

ОГРАНИЧЕНИЯ ЭКСТЕНСИВНОГО ПРОИЗВОДСТВА В ОБЕСПЕЧЕНИИ ПРОДОВОЛЬСТВЕННОЙ БЕЗОПАСНОСТИ КИТАЯ

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Аннотация. Находясь в состоянии сверхзависимости от импорта, Китай в последние годы сталкивается с проблемой продовольственной недостаточности. В связи с утверждением документа, устанавливающего показатели развития сельского хозяйства и соответствующие модели, настоящая статья посвящена факторам, влияющим на продовольственную безопасность в Китае, в частности технологическим элементам. Полученные данные свидетельствуют о том, что технологии играют жизненно важную роль в улучшении производства продовольствия. Рекомендуется увеличить вклад науки и техники и улучшить механизацию сельского хозяйства.

Ключевые слова. Недостаточность, продовольственная безопасность, технологии, механизация.

RESTRICTIONS OF EXTENSIVE PRODUCTION TO ENSURE FOOD SECURITY IN CHINA

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Abstract. Being over-dependent on imports, China has been faced with the problem of food insufficiency in recent years. This paper, with the adoption of the indicators of agricultural development and relevant models, aims to explore factors affecting food security in China, in particular, technological elements. The findings demonstrate that technology plays a vital role in improving food production. It is recommended to increase the input of science and technology and improve agricultural mechanization.

Keywords. Insufficiency, food security, technology, mechanization.

1. Introduction. Since the implementation of the Reform and Opening up Policy in 1978, China has witnessed great success in economy. Its GDP has increased about five times in the past 40 years. On the one hand, the rapid economic growth brings about the wealthiness of the whole nation. On the other hand, consequently, it results in rocketing demand for higher living standard as well, especially for more food since the turn of the 21st century. Domestic food output has kept a momentum of increase from 452.64 mts in 2001 to 657.89 mts in 2018 [1]. Nevertheless, the enhanced yield is far from meeting food demand in China. Data show that China is faced with the problem of over-dependence on food import.

According to the National Bureau of Statistics of China [1], the import of food in 2018 was 115.55 mts, increasing by 593% compared with 19.50 mts in 2001. The imports of staple foods such as rice, wheat, maize and soybeans climbed from 240, 188, 3 and 10416 thousand tons in 2001 to 3077, 3100, 3524 and 88030 thousand tons in 2018, rising by 12.82, 16.49, 1174.67 and 8.45 times respectively.

The gap between food supply and demand has been widened consecutively in recent years. Total food demand in China is projected to rise by 33% in quantity by 2050 compared with 2015 driven by both population and income growth [2]. A major factor causing larger food import is the rapid growth of domestic food prices. From 2001 to 2017, the PPIs of agricultural products and cereals increased by 121.07% and 95.54%, and those of four major products: rice, wheat, maize and soybean climbed up by 127.72%, 102.06%, 54.74% and 126.62% respectively [1]. The prices of staple food in China are much higher than those of other major exporting countries. According to UN Comtrade, in 2015, the exporting price of rice was \$935.1 in China, \$463.88 in Thailand and \$517 in America; the price of maize was \$439 in China, \$194 in America, \$187.1 in Argentina and \$173.2 in Brazil; soybeans were \$939.5 in China, \$393.2 in America, \$366.5 in Argentina and \$386.3 in Brazil. It is unlikely for China to maintain the target of 95% of food self-sufficiency [3].

2. Relevant studies in food security. Some scholars conducted relevant studies on food problems -- import growth -- in China and put forward some measures. Chen (2018) analyzed food production in China. The research illustrated that with the increase of agricultural cost and the deterioration of arable land, food security would get worse. He proposed that more investment in scientific research be an effective solution to food insufficiency. Jiao et al. (2018) reviewed and predicted China's food production and found that the

enhancement of food yield and productivity mainly derived from greater input of chemical fertilizers and natural resources. The mode of agriculture is unlikely to continue due to the confinement of certain reasons. Based on the study of the grain yield from 1960 to 2010, they recommended that enhancing nutrient use efficiency be imperative for sustainable development of agriculture in China.

In order to accurately grasp the current situation of food security in China and find solutions to cope with latent crisis, this paper, with the adoption of the indicators of agricultural development and relevant models, aims to explore factors affecting food demand and supply in China, in particular, technological elements. It is expected to provide both a quantitative and qualitative basis for the selection and adjustment of China's food security strategies and role of import for its implementation.

3. Current situation of food production in China. China has an agricultural population of more than 4 billion and almost the same size of arable land as that of America, but food insufficiency has become a challenge in recent years. Low productivity plays a vital role in food production. Compared with the developed economies, such as the EU and USA, grain production in China needs improvement [4]. For example, in 2005, grain yield in the EU and America was about 10 tons per hectare, while in China it was less than half of these western countries [5].

3.1 Factors affecting food yield. Generally two major ways are involved in enhancing food productivity: the extensive one, associated with the increased use of production factors; and the intensive one, which is determined by technological features and innovations. Factors like arable land, water resources, fertilizers and technology, are closely related to food output. In the past, China's food production mainly relied on the input of production factors such as land, labor force, chemical fertilizers and so on to maintain a high output. Whereas, with the development of economy, the potential of these factors is marginal, which makes it difficult for food production to keep up with the growth of demand.

A. Arable land. Land, particular arable land, plays a pivotal role in agricultural production. Both the quantity and quality of land have experienced significant changes in China. According to Fig. 1, the area of arable land is 103397 in 1961 and 119492 kilo hectares in 2016, a slight rise by 15.57%. Actually arable land had been diminishing from 1991 to 2014 (from 125545 to 106298 kilo hectares) [6]. The dilemma of agriculture results not only from the slow growth of arable land, but also from land degradation. With the development of industrialization, arable land suffers heavier pollution, and the polluted land accounts for about 20% of the total land. Furthermore, the fertile fields around the city have been shrinking so that agricultural production has been forced to move to more remote and less fertile regions.

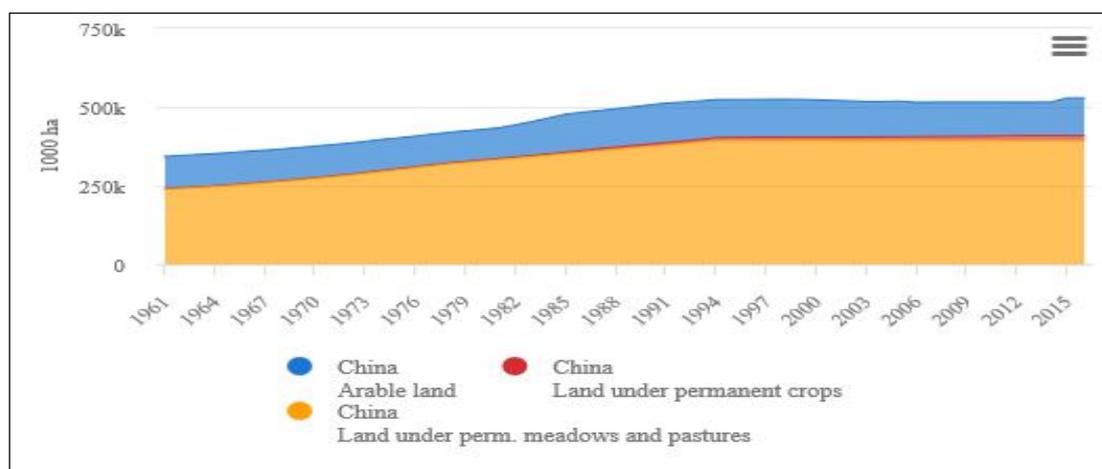


Figure 1 - The percentage of arable land in China. Source: FAO [6].

B. Water resources. China has been haunted by the shortage of water and severe pollution for years. The water resources are characterized by shortage in total and uneven distribution, with more in the south and less in the north. The Southern region occupies about 80% of the freshwater resources. In contrast, some regions in northern China are predicted to be dry in 30 years which will have destructive impacts on agricultural activities in the regions. The per capita share is one-third of the world average, ranking 109th place in the world. Agricultural water use presents a trend of increasing year after year, from 325.5 billion tons in 2003 to 376.6 billion tons in 2017 [1]. In the meanwhile, the discharge of waste water, from 48.24 in 2004 to 69.97 billion tons in 2017, increased by about 45.05%, which worsened the situation of water scarcity [7].

The World Wildlife Fund reported that 13% of China's lakes have disappeared in last 40 years along with half its coastal wetlands. The United Nations also identified China as one of 13 countries faced with extreme water shortages [3]. Industry and agriculture combined account for 85% of all water use in China.

Adequate availability of water is critical for optimum agricultural productivity and water scarcity is already seriously impacting grain production especially in northern parts of the country [8].

C. Fertilizers. Chemical fertilizers, especially N-enriched fertilizers, have been widely used by farmers to boost crop yield since 1980s.

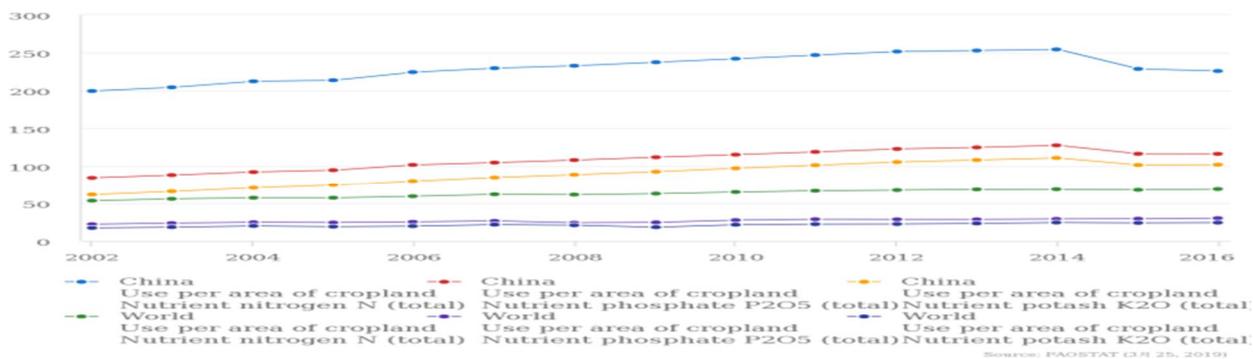


Figure 2 - Comparison between China and world average on the use of three main crop nutrients. Source: FAO [6]

Fig. 2 presents that the input of three major chemical fertilizers in China -- nutrient Nitrogen, phosphate P2O5 and potash K2O are about 4, 5 and 5 times as much as the world average respectively. Excessive use of chemical fertilizers maintains food output in a short period of time, while in the long run, it is destructive to soil. Excessive Nitrogen fertilization contributed substantially to soil acidification. A lower pH is a major threat to soil health for grain production [9].

3.2 Rapid growth of food costs. With the deterioration of the quality and quantity of natural resources such as land and water, it has become impractical to pull up output through the input of production factors. The scarcity of the factors hoists costs of food production, which causes less competitiveness of domestic food. In 2015, the production costs of maize, rice, wheat, soybeans and other major food crops in China were 56.05%, 20.82%, 210.42% and 38.44% respectively higher than those in the United States [10]. Among the costs of food production factors, labor force makes up 41.83%, which is a major reason for rocketing food prices [11]. From 2001 to 2015, the rising percentages of labor costs in the production of maize, rice, wheat and soybeans were 256.71%, 230.27%, 261.57%, 172.46% respectively, which were 14.78, 4.11, 16.33 and 8.5 times of those of America [10].

Soaring prices of domestically produced food cause less and less competitiveness in food market, and its share has been encroached on by foreign food enterprises. In the long run, China is likely to aggravate its dependence on food imports and a great threat is posed to food security. Reducing food production cost, particularly labor cost, is the crucial way to lower food price. China is the largest developing country in the world with low per capita wages, therefore it is unrealistic to reduce the cost of food production by cutting wages. Moreover, with the development of urbanization, the proportion of agricultural population in the total population has been declining, and this trend is expected to continue. The shrink of agricultural population will further push up labor costs, thus lifting food prices. Hence, in order to reduce the cost of food production, a more feasible way is to lower the percentage of labor force in agricultural production and improve productivity.

4. Strategies for guaranteeing food security. With less potential of natural resources it is preferable to promote agricultural production by boosting the development of science and technology, which is essential to improve food yield. Agricultural technology includes seeding, planting, irrigation, harvest, mechanization, etc. Taking mechanization as an example, this study aims to find the relation between machinery use and food output from 2001 to 2017 in China.

Model Summary and Parameter Estimates
 Dependent Variable: food output (kilo tons)

Table 1 - Regression analysis of total machinery power and food output

Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	.906	154.354	1	16	.000	221795.384	.393

The independent variable is total machinery power (kilo kws).

Through the calculation of SPSS, the regression equation is $Y = 221795.384 + 0.393X$, where $R^2 = 0.906$. Y represents the total grain yield and X stands for total machinery power. This model presents that for the input of every one additional kkw of machinery power, the output of food will increase by 0.393 kilo tons.

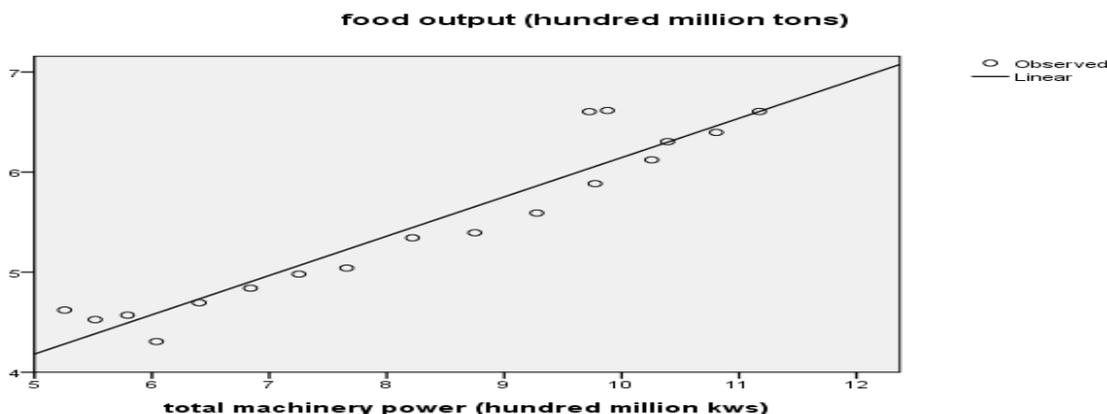


Figure 3 - Food output and total machinery power value scatter plot

Fig. 3 is a scattered point analysis of the total food output and the total power value of agricultural machinery in China from 2001 to 2018. From the trend line fitting, it can be seen that the ascent of food yield in China since 2001 is significantly correlated with the increase of the total power value of agricultural machinery. Compared with some developed economies like the United States, the mechanization rates in China are far behind. In 2015, the US realized 100% of mechanization in cotton, soybean and tobacco in the process of planting, seeding and harvesting. However, the figures in China are 80.43%, 52.08% and 53.40% respectively [10].

China's food production has entered a high-cost era in an all-round way. For a long time, the "small-scale" agricultural development mode is not conducive to the reduction of food cost and the improvement of production efficiency. Improving the mechanization level of food production, reducing the cost of grain supply and enhancing efficiency are an important part of the construction of food industry system, and it is more feasible to ensure food security through scientific and technological innovation. In agricultural production, the technology of agricultural machinery is likely by a large margin to improve labor productivity, land output rate and resource utilization. It is beneficial to improve the environment of agricultural production, realize sustainable development and promote the process of agricultural modernization.

Therefore, it is necessary to develop light and simplified agricultural machinery which caters to grain planting. It is recommendable to put more investment in innovation, inventing advanced, applicable, efficient agricultural machinery and supportive technology, to realize mechanization from planting to harvesting. In addition, in view of the low degree of mechanization of seeding and harvesting, it is advisable to learn the successful experience of developed agricultural countries, import efficient machines suitable for regional cultivation, thus improving comprehensive productivity.

5. Conclusion. Food security has been a top priority of all time in China. The 2008 world food crisis and the negative impact of trade war between China and the United States in 2019 have served as a warning signal to China's food security.

Under the background of trade globalization, although the cost of food import is rather low, the "core technology" of food production should be in one's own hands in order to achieve the goal of food security. This paper focuses on the details and timeliness of the data, combined with the current background, studies the current situation of food supply and demand in China and the problems in the process of food production, and analyzes the factors affecting food output. The parameters of mechanization are selected for a model test. Based on the regression analysis of mechanical power and food output, suggestions are put forward to increase the input of science and technology and improve agricultural mechanization. Other factors that affect food yield, such as labor, irrigation, breeding, capital investment and so on, are not covered in this paper, which will continue to be the focus of future studies.

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