



The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
<http://ageconsearch.umn.edu>
aesearch@umn.edu

Papers downloaded from AgEcon Search may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.

No endorsement of AgEcon Search or its fundraising activities by the author(s) of the following work or their employer(s) is intended or implied.

Study on Modern Agriculture Equipment and Technology Coordinating Innovation

Weilong WANG^{1*}, Zulin DA²

Science and Technology Office of Jiangsu University, Zhenjiang 212013, China

Abstract As the material foundation of agriculture modernization, the modernization level of agricultural equipment and technology is the significant signal of agricultural modernization, and the advancement of agricultural modernization is the important content of building a well-off society in an all-around way. Upgrading key technology research ability and promoting agricultural mechanization and industry development not only can shorten the gap between agricultural development level in China and that in developed countries, but also can advance the modernization process of China.

Key words Agricultural equipment, Agricultural technology, Coordinating innovation

In a speech given by President Hu Jintao on April 24, 2011 in the 100th anniversary of the founding of the Tsinghua University, Mr Hu pointed out that it is essential for companies, research institutions and universities to cooperate with each other and to establish innovative strategic league. Ancient Chinese used to say that people would have good manners after they have enough to eat. Agriculture, as the basis of national economy, attracts attention from both the Party and government. Since the reform and opening up policy, central Chinese party has issued fourteen most important documents about agricultural development and how to support agriculture, which suggests that agriculture plays an important role in national economy system.

Although China is a large country, the land per capita is relatively low, as China has to use 7% arable land to keep 22% world's population alive^[1]. Therefore, it is of vital importance for maintaining prolonged stability of the Party and state to ensure increase of crop output. However, with the increasing population and rapid progress of urbanization and industrialization, consumption of crop keeps rising while water and soil resources as well as climate restrict the lasting increase of crops, adjust agricultural industrial structure, quicken the extension of agricultural machinery technology, and improve the production efficiency. Just as Mao Zedong said, the fundamental way to develop agriculture is mechanization.

To push forward agricultural modernization is the essential step to realize a well-off society in a full-round way. The modernization of agricultural equipment and technology is the significant sign of agricultural modernization. Therefore, to quicken the development of agricultural mechanization and agricultural industry, and to enhance the creativity of key technology not only can shorten the gap of agricultural development in China and that in developed countries, but also quicken the pace towards modernized China.

1 The necessity and importance of the choice of synthesized innovation direction

1.1 Agricultural modernization being the inevitable choice of national modernization China has to support the lives of people that account for 22% of world population with its arable lands that only account for 7% of world arable land. Agriculture, as the foundation of national economy, is concerning national security and social stability, and plays an essential strategic role. Deng Xiaoping, Jiang Zeming and Hu Jingtao used to warn people that if there is something wrong with Chinese economy, it must show first in agriculture. Therefore, since the reform and opening-up policy, Chinese Communist Party has promulgated fourteen document of top importance concerning agriculture, farmer and countryside, which is enough to suggest that agriculture is extremely important in national economical and social development. However, the latest study result from Chinese Modernization Study Center of Chinese Academy of Science suggested that the agricultural production rate is ten times lower than industrial production rate in China. Chinese agricultural economic level lags behind Britain for 150 years and behind America for 108 years. Agricultural modernization becomes the short slab that influences national modernization. Meanwhile, along with the quickening pace of Chinese industrialization, urbanization, and modernization, China shall realize basic industrialization and preliminary modernization in 2020. National population will reach 14.5 billion yuan and urbanization rate will reach 60%. The ratio of agricultural labor force in all social employees will be less than 30%^[3]. Chinese agricultural economy face following challenges such as increase of population, reduction of soil resources, shortage of freshwater and drastic outsourcing of labor force. Hence, quickening the realization of agricultural modernization and improvement of agricultural labor production rate is the inevitable choice to ensure food safety and push forward national modernization^[4].

The modernization of agricultural equipment being the sign of agricultural modernization. Together with the further development

Received: September 16, 2012 Accepted: February 28, 2013
Supported by Subject on "Eleventh-five year" Plan in Jiangsu Province (C-A01/025).

* Corresponding author. E-mail: wlwang@ujs.edu.cn 212013

of urbanization and industrialization, 70% rural young labor force has to go out and work in the city, which has left the elderly work in the countryside. It is urgent to improve the necessity of agricultural production rate and to replace labor force with machine. The history of the development of various countries in the world suggests that the development of agricultural machine is the basic guarantee of modern agriculture and inevitable requirement to realize modernization and economic structure balance. To push forward agricultural mechanization and machine industry, it is necessary to improve the research ability of core technology, which would quicken the strategic demand of pushing forward modernization in China. For many years, Chinese government has issued many documents concerning the innovative development of agriculture, which renders new responsibility to the agricultural equipment and technological industry, and points new path and direction of technological innovation.

The education department paid high attention to modern agricultural development. Currently, it is universally acknowledged that modern agriculture depends on biological technology and agricultural equipment. Agricultural mechanization is leading the choice of crops species, cultivation policies changes and improvement of cultivation mode. The modernization level of agricultural equipment and technology, as the physical foundation of agricultural modernization, has become the essential signal of agricultural modernization.

1.2 The improvement of agricultural equipment development being national strategic demand In 2010, the overall output of agricultural machine in China was in the second place. But compared with that in developed countries, relevant technology of agricultural mechanization lags behind twenty to thirty years. The aim of agricultural mechanization is that the comprehensive mechanization of main agricultural crops should reach 65% and the mechanization level was up to 90%, while the rice plantation and harvest mechanization level should reach 60% and 85%^[5]. So far, the comprehensive mechanization in China has just been over 50%.

As an agricultural country in development, the mission of agricultural equipment and technology lies in the construction of a modernized agriculture, which will meet farmers' wish of realizing civilized production and decent work process, will promote the strategic transition from a manufacturing country to a powerful country, and will contribute to the development of agriculture and agricultural machine as well as an innovative country.

Therefore, the construction of synthesized innovative modern agricultural equipment and technology center is an essential measure to develop agriculture and realize modernization.

2 Status quo of agricultural machine and its development trend in China and foreign countries

2.1 Status quo in foreign countries and its development trend Developed countries in Europe and America have realized agricultural mechanization in the last century. So far, the agricultural

equipment in developed countries becomes multifunctional and highly efficient, and applies digital design and information management to save resources and protect environment. Developed countries in Europe and America reduced labor force by 2% through overall popularization of agricultural mechanization. The agricultural labor production rate improved and agricultural modernization was realized, which formed general occupation of global agricultural product.

2.2 Domestic situation and development trend Since the foundation of China, agricultural equipment and machine has made huge achievement, as the agricultural machine industrial system has been formed. The agricultural equipment is in developing stage now. The key to study agricultural equipment in China is the integration of agricultural machine and equipment and technology, the use of machine, electricity and solution to realize high efficient and low cost of agricultural mechanization. The agricultural production mode in China has changed from basic labor force to machine operation.

However, compared with developed countries, China has just went into middle level in the agricultural mechanization. The development level lags behind for 20 to 30 years. (1) Agricultural mechanization in China has just entered into the middle stage and the general mechanization level is only around 50%, far lower than that in developed countries. (2) Species structure can't meet agricultural development and food production hasn't realized overall mechanization. (3) Agricultural equipment technology is low and its property is poor. (4) The modern design method and indoor simulation test are immature. (5) The agricultural machines are poorly organized. The scale operation of agricultural machine is inappropriate with the small agricultural business. (6) There are few competitive brands and companies in China. (7) The agricultural process technology and equipment was low and weak. The quality of agricultural raw material can not be guaranteed. (8) Innovation is what China needs.

In recent decades, great progress has made in China concerning the key technology in production machine of main crops. Machine has been widely applied in the production of wheat. But, the machine for the production of rice and corn can not meet the current necessity.

(1) In the aspect of tractor, the distribution of tractor in China is unreasonable and most tractors are of moderate and small power, which lead to the inefficient exertion of the advantage of machine operation.

(2) For plantation machine, the mechanization used in rice production is the lowest. In 2010, the comprehensive mechanization level was 58% and plantation mechanization was 20%. The key technology to solve now was to cultivate seedlings that can adapt to the production of rice. The domestic machines to produce corn are largely small machine with lots of shortages, such as poor adaptability, repeated plantation and high damage rate. In the aspect of transplanting rapeseed and cotton, China has come up with various forms.

(3) Cultivation and field management aspect. Protective cultivation is a major change to the traditional agricultural cultivation. Compared with the advanced medicine spraying machine, machines used in China are mechanical and inefficient. In China, as an agricultural country, water being used for agricultural purpose accounts for 90% of the general water consumption. 70% farmland is desperate for water. Therefore, the highly efficient use of water is of great strategic significance to the sustainable steady development of agriculture in China.

(4) As for joint harvest machine, there are following disadvantages. Firstly, the structure is simple and the operation efficiency is limited, which can't meet the gradual formation of agricultural production. Secondly, the design often depends on experience and imitation. Thirdly, the operation can't be monitored. The manufacturing equipment of machine was poor and the operation work was lower than 60 hours.

Therefore, the scientific research of agricultural machine industry in China lags behind that in developed countries. Only by increasing the scientific research ability can China gets rid of its dependence on foreign advanced technology, build competitive and innovative agricultural machines and achieve general improvement in agricultural mechanization.

3 Main mechanism problems that China will face in the innovation of agricultural machines

3.1 Inefficient operation mechanism of scientific and technological organization The agricultural equipment and technological system are diverse and the agricultural scientific and research organization are formed according to major and subjects.

3.2 Insufficient investment in scientific research Though the general investment in agricultural equipment and technological scientific research increased, its percentage in general national financial consumption was low. The private company's investment occupies less than 2% in agricultural scientific research fund and most of this fund was used for crops.

3.3 Insufficient original innovation After many agricultural research academies becoming companies, their publicity and commonweal are weakened. The revoke of agricultural department and machine department and reform of higher education weaken the higher education of agricultural machine in university.

3.4 Low industrial intensity In recent years, being pushed forward by agricultural machine purchase subsidy policy, the agricultural market expanded rapidly and there were lots of small companies. The large number but small scale companies lead to inefficient resources configuration and low level construction and deteriorated competition, which restricts the healthy development of agricultural machine industry in China and makes it hard to become internationalized companies.

3.5 Inefficient resources integration mechanism The current policy makes it difficult to build effective scientific research equipment. The insufficient conservation and shortage of preservation made scientific and technological staff unable to share re-

sources. Meanwhile, the lack of communication results in repetition of research, which makes it hard to solve technological problems and reduces the overall competitiveness.

3.6 Unscientific innovative evaluation mechanism The evaluation mechanism depends on the evaluation of paper, patent and prize and focuses on number rather than quality. There is no effective link among each circle, which makes it difficult to improve the use of scientific and technological resource and to enhance the general efficiency of scientific and technological innovation.

3.7 Ineffective innovative personnel training and international cooperation mechanism The shrink of students and teachers majoring in agricultural mechanization, and the detachment of personnel training and actual demand contribute to the difficulty in the development of modern agricultural equipment and technology of international level.

4 Urgency and feasibility of synthesized innovation

4.1 Synthesized innovation being what the advanced agricultural equipments' need First of all, the object that agricultural equipment operates on is an organism of irregular height and various shapes. Agricultural equipment must face more complicated objects and must improve the dependence of improving work under the premise of strict control of cost.

Secondly, the largest characteristic of agricultural equipment innovation is comprehensive and systematic. Only by starting from scientific research mechanism can we break the traditional rule and realize synthesized innovation so as to realize rapid improvement of scientific research level of agricultural machine.

Only by getting down to the scientific research mechanism of agricultural machine, by establishing the long-term cooperation among universities, scientific research institutes and companies and by increasing investment in fundamental research can we lay firm foundation for the sustainable development of scientific research on agricultural machine.

4.2 Synthesized innovation being the realistic demand to change the outdated technology in agricultural equipment in China It is more urgent for agricultural equipment to carry out synthesized innovation than other industries.

Firstly, there are many agricultural companies but their scientific research abilities are weak. Most agricultural machines have to imitate the products being produced in foreign countries.

Secondly, the high-end product largely depends on imports. Though some products are introduced from oversea companies, their deep mechanism and core technologies are not known. Foreign companies make lots of money in Chinese high-end agricultural machine industry, which would increase the general cost of agricultural production in China. Experiences tell us that to use market to change technology would lead to monopoly.

The structure of current agricultural labor force is experiencing deep changes. Agricultural mechanization and precision demands synthesized innovation, which would fundamentally change

income, and improve agricultural efficiency, it is necessary to increase the sweet potato industry support strength, and establish the industrial demonstration projects to promote its healthy development.

References

[1] MI G, XUE WT, CHEN MH, et al. The distribution, characteristic and usage of sweet potato (*Ipomoea batatas*) in China [J]. *Science and Technology of Food Industry*, 2008(6):324–326. (in Chinese).

(From page 39)

the status quo of agricultural innovation and realize efficient configuration of scientific research resources.

4.3 Synthesized innovation being the successful product of scientific and technological development of agricultural equipment in developed countries Developed countries have realized overall mechanization in recent decades in China, which is due to the synthesized system of reasonable and efficient agriculture, agricultural equipment, scientific research and education. Taking America as an example, American government passed the *Morrill Act* in 1962, which specified that each state should build agricultural universities. In 1887, *Haqi Act* specified that government will finance agricultural experiment station. In 1914, *Smith – Lifer Act* required that the agricultural technology promotion should be operated by federal, state and regional government so as to establish systematic agricultural teaching, study and promotion system.

American government used to focus on study of agricultural science and technology. Besides of large amount of fund from federal government and each state government, huge public scientific research system has been built to realize the integration of teaching, scientific research and promotion. Agricultural department, the study center of agricultural science, and each agricultural academy in state universities, the powerful scientific research base, as well as the large and competitive private agricultural companies become the three-dimensional synthesized innovative system so as to make the transition rate and contribution rate being above 70%, which makes America the most advanced country in agricultural science and technology.

Practices suggest that synthesis and cooperation form development, reduction of cost, diverse risk and benefit sharing mechanism, which pushes forward the progress and upgrade, re-

[2] YUAN WZ, LIU CH, CAO XT. New development trend of sweet potato industry [J]. *Analytical Prediction*, 2006(2):36–37. (in Chinese).

[3] GUAN HX, XU BJ. Analysis on the development of Jiangsu rural red tourism industries based on SWOT model-taking the case of Shajiabin reed marshes scenic zone of Changshu City in Jiangsu Province [J]. *China Business (Economic Theory Study)*, 2008(21):93–95. (in Chinese).

[4] YI WL, LIU XW. Relationship between cultivated land change and food security in Baoji City [J]. *Chinese Agricultural Science Bulletin*, 2010(14):308–313. (in Chinese).

alizes resources integration and expands international development space. This becomes the efficient mode of innovation in globalization.

5 Conclusions

In order to occupy the leading role in agricultural equipment and technology industry in the drastic international competition, it is urgent for China to change the current diverse, to close and to update closed and outdated mechanism and system. It is important to break the boundary and realize maximum integration of innovative resources and elements, to build research centers of international significance through modernized agricultural equipment and technology, to build personnel training mode, which would fundamentally change the situation of scientific research of agricultural equipment, narrow down its gap to developed countries quickly, which would provide solid material support to agricultural modernization and national modernization in China.

References

[1] QIANG GZ. Thoughts about innovating agriculture science and technology and advancing modern seed industry development [J]. *Seed Science and Technology*, 2011, 10(3):3–4. (in Chinese).

[2] CHEN C, ZHANG M, SONG JX. Analysis on the current situation and countermeasure of protected agriculture in China [J]. *Journal of Hebei Agricultural Sciences*, 2008, 12(11):99–101. (in Chinese).

[3] HUANG Y. Correlation analysis of urbanization process and economic growth [J]. *Journal of Southwest University for Nationalities*, 2006, 4(3):147–151. (in Chinese).

[4] ZHAO YX. The research aim and strategy of national food security system [J]. *Economic Research Guide*, 2009, 68(30):133–155. (in Chinese).

[5] ZHANG YQ, LI Q. The development of agricultural mechanization and its contemporary enlightenment of new China first 30 years [J]. *Mao Zedong Deng Xiaoping Theory Research*, 2012, 4(4):53–59. (in Chinese).