

FOREIGN EXPERIENCE

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Agricultural modernization and sustainable development under resource and environmental constraints



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Abstract. The agricultural modernization of any country must be considered in the light of its national conditions, its population, resources and economic and social conditions. China's government clearly expresses the desire to promote agricultural modernization at the same pace with the in-depth development of industrialization, information technology, and urbanization, which is a major task for the construction of a moderately prosperous society and for the achievement of modernization. Due to the growing resource and environmental constraints, promoting the agricultural modernization must take the way of achieving its sustainable development based on the status quo of the environment and basic national conditions.

Key words: agricultural production, modernization of agriculture, industrialization and urbanization, sustainable development, environmental protection, resource constraints.

I. Supportive policies on China's agricultural modernization and achievements

Agriculture is the foundation of a nation or a region, because its economic development depends on the rapid and stable agricultural growth, while the traditional agriculture is incapable of growing rapidly and stably; therefore, the fundamental

way out for traditional agriculture lies in the transformation to modern agriculture, namely, agricultural modernization. China has the basic national conditions of huge population and limited arable lands. As a result, the agricultural modernization can only be achieved with sustainable and modern development.

1. The government has increased the investment in agriculture. China's reform began in rural areas in the 1980s, allocating the farmlands to farmers, which greatly aroused the enthusiasm of farmers; in 2004, Chinese government abolished agricultural taxes, ending 2,000-year history of collecting taxes from farmers; meanwhile, Chinese government has increased the support and subsidies to agriculture, mainly including direct grain subsidies to farmers, comprehensive agricultural subsidies, subsidies for superior crop varieties, and subsidies of farm machinery purchase; in addition, other subsidies were gradually increased from RMB 11.67 billion Yuan in 2004 to RMB 167.05 billion Yuan in 2013 (see Figure 1). At the same time, China's government also places a great emphasis on the investments in agriculture, forest

and irrigation, increased from RMB 304.07 billion Yuan in 2007 to RMB 1.322791 trillion Yuan in 2013, an increase of four times (see Figure 2).

2. Comprehensive productive capacity of grain has been greatly improved. Since the reform and opening up, China's total grain output has doubled, which resolved the problem of food and clothing of 1.3 billion Chinese people; the output has been increased from 304.765 million tons in 1978 to 601.9384 million tons in 2013 (see Figure 3); since 2004, the grain has been increased for ten years on end. The increase in the food yield per unit area is the major factor for the increase in grain production in China, increasing from 2527.3 kg/hectare in 1978 to 5301.76 kg/hectare in 2012, an increase of over 100 percent (see Figure 4).

Figure 1. Chinese agricultural subsidies (Unit: RMB 100 million Yuan)

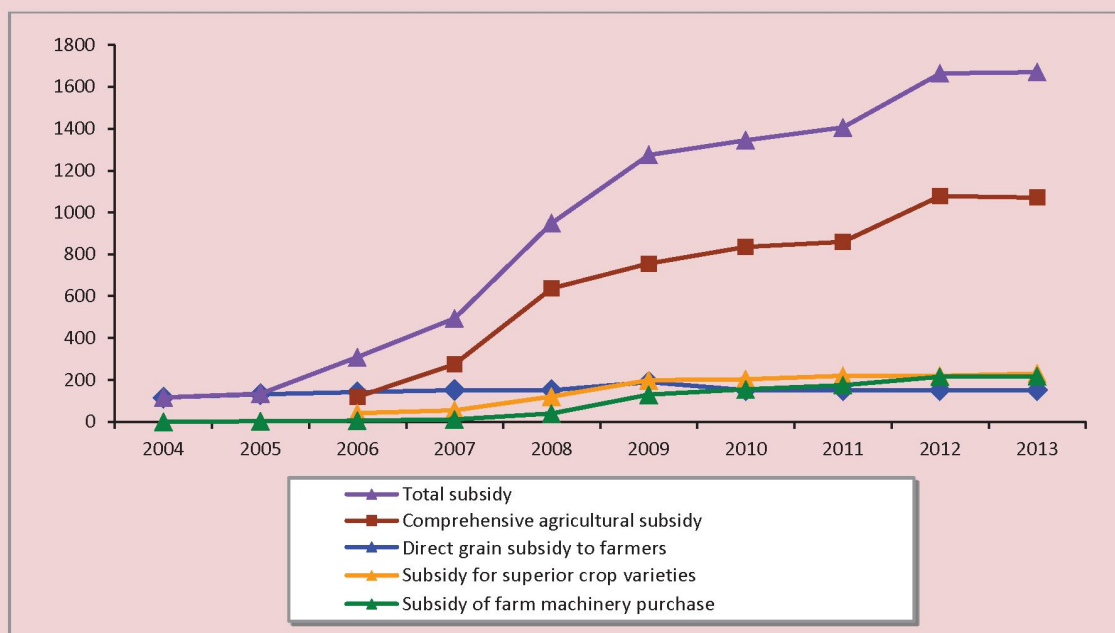


Figure 2. Change of China's expenditure for agriculture, forest and irrigation from 2007 to 2013

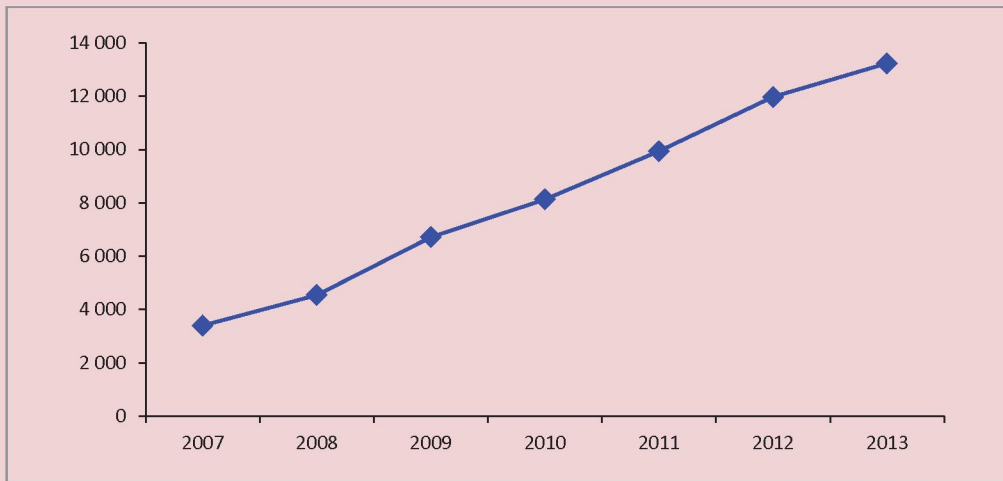


Figure 3. Trend of China's total grain production

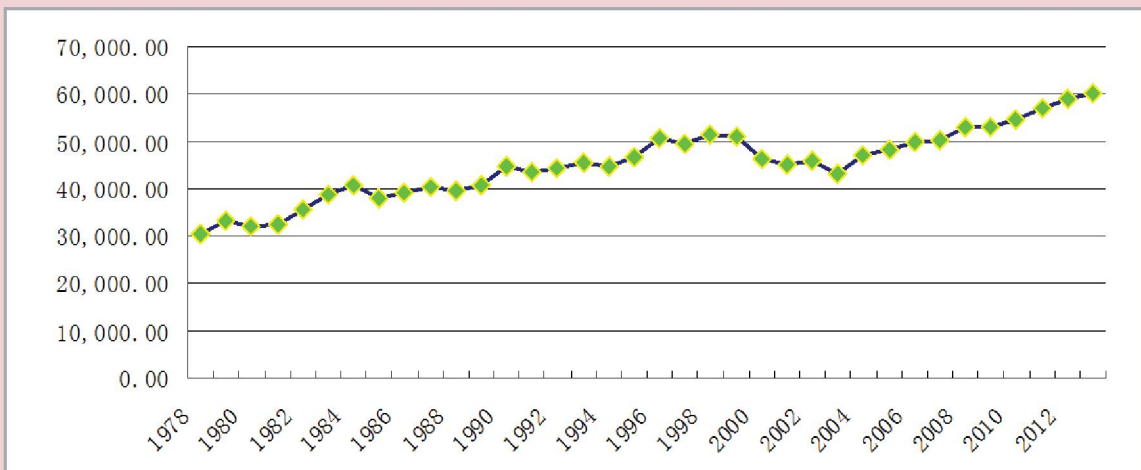
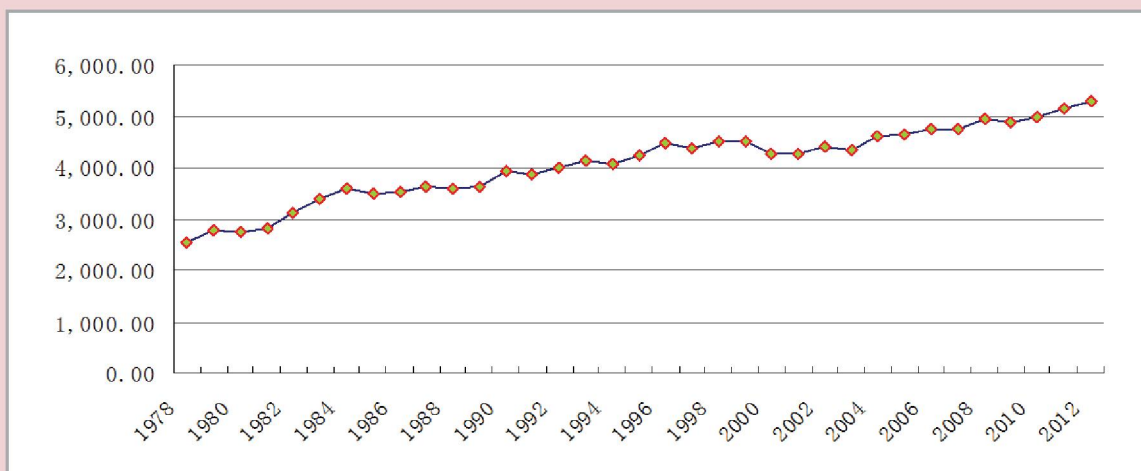


Figure 4. Trend of China's grain yield per unit area

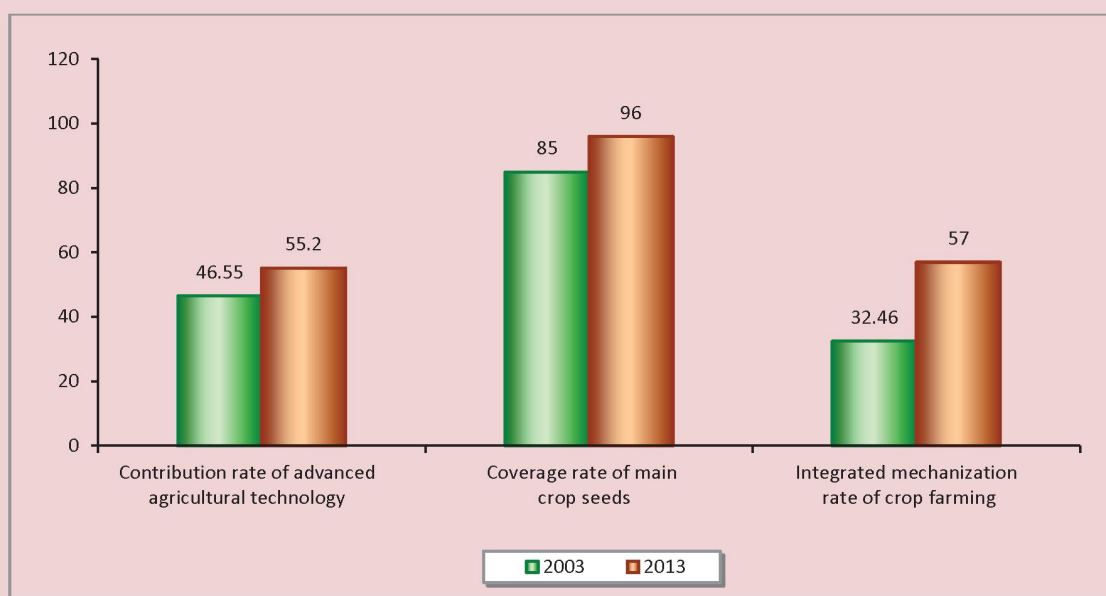


As a result, a complete system consisting of grain production, processing, and distribution has been formed, promoting the increase in China's total grain and the improvement of its quality.

3. Advances in agricultural technology contribute more to the agricultural development. Since the reform and opening up, China's agricultural technology has been developed steadily. The modern crop breeding technology system has been initially established, especially the hybrid rice breeding technology developed by Yuan Longping which has made outstanding contributions to the increase in food production of China and to the resolution to the problem of food and clothing in

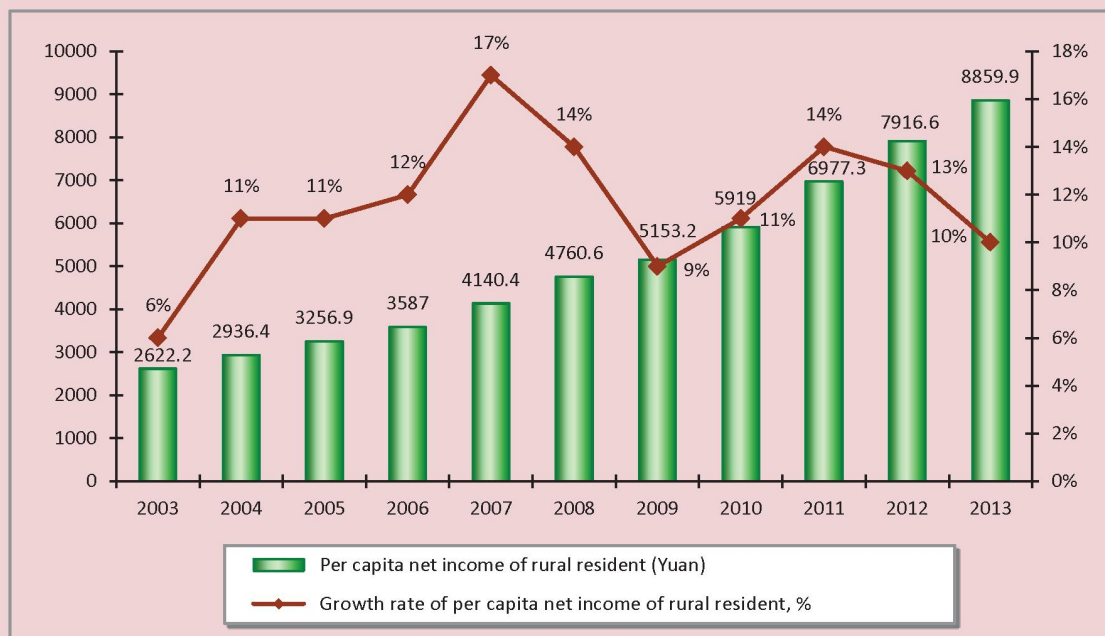
China and even the world, especially, the 4th super rice currently can increase the yield to around 1000 kg per mu¹; in addition, China's investment to agriculture, forest and irrigation has promoted the wide application of advanced agricultural machinery and equipment, GPS, remote sensing, agricultural biotechnology and other technologies. The contribution rate of advanced agricultural technology has been increased from 46.55 percent in 2003 to 55.2 percent in 2013, and the coverage rate of main crop seeds has been increased from 85% in 2003 to over 96% in 2013, and the integrated mechanization rate of crop farming has risen from 32.46% in 2003 to 57% in 2013 (see Figure 5).

Figure 5. Contribution of China's agricultural technology, %



¹ Mu – unit of measurement of land area in China, equal to 0.067 ha.

Figure 6. Per capita net income of rural resident and its growth



4. Rapid increase in farmers’ income.

The ultimate goal of agricultural modernization is to improve farmers’ living standard. Since 2004, the per capita net income of farmer has been increased from RMB 2936.4 Yuan in 2004 to RMB 8859.9 Yuan in 2013, an increase of three times. During the period, except for several years impacted by the financial crisis, the per capita net income of farmer in other years has basically been increased by double-digit (see Figure 6).

II. Increased resource and environmental constraints for China’s agricultural modernization

With China’s economic development and the rapid progress of urbanization as well as industrialization, the competition in arable land, labor, and water resource

between agriculture and non-agriculture and between rural areas and urban areas has been increasingly intense, indicating that the sustainable development of China’s agricultural modernization has faced gradually strengthened “hard constraints” in resource and environment.

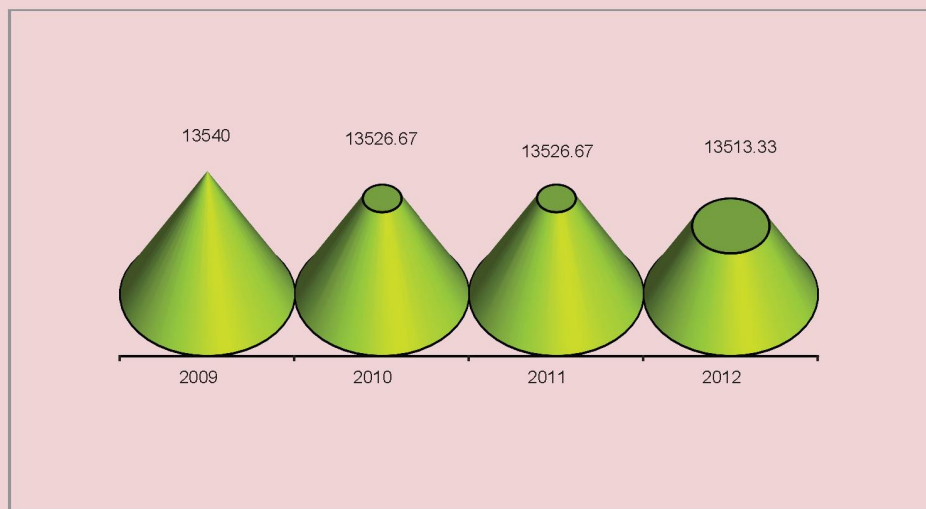
(A) Huge pressure from arable land resource

The increasingly prominent scarcity of arable land resource has been the bottleneck for the sustainable development of China’s agricultural modernization. According to *China’s Land and Resources Report 2013*, by the end of 2012, China’s arable lands have been 135.1333 million hectares, ranking the fourth in the world, lagging behind the United States, India, and Russia, but the total amount of arable land resource

is large; however, with more lands for industrialization and urbanization, China's arable land has decreased (see Figure 7). In addition, China's per capita arable land is fewer, only 0.08 hectares, 40 percent of

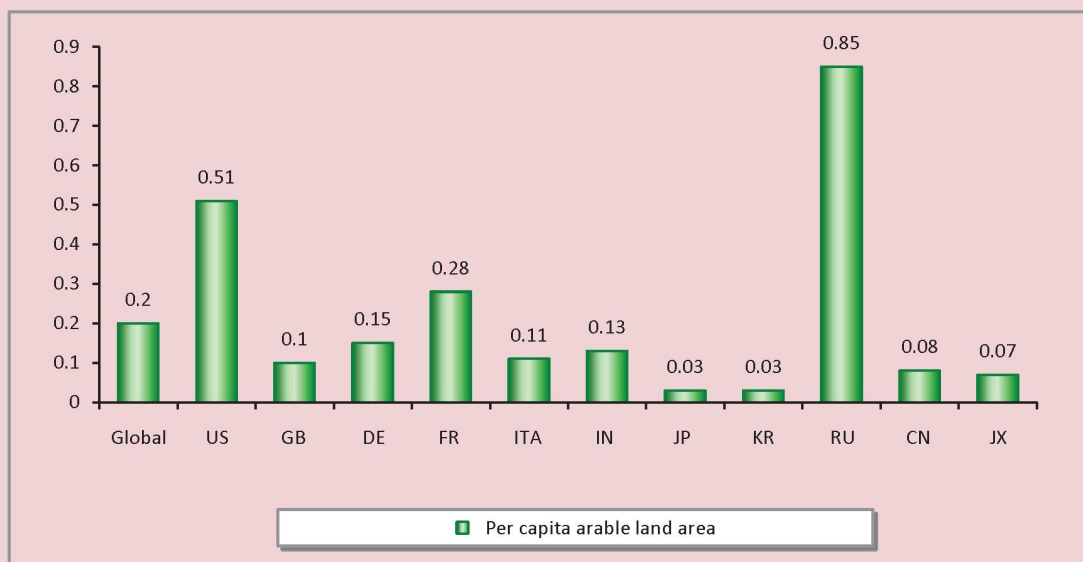
the world average, far lower than that in Russia, the United States, France and other developed countries; and the per capita arable land of Jiangxi Province is below national average (See Figure 8 for details).

Figure 7. Trend of China's arable land 2009–2012



Source: *China's Land and Resources Report 2013*.

Figure 8. Comparison of per capita arable land area between China and the world



Source: database of World Bank.

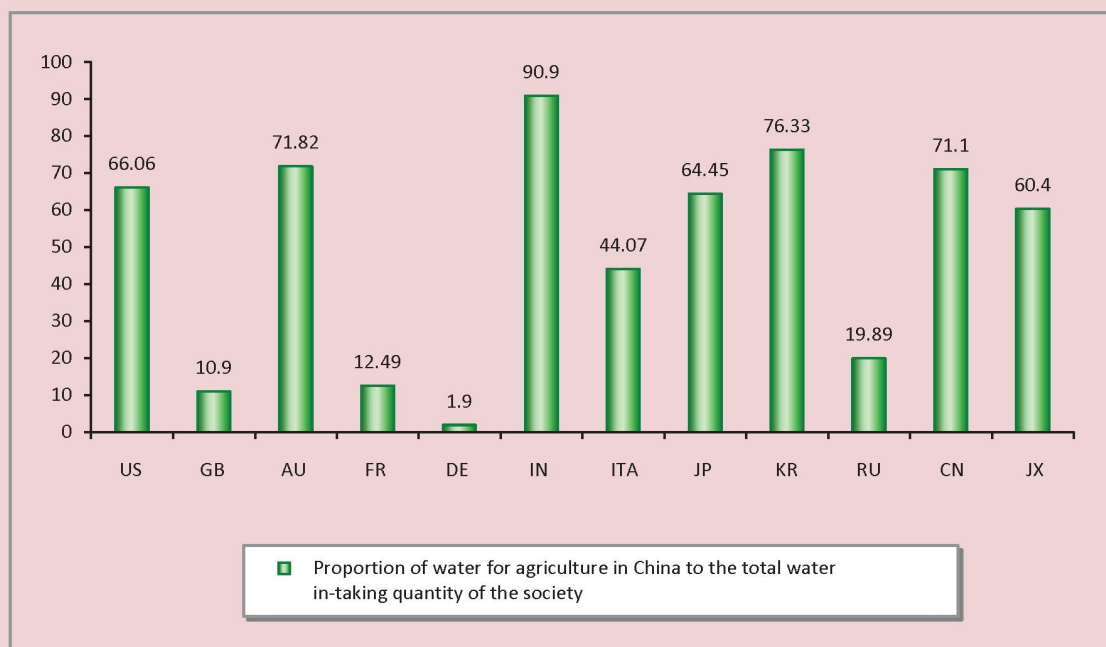
China in the next period of time will continue to accelerate the industrialization and urbanization, which will further occupy the arable land required by the sustainable development of modern agriculture; therefore, the “hard constraints” on arable land has been intensified.

(B) Increasing shortage of water resource for agriculture

China has the total freshwater resource ranked the sixth in the world, but its per capita has been very low; in accordance with the data from the sixth census released in 2011, the per capita availability of water resource in China is only 2.093 cubic meters, less than one-third of the world average; as a result, China has been

one of the world’s 13 countries with the poorest water resource listed by the United Nations. Under the current condition of severe water shortage, the extensive flood irrigation mode has been still used in Chinese agriculture, and the water for agriculture occupies higher proportion in the total water in-taking quantity of the society. From 1992 to 2012, the proportion of water for agriculture in China to the total water in-taking quantity of the society was 71.1% on average, and Jiangxi’s proportion was slightly lower than the average level of China, basically the same to that in the United States, Australia, Japan, South Korea but much higher than that in the UK, France, Germany and Russia (*see Figure 9*).

Figure 9. Proportion of water for agriculture in major countries to their respective total water in-taking quantity, %



Note: The data of major countries is the annual average 1994-2012 from FAOSTAT.FAO.ARG; and the data of Jiangxi is the data 2012 from *Jiangxi Water Resources Bulletin 2012*.

Meanwhile, the agricultural water of China is mainly used for irrigating farmlands, characterized in low utilization rate and a large gap between supply and demand. Currently, its utilization factor is only 0.5, with a great gap when compared with 0.7–0.9 for developed countries, which has reached more than 30 billion cubic meters. With a water shortage in China and the advance of China's industrialization and urbanization, the water demands for industrial and domestic uses will be increased; coupled with the population growth, the water resource for agriculture in the future will be quite severe.

(C) More obvious outflow trend of young rural labors

China is in the middle and late period of industrialization; therefore, its industrialization and urbanization will continue to advance, and more and more rural labors will outflow for work; according to the data from National Bureau of Statistics, China had 225.4 million rural labors flowing out for work in 2008, increasing to 268.9 million to the end of 2013, an

average annual increase of 8–9 million people, mostly young labors (*see Table 1*). Meanwhile, most of such labors have the educational background of junior high school or higher. Such an outflow will lead to hollowing and destitution of rural areas, and aging and low education of agricultural labor forces. The problem who will till the land will be the major challenge for achieving the sustainable development of China's agricultural modernization.

(D) Severer agro-ecological and environmental constraints

Severer agricultural nonpoint source pollution: According to China's first national pollution census, the agricultural nonpoint source pollution has accounted for about half of total pollution, characterized in more points and wide coverage. China's utilization rate of agricultural fertilizer is only 40% and that of pesticide is about 30%, and about 1.4 million hectares of arable lands were contaminated by pesticides. Meanwhile, the pollution of agricultural film residues and animal manures on agricultural environment has become increasingly serious.

Table 1. Number of rural migrant workers and age structure of China from 2008 to 2013 (Unit: 10,000; %)

Indicator	2008	2009	2010	2011	2012	2013
Quantity of rural migrant workers	22542	22978	24223	25278	26261	26894
16-20 years old	10.7	8.5	6.5	6.3	4.9	–
21-30 years old	35.3	35.8	35.9	32.7	31.9	–
31-40 years old	24.0	23.6	23.5	22.7	22.5	–
41-50 years old	18.6	19.9	21.2	24.0	25.6	–
Over 50 years old	11.4	12.2	12.9	14.3	15.1	–

III. Path to the sustainable development of China's agricultural modernization

To achieve the sustainable development of agricultural modernization, China's government must change the mode of agricultural development, break the resource and environmental constraints, and strive to open a new agricultural modernization road with advanced production technology, appropriate management scales, strong market competitiveness, and sustainable ecology and environment based on the basic conditions of scarce arable lands and fresh water and other natural resources.

(A) Strengthening the intensive and economical use of water and land resources

Land and water resource have been the most important elements among agricultural production factors. To achieve the sustainable development of China's agricultural modernization, it must take the intensive and economical use of arable land and water resources, to guarantee the two "lifelines" for agricultural production.

First, it needs to strengthen the management, control and implementation of *Notice of Strengthening the Control, Management, and Implementation of the Most Stringent Farmland Protection System*, strictly define and permanently protect basic farmland, strengthen the economical use of land resources, and make ensure that the cultivated land inventory is not fewer than 1.8 billion mu and the basic farmland inventory is not fewer than 1.56 billion mu; furthermore, it still needs to accelerate the land transfer, actively encourage the moderate scale of operation

of lands, strictly control the land occupied by industrialization and urbanization and strengthen the intensive use of lands. Second, it needs to strictly implement the *Opinion on the Implementation of the Most Stringent Water Management System*, create the system for realizing the efficient use of agricultural water resource, promote the new irrigation technologies with water and energy conservation and realize the transformation from extensive water utilization to intensive water utilization.

(B) Accelerating the innovation of agricultural technology

We should vigorously promote the use of agricultural technology and improve the comprehensive utilization of agricultural resources as follows: first, with accurate agriculture technology focused, accelerating the popularization and utilization of comprehensive agricultural information technology; second, with automation and intelligence equipment and technology focused, accelerating the popularization and utilization of machinery throughout agricultural production; third, with quality and safety of agricultural products and agro-processing technology focused, accelerating the popularization and utilization of food safety technologies; fourth, with farmland pollution remediation technologies focused, accelerating the popularization and utilization of ecological agriculture technologies. At the same time, it needs to improve the conditions for the innovation of agricultural technology, expand the technological team, improve the capabilities in the promotion of agricultural

technology, provide the exemplary role for farmers and technical personnel, and strive to develop the social service system for agriculture.

(C) Cultivating new agricultural business entities

Studies of many experts and scholars in China show that, fostering new agricultural business entities such as professional large landlords, family farms, and farmer cooperatives and leading agricultural enterprises is the main way to achieve the sustainable development of China's agricultural modernization.

First, it needs to strengthen the cultivation of professional large landlords, family farm operators, cooperative leaders, farmers' brokers, agricultural machinery drivers and plant protectors and other new farmers.

Second, it needs to spend the incremental subsidies supporting the development of new and main agricultural business entities.

Third, it needs to make the demonstration by examples. Furthermore, it needs to formulate the standards and conditions for new agricultural business entities such as professional large landlords, family farms, and farmer cooperatives and leading agricultural enterprises and to develop the demonstration list.

(D) Strengthening the agro-ecological and environmental protection

The agro-ecological and environmental protection should be strengthened. It needs to accelerate the development of clean energy in rural areas, promote the comprehensive treatment, conversion and utilization of agricultural production and domestic wastes and improve the agricultural production conditions; to develop new agro-industries, actively develop new fertilizers and efficient pesticides of low toxicity, multifunctional agricultural machinery and biodegradable agricultural films and other new agricultural inputs.