Study on High-efficiency Ecological Agricultural Development Based on Science and Technology in the Yellow River Delta

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Abstract Based on the analysis of the status, characteristics and technological functions of high-efficiency ecological agricultural development in the Yellow river delta, the paper pointed out technological bottlenecks of the high-efficiency ecological agricultural development in the Yellow river delta. Some suggestions were proposed including changing the development concept, implementing nine projects, increasing capital investment, focusing on demonstration, and strengthening human resources.

Key words Science and technology, The Yellow River Delta, High-efficiency ecological agriculture

1 Introduction

The Yellow River Delta which is located in the coastal area in the estuary of Yellow River Delta has great strategic significance in the coastal Bohai area. Chinese government paid a lot of attention to the sustainable development of Yellow River Delta. In November 2009, Chinese State Department passed the document named *High-efficiency Ecological Agriculture Development in Yellow River Delta*, which upgraded the development of Yellow River Delta as national strategy, an essential part of state regional coordinated development strategy. The plan is carried out against such background that China and Shandong Province have entered into the critical period of transforming into an innovative and scientific industry. Based on the analysis of the status, characteristics and technological functions of high-efficiency ecological agricultural development in the Yellow River Delta, the paper pointed out technological bottlenecks of the high-efficiency ecological agricultural development in the Yellow River delta. Some suggestions were proposed including changing the development concept, implementing nine projects, increasing capital investment, focusing on demonstration, and strengthening human resources.

The administrative area of high-efficiency ecological economic area of Yellow River Delta which is described in this paper includes Dongying City and Bingzhou City in Shandong Province, Hanting area in Weifang City, Shouguang and Changyi City, Laoling City, Qingyun County, Gaoqing County and Laizhou City, which covers an area of 26 500 km^2.

2 Current situation of the high-efficiency agricultural development in Yellow River Delta based on science and technology

2.1 Current situation and characteristics of regional agricultural scientific and technological development The high-efficiency ecological economic area of Yellow River Delta is the place with strong economic competence in Shandong Province and with fast scientific and technological development. For many years, especially since the "eleventh five-year plan", government at each level has paid attention to the development of innovative agricultural science and technology, and has achieved significant progress.

2.1.1 Construction of high level of agricultural scientific and technological innovation platform. The sustainable development of Yellow River Delta has been named as the first national sustainable development lab in China. The construction of the academy of sustainable development in Yellow River Delta, the scientific and technological garden of China University of Petroleum, the wetland ecological experiment station and field construction in Yellow River Delta and the modern technological institute of high-efficiency ecological industry in Yellow River Delta have been constructed.

2.1.2 Construction of technological innovation system. sAccording to preliminary study, there are 82 private scientific research institutes in Dongying City, 40 provincial technological centers, three national technological centers, 25 provincial technological centers, four provincial stations, two key labs and three new provincial demonstrative stations.

2.1.3 Construction of sound agricultural science and technology promotion organization. Taking Dongying City as an example, four agricultural management departments and a scientific industrial management department have been built in each city.

2.1.4 Significant increase of investment in agricultural science and technology. In order to improve innovation capacity, each place has made policy to enlarge investment in agricultural science and technology and to encourage company and private savings into scientific research field.

2.1.5 Achievement in agricultural scientific and technological innovation. During the "eleventh-five-year plan" period, Binzhou and Dongying alone have scored 1 082 scientific research programs of various kinds above provincial level. In Dongying, 190 programs have been carried out and 21 sample gardens have been

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built.

2.1.6 Improvement of science and culture quality of farmers. The professional quality and capacity of agricultural scientific and technological staff have increased significantly through the introduction of personnel and scientific and technological employees' training.

2.2 Increasing influence of science and technology on the agricultural development Through many years of ecological agricultural development, especially after the implementation of various scientific research programs, such as training farmers' project, agricultural machine promotion and agricultural service system, the infusion of scientific technology and agriculture and the connection between farmers and company were strengthened. The coverage rate of main crops in the region was around 98% and the contribution of scientific and technological advance on agricultural development enhanced to 55%, which promoted the sustainable growth of main agricultural crops and ensured the efficient supply of agricultural crops.

2.2.1 Continual increase of comprehensive production capacity of agriculture. According to the statistics, the total output of crops in Yellow River Delta in 2009 was 6.904 million ton, which accounted for 16% of the amount of crops in the entire province. Compared with the data in 2000, the total production in 2000 increased by 24 000 ton, which rose by 33.7%.

2.2.2 Gradual optimization of agricultural industrial organization. Given the stable production of crops, and based on the scientific technology adjustment and optimization of industrial structure, it is necessary to develop key industries, such as vegetables, fruits, flowers, herbs and edible fungi.

2.2.3 Exploration of many kinds of high-efficiency ecological agricultural mode[1]. Through incessant struggle from all sides, there are many kinds high-efficiency ecological agricultural mode that based on science and technology. The first one is to combine saline-alkali soil treatment and high-efficiency cultivation. Since 2000, nearly 70 000 hm^2 deserted lands have been reclaimed and annual output of crops has increased by 43 000 ton, which provides experience for the development of alkaline land. The second one is the mode to establish high yield base of crop and cotton. Given the plan to increase tens of thousands of kilograms of crops, many counties have built the crop and cotton high yield demonstration base and have found the efficient way to achieve high yield. The effects are outstanding. The third mode is to form standard production of green crops. Considering the advantage of ecological environment in Yellow River Delta, Chunguang and Guangrao have built green vegetable standard production area, and Laoling, Zhanhua, Wudi and Yangxing have established green fruit standard production demonstration, which formed characteristic green crop production system. The fourth mode is high-efficient recycling agricultural development mode. A group of leading companies came up with the mode to combine biogas and cultivation, to extend the connection and infusion of plantation industry, husbandry, fisheries, fruits, crop process industry and service industry. The fifth one is sightseeing mode of agricultural development. Lots of sightseeing gardens have been built for tourists to pick fruits and vegetables while enjoying the sightseeing. The sixth one is the high-tech ecological agricultural garden. For so many years, the high-efficient ecological agriculture demonstration garden in Yellow River Delta points out direction for the regional high-efficient ecological agricultural development.

2.2.4 Improvement of agricultural infrastructure and equipment. Recently, with the comprehensive development of agriculture, alkaline development and soil management, 70% of low-yield land was reclaimed to different degrees and several high standard farm lands have been built. With the wide promotion of new technology, new machine and green agricultural production, the agricultural equipment has enhanced greatly.

2.2.5 Leading the high efficient ecological agriculture industry construction. With the support and guidance of scientific innovation, the high-efficient ecological agricultural industrial system in Yellow River Delta has been constructed. The ecological agricultural industry chain has been extended. Leading companies and professional cooperatives have been helped to prosper. The service industry is conductive to the increasing efficiency of agriculture. The construction of comprehensive service platform of agricultural information in Yellow River Delta promoted the development of agricultural industry.

2.2.6 Increasing farmers' income. Through the structural adjustment of agriculture, promotion of new technology and farmers' training, science and technology helps to increase farmers' income. In 2010, the net income of farmers in the richest Laizhou City was 10 587 Yuan, which doubled than the 4 339 Yuan in 2005 (Table 1).

Table 1 Farmers' net income per capita in each county of Yellow River Delta Yuan

Year	2000	2005	2010
Dongying	2 824	4 642	8 560
Hekou	2 549	4 482	8 157
Kenli	2 591	4 477	8 223
Lijin	2 639	4 417	7 965
Guangrao	2 978	4 820	8 794
Bincheng	2 470	3 826	7 381
Huiming	2 378	3 667	6 626
Yangxing	2 288	3 370	6 305
Wuli	2 201	3 508	6 672
Zhanhua	2 254	3 726	7 198
Boxing	2 730	4 065	7 375
Zhouping	2 861	4 465	8 551
Shouguang	4 010	5 566	9 495
Changyi	3 638	5 159	8 815
Hanting	3 598	5 309	9 301
Laizhou	3 656	5 546	10 587
Gaoqing	2 496	3 916	6 798
Laoling	2 546	3 785	7 006
Qingyun	2 055	3 700	6 888
Mean value	2 777	4 339	7 931

Note: The data comes from the *Statistic Yearbook of Shandong Province*.

3 Restraining factors and scientific bottleneck of ecological agricultural development in Yellow River Delta

The ecological construction in Yellow River Delta faces both opportunities and challenges.

3.1 Poor water and soil resources Though there is less population and more land in the high-efficient ecological agriculture area in Yellow River Delta, the cultivated land faces the alkaline of soil and reduction of land productivity. Such structure has become the bottleneck for the development of ecological agriculture. How the water and soil resources are allocated and how to improve land productivity are what scientific innovation faces.

3.2 Contrary co-existence of shortage and consumption of water resource and waste Besides of water pollution problem, the water in Yellow River Delta is also in shortage. According to many years of data, the precipitation in Yellow River was little and annual average precipitation was 580 mm. The underground water mainly was light salt water, salt water and brine. The underground water resource is only 1.21 billion m^3. Most water comes from Yellow River. So far, the irrigation coefficient in Yellow River Delta is 0.5, far lower than that in developed areas.

3.3 Relative weak agricultural ecological infrastructure On the one hand, the natural vegetation in Yellow River Delta is grass, which has natural ecological vulnerability. It is quite easy to damage ecological environment if ecological agriculture is developed improperly. On the other hand, the agricultural infrastructures are old and inefficient. Such equipments restrict the construction of ecological agricultural construction and need innovative science and technology.

3.4 Outstanding contradict of extensive management and low-carbon, ecological and safe agriculture Although the agriculture industry in Yellow River Delta develops fast, the agricultural increase comes from consumption of resources and extensive management. The investment of pesticides, fertilizer and membrane cause pollution and pose threat to the safety of product. Thus, it is necessary to depend on science and technology to change development mode and to build low-carbon emission and intensive management.

3.5 Contradiction of low agricultural infrastructure and overall modern agricultural element Generally speaking, the agricultural infrastructure in Yellow River Delta is weak and the agricultural product process is in the preliminary stage. The agricultural science and technology service industry is outdated and the added value of agricultural product is low. The transformation mechanism needs improving.

3.6 Pessimistic agricultural scientific and technological system and operation mechanism Currently, though agricultural science and technology innovation and promotion system have been modified, the innovation and operation mechanism still are pessimistic. The imperfect information service system and outstanding shortage of market information restrain the high-efficient ecological agriculture development.

4 Suggestions and discussions

4.1 The scientific technological support and development concept The fundamental way for agriculture industry is science and technology. Chinese communist party and governments at all levels have constantly pay attention to agricultural science and technology. In the construction of high-efficient ecological agriculture in Yellow River Delta, the influence of science and technology is more outstanding. It has become the priority of agricultural science and technology development, breakthrough of mechanism disorder and increase of investment in scientific research.

4.2 Nine projects In response to the science and technology bottleneck of high-efficient agricultural development in Yellow River Delta, it is suggested to implement nine projects to make breakthrough in the development of agriculture in Yellow River Delta.

4.2.1 Projects to improve science and technology in crops cultivation. It is suggested to rely on agricultural scientific research companies, universities and companies to establish coordination system of new species cultivation and to improve innovation capability. Considering flood prevention, drought resistance and ecological environment, the flood prevention system is constructed and species cultivation is encouraged. The construction of efficient, functional and preventive pests monitoring and prevention system can effectively control the crop production loss which is caused by plant disease and insect pests.

4.2.2 Projects to support resources and recycling agriculture science and technology. The development and promotion of agricultural technology realize the recycling use of resource, ease the shortage of water resource, protect and restore ecological system of agriculture. The promotion of comprehensive technologies such as protective cultivation, biological reactor and fertilizer allocation can enhance resource utilization rate, enhance life production condition and protect agricultural ecological environment.

4.2.3 Project to implement agricultural product quality safety. The study and promotion of agricultural product are strengthened. The surveillance of quality and market admission is established. The toxic pollutants in the agricultural product provide technological support to the regional agricultural product base. Considering the agricultural products in the region, it is encouraged to build several famous brands in Yellow River Delta [3].

4.2.4 Projects to help leading agricultural companies and scientific and technological support. Through optimization of policy, program support and industrial study, the innovation capacity and core competitiveness of companies are improved. A group of competitive agricultural companies came into being[3]. Dominant technological resources and advantageous products are distributed to superior companies. Relevant laws and regulations are encouraged to be made to expand export market of agricultural product.

4.2.5 Projects to implement refined agricultural industrialization. According to the Suggestion on the Implementation of Modern Agriculture Crops Development, it is suggested to carry out refined species projects based on modern agricultural development

demand and considers seed cultivation as national strategy and fundamental core industry. The cultivation of new species in Yellow River Delta enhances the position of husbandry in Shandong Province.

4.2.6 Projects to implement scientific and technological support. Starting from policy guidance, specification management, investment enlargement, the way to explore innovative rural occupation training was explored. The training network was established. Based on the principle of scientific distribution, convenience to farmers and efficiency, it is encouraged to assemble training and education resources of all levels, to support regional training organization and cooperation among central and provincial agricultural scientific research institutes. The training makes people become new type farmers who are cultured and has a good knowledge of management and technology.

4.2.7 Projects to carry out agricultural science and technology innovation and promotion system. Through assembling of regional scientific and technological resources, deepening systematic reform and connection, and strengthening cooperation, it is necessary to break through major technology in high-efficient ecological agriculture and improve transformation efficiency of scientific achievement. Through market competition and policy support, innovative agriculture companies are encouraged to prosper so as to improve the competitively of nationality. Relevant agricultural scientific research programs and schools are involved into the agricultural technician promotion system. The integration of industrial technological system and agricultural technology promotion system leads to increase of agricultural science and technology contribution rate and transition of agricultural development mode in Yellow River Delta.

4.2.8 Projects to implement technological support of agricultural informationization. Considering the construction of state rural demonstration province, and based on the agricultural internet of things technology center in Yellow River Delta, the comprehensive service platform in Binzhou City intensified the sharing and development of information within and outside the region. The establishment of internet of agricultural product and global location system, characteristic agricultural product and internet are connected for information exchange and communication. The agricultural information construction realizes the effective integration of various agricultural resources, which provides comprehensive information for the production and circulation of agricultural products and modern agricultural development.

4.2.9 Projects to carry out financial science and technology support. It is suggested to build rural financial support market system and mechanism to subsidy agriculture, to improve rural credit insurance mechanism. Agricultural and rural insurance should be developed and sound agricultural insurance policy should be issued.

4.3 Increasing financial input The investment method and ways should be innovative. It is encouraged to take government investment as guidance, to take company, social, private and foreign investment and to attract more funds to invest in agricultural science and technology career. Agricultural companies can cooperate with scientific research cooperation to crack difficult problems and manage to improve the innovation capacity of a company. Banks should cooperate with companies, increase credit investment, guide and encourage various financial institutions increasing support to companies and build ecological agricultural development platform.

4.4 Demonstration effects It is a good idea to build a demo of modern agricultural industry in China which focuses on the characteristics of ecological agriculture. The government plays a leading role in the construction of modern ecological demonstration base. Based on different nature features and production bases, various innovative demonstration bases are to be built, which manage to realize scale production, improve the competitiveness of agricultural products in the market and enhance farmers' position in the market.

4.5 Personnel support In response to the demand of ecological agricultural development in Yellow River Delta, it is necessary to enhance the introduction and cultivation of creative personnel and to form a system that can give support to the innovative move. Agricultural universities and colleges hire professors and take measures to make professors be enthusiastic about the promotion of agricultural technology, which will provide professional support to the ecological agricultural development. Taking the improvement of scientific quality, professional skills and management capacity as the critical mission, government at all levels are trying to build an group of people who equips knowledge of modern production and promotes the fast transition of advanced scientific achievement in the countryside.

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