveness, high capability and efficiency for scientific and technical innovation. Follow the tendency of the international academic development, enhance key agricultural discipline construction, and make it become a base for innovating agricultural knowledge and cultivating creative talents. Establish a reasonable echelon structure involving principal experts and high-level talents and stabilize the innovative team for scientific and technical innovation in agriculture, improve the quality of cultivating Master and Doctoral Candidates of Agriculture, and transport high-quality talents for realizing agricultural scientific and technical innovation. Implement the policy of attracting a batch of excellent personnel studying abroad to further enhance the international cooperation and communication and promote China's agricultural scientific and technical innovation level reach the international most advanced level. Establish and improve incentive mechanism and award those scientific and technical personnel in agriculture who have made outstanding contributions, and create an atmosphere which is conducive to the development of innovative personnel so as to improve the performance of the agricultural scientific and technical innovation.

(IV) Further deepen the reform of agricultural scientific and technical system

We shall integrate the “technical, talent and fund resources” to further deepen the reform of agricultural scientific and technical system, give full play to the advantages of region, resources and talents, and implement the independent innovation actions in agricultural science and technology stipulated in the “Eleventh Five Year Plan” so as to provide scientific and technical support for

building a modern agriculture in an all-round way. Enhance the cooperation between agricultural scientific and technical departments and accelerate the construction of agricultural scientific and technical innovation system. The said system can be divided into two systems at the national and regional levels, the national system is a foundation of the core competitiveness of national agricultural science and technology, which takes ledge innovation as the main part, original innovation as a focus and emphasizing on resolving the overall, fundamental and strategic problems in agricultural scientific and technical innovation system; while and latter system is an important component of the national agricultural scientific and technical innovation system, which embodies the hierarchy of a national system, takes technical innovation as the main part, focuses on the system integration of significant and key technologies and emphasizing on resolving regional and local problems in agricultural scientific and technical innovation.

Improve the reform of the management system of scientific research institutions, indirectly manage the said institutions by means of policy guidance, market regulation, etc., and thus reduce the administrative intervention. Allow the said institutions to freely choose and explore their own reform and development mode, further reform their operating mechanisms, establish the chief scientist responsibility system, build a trans-regional, interdisciplinary and multi-major innovative team, actively explore a coordinative and problem-tackling mechanism with division of tasks as a foundation, reasonable distribution of rights and interests and resource and information sharing as the core, and projects as a link; establish a talent-selecting mechanism which have flexible distribution and professional titles and is conducive to topping others; further improve the achievement evaluation mechanism

which is conducive to achievements conversion; establish a income distribution mechanism embodying the working performance and promoting the reasonable turnover of talents and resources; and establish an incentive mechanism of encouraging the scientific and technical personnel to make bold innovations, establishing an enterprise and penetrating deeply into the front line in the rural areas.

IV. Policies and Measures to Be Taken by the Government

(I) Establish and improve the laws and regulations and the policy-support system

The establishment and improvement of agriculture and the system of agricultural sci-tech laws and regulations constitutes an integral part of the establishment of the legal system of a state with adequate legal system, and is a major proposition of strategic and historic significance as well as a long-term arduous task. In view of existing legal and policy problems arising from our agricultural sci-tech innovation system, laws and regulations of agricultural sci-tech progress shall be enacted timely in order to improve the agricultural sci-tech market and intermediary agencies as well as to fundamentally resolve such issues existing in agricultural sci-tech input as replacing the law with the leaders' order, the non-execution of orders and subject to the leaders' preference and succession. The resolutions shall encompass: the establishment of a mechanism under which the agricultural sci-tech innovation input supplied by the government will keep a steady growth; the improvement of IPR laws and regulations; and an enhanced legal and policy system of agricultural sci-tech expansion and service network.

(II) Further deepen the reform of agricultural sci-tech management mechanism and system

First and foremost, quickly adjust agriculture scientific research institutions, optimize the general arrangements, perfect the integration mechanism of sci-tech research institutions and optimize the allocations of sci-tech resources. Meanwhile, adjust the setup of disciplines and specialty based on the needs of economic development. Secondly, reform the sci-tech management system. Currently, a series of management mechanisms concerning the setting up of an agricultural sci-tech research project, selecting the sci-tech research theme, organizing the theme, appraising its result and determining the personnel's professional rank, etc. must be under complete reform. For example: change the mechanism of setting up and commissioning of a sci-tech research project; reform the management of sci-tech research funds; manage agricultural sci-tech research projects in a macro perspective by learning the foreign experiences in managing sci-tech research projects and funds; build an effective incentive mechanism to trigger the dynamics of institutions and enthusiasm of researchers; improve the mechanism of appraising sci-tech research achievements. Thirdly, build a better stimulus mechanism to improve technology innovations. The stimulus mechanism of technology innovations mainly refers to the impetus source of technology innovations and its operational mechanism. The impetus models for technology innovation include: model of market demand for technology innovation, model of technology supply innovation, model of technology innovation induction and model of government policies promotion. Since China has currently witnessed the overall structural surplus and the depressed price of agricultural products and the slow growth of farmer's income, a technology innovation model that is mainly driven by government

policies and incorporates other models meets the needs of the production and market alike. Fourthly, construct an effective coordination mechanism including the tripartite coordination among the departments of sci-tech research, education and expansion, and the coordination among entities doing expansion services.

(III) The establishment of an agricultural sci-tech talent pool with strong international competitiveness

The government and social society should take initiatives, through various forms and channels, and make every attempt to cultivate a large batch of discipline leaders, entrepreneurs for sci-tech enterprises, high level sci-tech management experts, technology experts and professional farmer-technicians. Exert every effort to carry out an innovational talent agglomeration strategy to attract more technicians by incentive policies, especially targeting those holding PhD or master degrees, to engage in the agricultural technology R&D. Meanwhile, through rationally utilizing sci-tech innovation funds, reward technicians with outstanding contributions in terms of sci-tech innovation to encourage them and respect their jobs and to constantly consolidate and expand the agricultural sci-tech talent pool. Regard exploring human resources as a task with strategic significance and conduct academic communications, on-job trainings and joint technology studies both at home and abroad to continually update and advance the basic knowledge and professional skills of agricultural technicians and enable them to closely track the latest hi-tech information in the world and strengthen their persistent creativity.

(IV) Reinforce the primary research capacity of public sci-tech research institutions and enhance the agricultural sci-tech innovation capacity of enterprises

Reliant upon national key research institutions, and key laboratories and major disciplines of higher learning institutes, organize and conduct the basic agricultural researches, applied fundamental issues as well as the research pertaining to the overall situation, directionality and regularity of the major innovative issues in the course of agricultural production and rural economic development.

Enhance the technology innovation capacity of agricultural enterprises. Firstly, intensify their awareness of independent innovation. Secondly, proactively guide agricultural research institutions to enter into enterprises and cooperate with enterprises so as to turn around the isolation phenomenon of research institutions with enterprises and systematically strengthen the combination among agriculture, science and education. Thirdly, accelerate the reform of existing agricultural enterprises and improve the modern cooperation system to make enterprises real legal entities and competition subject adapting to the market. Only by doing so can enterprises obtain internal motivation for technology innovation and really become the subject of technology innovation.

(V) Adopt vigorous measures to safeguard the smooth and easy spread of technologies

Firstly, the government should strengthen the construction of agricultural infrastructure (public information infrastructure, sci-tech enterprises incubator, technology trade agencies, etc.). In order to guarantee the smooth and easy spread of agriculture technology, further efforts need to be made in providing agricultural sci-tech information, rural youth training for technical knowledge,

conducting rural domestic service education and guiding farmers to rationally plan and utilize the land as well as to protect natural resources and environment.

Secondly, gradually establish an agricultural sci-tech service system integrating scientific research, education and expansion. Upon learning and drawing lessons from agricultural cooperation and expansion systems of foreign nations, tighten the combination among sci-tech education, research and expansion, and encourage agricultural sci-tech research institutions and universities or colleges to engage in the development, consultancy, service and transfer of technology, which constitutes a significant component of the expansion system.

Thirdly, actively foster agricultural sci-tech intermediaries. We should prohibit the absolute separation between agricultural technology and agricultural economic development in order to achieve the match and smooth circulation of the supply -demand of agricultural technologies. In the first place, nurture the technology market and improve such infrastructure constructions as the supply-demand information base of important technologies and sci-tech information network, and particularly improve the laws and regulations governing the agricultural technology market, so as to make agricultural sci-tech patents circulating as smoothly as general merchandise in the market. Secondly, cultivate and develop agricultural technology intermediaries. Through providing services concerning information, consultancy, evaluation, intermediary, law etc., these agents may reduce the transaction cost and opportunity cost while increasing the success rate of technology transactions.

Fourthly, develop and take advantage of industrialized agricultural

organizations, and guide them to gradually involve into the subject of the agricultural sci-tech expansion system. Make preferential policies and give appropriate special treatment in areas of enterprise financing and taxation to allure increasing leading enterprises into agricultural hi-tech R&D, strengthen their technology development capacity and encourage them to conduct agricultural technology innovations. Meanwhile, while proactively exploring a new integration path of agricultural sci-tech and economy, efficiently apply agricultural sci-tech achievements into agricultural production and business activities so as to obtain more productive outcomes.

Fifthly, bring into play the demonstrational and motivational effect of agricultural sci-tech parks. The state treasury and agricultural policy banks shall enact favorable policies to facilitate the establishment and improvement of the mechanism for venture capital investments in sci-tech parks, create a sound environment for investment and financing development, support the progress of hi-tech enterprises in parks, accomplish scale economy effect and accelerate the demonstration and expansion of innovational technologies.

(VI) Concretely upgrade farmers' sci-tech calibers

As the subject conducting agricultural production and applying sci-tech achievements, farmers' sci-tech calibers directly influence the result of agricultural sci-tech innovations. In order to improve farmers' calibers, in the first place, the government shall formulate relevant supporting policies in terms of directing farmers to learn and use science and motivating them to receive agricultural technology training, especially those supporting policies pertaining to post-training. Secondly, spare no efforts to carry out education and training for farmers through various channels and forms. Make

more efforts to intensify trainings for farmers through such education and training forms as “Green Certificate Education”, “Sci-Tech Training for Young Farmers” and “Applied Technology Training for Farmers”. By conducting agricultural technology lectures, trainings, correspondent education night schools and some else useful ways and forms, substantially enhance hundreds of millions of farmers’ scientific &cultural calibers and the level of their sci-tech skills so as to further boost their enthusiasm in participating agricultural sci-tech innovations.

For developing modern agriculture, safeguarding food security, improving the competitiveness of agricultural products, increasing farmers’ income , achieving sustainable agricultural development and balanced development among rural resources, environment and ecology , all in all wind up with reliance upon the sci-tech progress. Since the course of agricultural sci-tech in China is embracing new development opportunities, seize opportunities and keep abreast with them to vigorously push forward the independent innovations of agricultural sci-tech, continuously upgrade mechanisms and systems, and strive to provide powerful support for advancing the construction of modern agriculture with Chinese characteristics and new socialist countryside. The great majority of agricultural sci-tech practitioners will shoulder heavy responsibilities.