



## **Potatoes: The Fourth Staple Food of China**

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### **Introduction**

As known to us, potatoes are vegetables. However, potatoes can also fill our belly without other foods. Hence, more and more people see potatoes as one kind of food. In response to this trend, China recently planned to launch a potato staple strategy so that the crop could become the county's fourth staple food. We would like to exploit the mainspring of this change.

According to the Ministry of Agriculture website news, China will start the potato main grain strategy, promote the processing of potatoes into steamed bread, noodles, rice and other staple food, potatoes into rice, wheat, corn and into another staple food. More than 50% of potatoes are expected to be consumed as staple foods by 2020.

On January 6, 2015, the Chinese Academy of Agricultural Sciences, the National Food and Nutrition Advisory Committee, the Chinese Seed Association held in Beijing, in which the main staple food development strategy seminar on potatoes as well as the national food security of this staple food became its main theme. It also held an in-depth study of the strategic significance of this crop. The seminar became an avenue for the development of ideas, objectives and tasks and sought out ways to promote the development of the crop. Vice Minister of Agriculture Yu Xinrong, who attended the seminar said that the development of potato as main food is being undertaken to thoroughly implement the central authorities to promote agricultural restructuring which is an important measure of sustainable development to protect national food security and promote farmers' income. The objectives are to firmly establish the guidance of consumption and scientific and technological innovation to take more measures to promote the formation of potatoes and grains in the coordinated development of a new pattern to better meet people's potato consumption and improve nutrition and health requirements .

In the said meeting, potatoes has been declared as the inevitable choice among many crops since it aims to help improve the dietary structure, and meet the people's desire to enhance their physical health.

The meeting proposed that potato be used to process into a suitable crop for Chinese consumption habits of steamed bread, noodles, rice and other staple food products.

Experts suggest potato becomes the major focus of scientific research, production, processing, circulation, consumption and other links, into the complex systems of engineering. There is a need to continue to increase support and concentrate on research, to develop a number of production to adapt to the market demand. The next step is to formulate development plans, to carry out the main grain technology model research, improve and perfect the main grain processing technology, do a good job in the production of the main food consumption guide, and make potato become the staple food of the people.

On February 23, 2016, the Ministry of Agriculture officially released "the guide to the promotion of the potato industry development", with potato becoming staple food products for industrial development, expansion of planting area and at the same time, promotion of industrial upgrading.

Opinions pointed out that it is of great significance to base potatoes on China's resource endowment and grain supply and demand situation, to conform to the new trend of residents' consumption upgrading, to establish a big food concept, to develop food resources in all directions and various ways to actively promote the development of the potato industry. It is estimated that by 2020, the total area of potato planting in China will be expanded to more than 100 million mu. The planting proportion of potato varieties is suitable for staple food processing, and will reach 30%. Staple food consumption, on the other hand, will account for 30% of the total potato consumption.

Thus, potatoes being a non-staple food should undergo a process of change. The current domestic planting structure improvement is of great significance, is also vigorously pursued by China's major policies, but is also considered conducive to the realization of sustainable agricultural development strategy.

### **Virtues of the potato**

From a nutritional standpoint, potatoes were superior to preexisting staple crops because they provided more vitamins and nutrients and they provided a greater supply of calories. Because potatoes contain nearly all important vitamins and nutrients, they support life better than any other crop when eaten as the sole article of diet (Davidson *et al.* 1975; Reader 2008). Humans can have healthy diets from consuming potatoes, supplemented with only dairy, which contain the two vitamins not provided for by potatoes, vitamins A and D (Connell 1962; Davidson *et al.* 1975). Historically, this was the typical Irish diet, which although monotonous, was able to provide sufficient calories, vitamins, and nutrients (Connell 1962; Burton 1948, p. 189).

According to the U.S. Department of Agriculture (2007), a medium potato (150 grams/5.3 ounces) with the skin provides 29.55 milligrams of vitamin C (45 percent of the daily value [DV]). This is important since other staple crops such as wheat, oats, barley, rice, and maize do not contain any vitamin C, a necessary deterrent for scurvy. For much of the Old World,

the potato provided the only source of vitamin C and protection against scurvy. A medium potato also contains 632 milligrams of potassium (18 percent of DV), 0.44 milligrams of vitamin B6 (20 percent of DV), as well as significant amounts of thiamin, riboflavin, folate, niacin, magnesium, phosphorus, iron, and zinc. Moreover, the fiber content of a potato with skin (3.5 grams) is similar to that of many other cereals such as wheat.

Table 1. Average Crop Yields of English Farms in the 18<sup>th</sup> Century

	Average yield per acre		Energy value of crop	Acres of land needed to provide 42 megajoules per day for one year
	Bushels	Kilograms	Megajoules	
Wheat	23	650	8,900	1.70
Barley	32	820	11,400	1.40
Oats	38	690	9,300	1.60
Potatoes	427	10,900	31,900	0.50

Source: Data are from eighteenth-century England, recorded in Young's (1771, p. 20) *The Farmer's Tour through the East of England*, Volume 4; reproduced in Davidson et al. (1975).

The second benefit of potatoes is that relative to Old World staples, they require less land to produce the same amount of calories (Connell 1951, p. 391; Langer 1963, pp. 11 - 12). Historical evidence of the caloric superiority of the potato over preexisting Old World crops is shown in Table I, which reports data collected in Arthur Young's (1771) survey of farming communities throughout England in the 1760s. The first two columns compared the average yields of oats, wheat, barley (three Old World staple crops), and potatoes. It shows that yields (measured in either bushels or kilograms) are well over 10 times higher for potatoes relative to the other crops. To adjust to the fact that potatoes are 75 - 80% water and therefore naturally heavier and more bulky than the other crops, the third column compares the energy value of the yields reported in the first two columns. It shows that an acre of potatoes yields approximately three times more energy than an acre of each of the other crops. The final column shows the number of acres required to provide the total energy needs for a family of two adults and three young children, which is estimated to be 42 megajoules (or approximately 10,000 calories) per day. While this family could subsist by cultivating a plot of only half an acre of potatoes, it would need to cultivate about 1.5 acres—three times as much land—if it were to grow wheat, oats, or barley. The data from Table I confirm historical reports that a single acre of land cultivated with potatoes and one milk cow was nutritionally sufficient for feeding a large family of six to eight (Langer 1963; McNeill 1999).

Although there is a consensus among historians that potatoes required less land to produce the same amount of calories, it is less clear whether potatoes required more or less labor than Old World cereals. Turner (1996, Ch. 6) reports historical labor requirements data from an Irish tenant farm collected between 1837 and 1885. In the sample, potatoes required approximately 2.5 times more labor input per acre cultivated than wheat, oats, or barley. However, the figure does not account for the fact that potatoes yield three times more calories per acre (recall the figures from Table I). Therefore, in terms of labor per calorie harvested, potatoes appear to be comparable or even better than cereals.

An additional benefit of potatoes was that their cultivation did not require a complete switch away from the cultivation of Old World staples; it was possible to plant potatoes between the growing seasons of other crops. Potatoes could be planted on land that was otherwise left fallow between the periods of grain cultivation (Mokyr 1981; McNeill 1999). McNeill (1999, p. 79) describes this benefit of potatoes, writing that "by planting potatoes on the fallow, and using hoes to eliminate weeds, there was absolutely no need to decrease the grain supply! What a bonanza!" One short coming of the potato was that unlike rotation crops such as clover and legumes, it did not increase the supply of nitrogen in the system, which was a constraining factor for agricultural productivity at the time (Allen 2008; Chorley 1981).

Potatoes also provided indirect benefits. Being relatively easy to store, potatoes provided excellent fodder for livestock (primarily pigs and cattle), especially through the winter. Often, a significant proportion of the potato crop would be used as fodder. This meant that potatoes also increased meat consumption, as well as manure, which was a valuable input for crop production. Finally, potatoes, as well as other crops introduced over time, provided additional means of crop diversification, which reduced vulnerability to famine (Ó Gráda 2009, p. 35).

### **Current Situation of Potato Plan in China**

According to statistics released by the World Food Organization, the global potato output in 2013 was 368 million tons, of which potato production in Asia was 180 million tons, accounting for 49%; European potato production accounted for 30.7%. China's potato production reached 8,892.5 million tons, accounting for 24.2% of the world's total potato production, the world's largest potato production; but China's potato yield is only 15.41 tons / hectare, only 81.5% of the global average, there is still a big upgrade space. The reason for low yield is due to the lack of fine varieties and advanced cultivation methods, and the problem of seed is particularly serious. At present, China's 8,000 million mu of cultivated area in more than 7,000 million mu in a long-term low-yield state, quantity and quality are urgent to improve.

Dominant areas of potato production in China are mainly distributed in the northeast, northwest, southwest and other regions, planting the world scale. The Ministry of Agriculture said that of the three main staple food area without the premise of the existing more than 8,000 mu of potato planting area expanded to 1.5 million mu, the yield will be increased to more than 2 tons, the proportion of potato in the staple food Qualitative leap. According to the Ministry of Agriculture Institute of Food and Nutrition analysis and prediction, by 2025, China's potato production will be an additional 52 billion jin (grain), the average per-mu yield of 1,500 kg; acres will increase the effectiveness of at least 300 yuan, farmers potatoes an increase of 45.0 billion yuan in net income from cultivation, and an increase of more than 300 billion yuan in the processing of agricultural products.

### **The Potato's Contribution to Population and Urbanization**

Between 1000 and 1900, world population grew from under 300 million to 1.6 billion, and the share of population living in urban areas more than quadrupled, increasing from 2 to over 9%. The determinants of these phenomena have been of much interest to economists,

demographers, and historians alike. This study uses country-level historical data on population and urbanization to empirically investigate the extent to which this historical increase is due to the introduction of potatoes from the New World to the Old World, by which we mean the entire Eastern Hemisphere.

Potatoes provide more calories, vitamins, and nutrients per area of land sown than other staple crops. The potato's role in increasing population and promoting economic development has been a subject of much discussion amongst scholars across a variety of disciplines (e.g., Langer 1963; McNeill 1948, 1999; Salaman 1949). For example, historian William Langer (1963, p. 14) argues that within Europe, "the spread of the potato culture everywhere corresponded with the rapid increase of population." Potatoes dramatically improved agricultural productivity and provided more calories and nutrients relative to preexisting Old World staples. In *The Wealth of Nations*, Adam Smith extols the advantages of potatoes over preexisting staples in Europe, writing that "the food produced by a field of potatoes is . . . much superior to what is produced by a field of wheat. . . . No food can afford a more decisive proof of its nourishing quality, or of its being peculiarly suitable to the health of the human constitution" (Smith 1776, pp. 67 - 68).

Similar observations have been made outside of Europe. A particularly interesting example comes from anthropologist Christoph von Fürer-Haimendorf (1964), who argues that the introduction of the potato into Nepal significantly increased food production and agricultural surplus. He writes that "the population of Khumbu was a fraction of its present size until the middle of the nineteenth century and there can be no doubt that the great increase of the last hundred years coincided with the introduction and spread of the potato" (pp. 9 - 10). Another example is from the famous Japanese scholar Takano Chôei, who wrote of the benefits of the potato in his 1836 treatise *Ni butsu kô*. He argued that extensive cultivation of potatoes would cure many social ills of the empire by alleviating food demands from a growing population (Laufer 1938, p. 83).

Despite qualitative accounts of the benefits of the potato to the Old World, empirical evidence quantifying the overall impact of the potato is scarce. This is no doubt partly due to the estimation difficulties caused by the endogeneity of potato adoption. First, there is an issue of reverse causality. The adoption of potatoes might have caused population growth, but alternatively, latent population pressure and the associated demand for food might have caused the adoption of potatoes. A number of historians have argued for the latter relationship (e.g., Salaman 1949; Connell 1962; Cullen 1968). The second problem is joint determination. Both population growth and the adoption of new agricultural technologies can be the outcome of a third unobserved factor.

To the best of our knowledge, the only existing empirical study attempting to estimate the causal effect of potatoes is a study by Joel Mokyr (1981), in which he examines the relationship between potato adoption and population growth across Irish counties in 1845. He addresses endogeneity issues by estimating a system of two equations using 2SLS, instrumenting for potato cultivation with per capita income (intended to capture the demand for potatoes), the capital to labor ratio (intended to capture the supply of manure), the standard deviation of altitude, and the proportion of land classified as "improvable" for tillage but not currently under cultivation (both of which are intended to capture geographic features that increased potato adoption). Mokyr finds that potato cultivation resulted in a statistically

significant increase in population growth. He finds no evidence of the reverse causal relationship—that the potato was adopted in response to rapid population growth.

Nathan Nunn and Nancy Qian exploited regional variation in suitability for cultivating potatoes, together with time variation arising from their introduction to the Old World from the Americas, to estimate the impact of potatoes on Old World population and urbanization. Their results show that the introduction of the potato was responsible for a significant portion of the increase in population and urbanization observed during the eighteenth and nineteenth centuries. According to their most conservative estimates, the introduction of the potato accounts for approximately one-quarter of the growth in Old World population and urbanization between 1700 and 1900. Additional evidence from within-country comparisons of city populations and adult heights also confirms the cross-country findings.

### **The Main International Mainstream Trends: Staple Potato**

FAO has long been listed as one of the fourth staple potatoes to staple food standards to ensure that the potato planting area, scientific research and other support, and in 2008 as the "International Year of the Potato"; many countries in Europe have considered potato as a staple food with the huge proportion of residents including the crop in their daily diet.

Compared with other food crops, potato has the advantages of easy storage, high yield, low planting requirement, wide planting area, high nutritive value and high mach inability. The tuber is suitable for growth temperature 16-18 °C, most of northern and central China are suitable for planting area. In arid / semi-arid areas with annual precipitation below 350 mm, cereal crops have been difficult to grow, while potatoes can still grow normally and can reduce soil erosion. In the annual rainfall of 500 mm in North China, potato per mu can still reach about 1.8 tons. In terms of the nutritional content, planting scale and processing potential potatoes are in line with the requirements of a country's staple food. On January 6, the Chinese Academy of Agricultural Sciences, the National Food and Nutrition Advisory Committee, the Chinese Seed Association held a seminar in Beijing, where the main staple food development strategy on potato was conducted. Topic include national food security (as the theme), in-depth study of the main grain of potatoes, its strategic significance, development of ideas, objectives, tasks and ways to promote the crop, etc. With the relevant policies to promote in the next few years, potato acreage, yield levels, total output and the main grain products in the proportion of total consumption of potatoes will have a rapid increase.

### **Policy Support for Potatoes of China**

In order to respond to international trends, and to better develop China's economic and urbanization level, China began to switch its focus on potato from being a vegetable to an important food crop that will be the focus of its research and development from 2013, including increasing scientific research and innovation, the concept of education and other public consumption. At present, some achievements have been made. More than 10 new varieties of potatoes have been screened and processed in nine provinces in Beijing and Hebei.

At present, one of the bottlenecks of the strategy is to control the cost of whole flour processing, and the other is to stabilize the cultivation of potato varieties with high yield and high starch. As the whole potato powder production and technological maturity is still at a low level, the current cost of potato powder reached 10,000/tons, which is nearly three times the cost of flour. Therefore, the potato industry through its scale, innovation, improved seed cultivation (promote industrial development) will become the development trend. The introduction of relevant agricultural support policies, the strengthening of financial services, planting and processing subsidies will also benefit the development of the industry.

### **Conclusion**

Potato is the main grain of china's agricultural cultivation and the concept of mass consumption of a proposed solution to food security, promotion healthy eating, leading to the transformation and upgrading of agriculture, and drive farmers to increase their forward-looking strategy.

From the perspective of the overall plant structure, potato holds a great significance. Of the three main staple crops, corn has become a feed crop, due to the previous price increases and more efficient planting, the rapid expansion of corn planting area, while other crops and cash crops acreage has been affected. Potato grain, on the one hand, can replace part of the corn planting gap (caused by lower corn prices), and can contribute to China's food security.

Potatoes can be developed into a staple food crop which can be expected to drive its varieties of specialization, management of industrialization. In the context of the regulation of staple food prices in China, it is expected to enter the price protection mechanism to promote the potato price balance, which for the promotion of potato industry has a positive effect, but also conducive to the realization of sustainable agricultural development strategy. At the same time, the main grain of potatoes will also benefit the seed and other growing agricultural companies. Therefore, this is an important measure which is worth promoting to benefit the country and the people.

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