



Analysis of food demand projections under the nutrition goal and recommendations

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Abstract. As the basic material foundation of human development, the supply and demand of food plays an important role in the development of a country. After solving the problem of food and clothing, the pursuit of dietary nutrition of human beings has been increasing. Based on the demand for food under the nutritional objectives, this paper organizes the food demand data of China in the past ten years, and uses the gray prediction model to predict the food ration for the next five years, compares it with the amount of food needed under the nutritional objectives, summarizes the problems in the structure of China's food supply and demand, and puts forward the suggestions about the supply and demand of food on this basis. The study found that: (1) the demand for vegetables and cereals is higher for the whole population under the nutritional objectives, followed by fruits and dairy. (2) The expected consumption of cereals and soybeans by the population will grow gradually, with soybeans growing more slowly than cereals, and cereal consumption will exceed the nutritional standard by about 50%. (3) Residents' consumption of milk is lower than the demand under the nutritional target, and meat intake is higher than the demand under the nutritional target. This study provides a new research perspective on food supply and demand, which in turn provides a basis for scientific decision-making in areas such as food development planning and agricultural policy.

Keywords: Nutritional objectives; Gray forecasting; Food for rations; Food supply and demand structure.

1 Introduction

The China Food and Nutrition Development Report 2022 points out that with the increase in the income level of the population, the nutritional situation has been substantially improved, and the dietary consumption pattern has been changed from mainly plant-based foods to animal and plant-based foods, although there are still some food and nutritional problems that need to be solved urgently. In recent years, the State has introduced a series of plans and policies related to food and nutrition, and is committed to promoting the innovative development of food and nutrition. At the national and provincial levels, steering committees on nutrition and health, food

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safety standards committees and expert committees on food risk assessment have been established, as well as a working group on the "Healthy China" Rational Diet Initiative, and a working mechanism for the committees has been set up.

According to the study of Yi Shanjiao et al. (2017) and Tang Huajun et al.(2012)on the current situation of the domestic food consumption structure, it was found that in recent years, the proportion of food consumption expenditures of urban and rural residents in the total consumption expenditures showed a gradual decline, in which the proportion of food rations consumption declined more significantly^{[1][2]}. At the same time, Luo Qianfeng et al. (2017) and Xiao Yu et al.(2017)found that the indirect food consumption of urban residents, such as meat and poultry, eggs, and milk, is significantly higher than that of rural residents. ^{[3][4]}As for the nutritional intake of Chinese residents, Luo Jianzhong (2008) and Yuan Mengye et al. (2016) found that the proportion of calories, proteins, and other nutrients provided by rations in the food consumption of Chinese residents is decreasing, while the proportion of nutrients provided by meat, eggs, and milk is increasing. ^{[5][6]}Zhong Funing et al. (2012) predicted changes in per capita food consumption in urban and rural areas by combining changes in population structure and occupational structure, and proposed that in order to achieve nutritional balance and balance between supply and demand of food, the planting area of rice and wheat needs to be increased, and correspondingly the planting area of maize and soybeans needs to be reduced accordingly, based on the current structure of food consumption.^[7] In addition, in terms of food supply and demand under nutritional objectives, foreign scholars Basuand Basole (2013) studied the nutritional consumption situation of Indian residents and found that the nutritional intake of residents showed a decreasing trend, but the trend was different from that of China.^[8]

To summarize, in terms of the analysis and forecasting of the current situation of food demand, there have been numerous studies by domestic and foreign academics; in terms of nutritional needs, domestic and foreign research institutions and scholars have established scientific evaluation indicators of nutritional intake. However, the existing researches are more on analyzing the gap between the actual food consumption of residents and the nutritional target, and less on predicting the food demand based on the perspective of nutritional target. This study not only focuses on the total food demand, but also pays more attention to the structure of food supply and demand under the goal of nutritional balance, predicts the food and nutritional supply and demand situation in China in the next five years based on the data of China's food consumption in the past ten years, analyzes the potential risks under the current nutritional supply and demand structure from the perspective of nutritional goals, encourages the development of nutrition-oriented agriculture and provides relevant suggestions for the establishment of a long-term strategy to adjust the structure of food supply and demand with the goal of nutritional health. It encourages the development of nutrition-oriented agriculture and provides relevant recommendations for the establishment of a long-term national strategy to adjust the structure of food supply and demand with the goal of nutritional health.

2 Research methodology and data sources

2.1 Projections of food demand

This study firstly collated various types of food consumption data in the past ten years, and then used the gray prediction model to forecast the total food supply, food import and export, feed grain consumption, industrial grain consumption, and seed grain consumption in 2023-2027, and finally used the total food supply to subtract food import and export, feed grain consumption, industrial grain consumption, and seed grain consumption to derive the forecast value of the food ration consumption. Finally, the total food supply is subtracted from the food import and export, feed use, industrial use and seed use to arrive at the projected rations.

Gray forecasting is a method of forecasting a system containing uncertain factors, the essence of which is to calculate the degree of correlation between the factors, and then determine the degree of similarity or difference in the development trend between the factors of the system. Gray prediction is based on the gray model, which is able to use a smaller portion and incomplete information to construct a model for prediction (Yi Zhou et al., 2023).^[9] The model, as an effective tool for dealing with small sample prediction problems, requires less modeling information and is easier to operate, has high modeling accuracy, is widely used in the field of quantitative prediction, and can solve the problems of insufficient data of some agricultural products and short system cycle that exist in this paper.

2.2 Total food requirements of the population under the nutritional objectives

This study is based on the standardized energy requirements for residents provided in the Dietary Reference Intakes (DRIs) for Chinese Residents (2013 Edition), and based on the recommended intake standards for various foods at different energy levels under the nutritional objectives established in the book, and in combination with the data from the Seventh National Population Census, the requirements for various grains and meat, eggs, and milk for the whole year under the total nutritional needs of the national population being met are measured to arrive at the ideal. The ideal dietary target was then derived.

2.3 Data sources

The data on consumption and production of different types of grains used in this paper come from China Statistical Yearbook, China Food Yearbook, China Wine Yearbook, China Rural Yearbook, Seventh National Population Census, and statistical yearbooks of various provinces (excluding Hong Kong, Macao and Taiwan). Missing data for some years are made up by interpolation and estimation.

Some of the secondary data and calculation methods are referred to from existing literature.

3 Rations consumption forecast

This paper constructs a gray prediction model based on the total supply of various agricultural products, import and export, grain for feed, grain for seed, and grain for industrial use from 2011 to 2021, and derives the following table1 of China's grain for ration from 2023 to 2027 based on the prediction formula of grain for ration consumption mentioned in the previous research method:

Table 1. Projected rations consumption (tons/year)

variable name	2023	2024	2025	2026	2027
cereals	42453.53	44132.35	45840.26	47577.97	49346.21
soybeans	3060.27	3364.88	3691.53	4041.63	4416.70
fruits	79327.03	81277.90	83276.73	85324.72	87423.07
fruit	30654.70	31434.01	32232.72	33051.33	33890.34
meats	9377.62	9474.47	9576.61	9684.26	9797.62
dairy	3669.41	3655.94	3643.09	3630.88	3619.31
egg	3592.75	3673.92	3756.94	3841.84	3928.65
aquatic product	6837.84	6905.95	6974.66	7043.97	7113.89
oilseeds	4459.98	4484.49	4509.11	4533.85	4558.70
edible salt	1175.37	1184.95	1194.52	1204.09	1213.66

Source: China Statistical Yearbook, China Food Yearbook, China Wine Industry Yearbook, China Rural Yearbook.

With the increase of per capita income of China's residents, as well as the change of food prices with the change of supply and demand, China's ration consumption also changes (Zhang Zhixin, 2022).^[10] By organizing and forecasting the ration data from 2011-2021, it can be seen that China's ration usage gradually increases from 2023-2027, with an average annual growth rate of about 2.7%. From the trend of time change, the change of different types of ration usage shows different growth rates, among which vegetables have the highest annual growth rate, while cereals and salt do not change much.

With the passage of time, China's growing population and increasing per capita consumption demand, China's ration usage will continue to rise, but it is not the case that higher ration usage means a healthier state of food supply; China needs to further guide its agricultural production and supply in accordance with the prescribed healthy nutrient intake indicators, so as to allow the Chinese population to have a nutritious and balanced state of food intake.

4 Findings

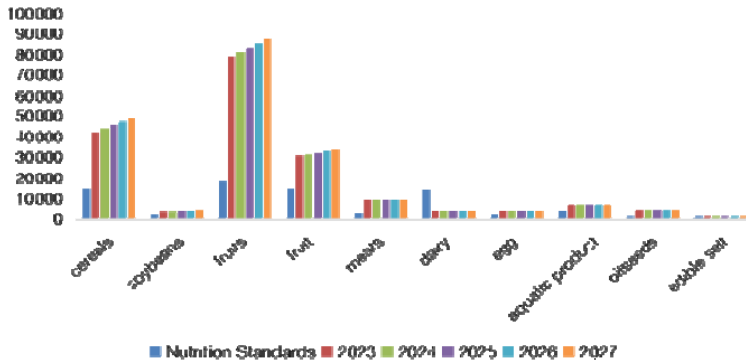


Fig. 1. Comparative analysis of food consumption of the population

Source: China Statistical Yearbook, China Food Yearbook, China Wine Industry Yearbook, China Rural Yearbook.

According to the forecast and structural analysis of China's food consumption in 2023-2027, comparing the food consumption structure under the balanced nutrition objective, it is clear that if no intervention measures are taken for food nutrition and food supply (like the figure1 showed), then the future consumption structure of China's population will deviate from the ideal food consumption structure under the balanced nutrition objective: (1) Cereals and soybeans. Resident cereal soybean consumption will grow gradually, soybean growth is slower than cereal, cereal will exceed the nutritional standard of 50% left after soybean almost remain equal. (2) Vegetables. Vegetables deviate from the nutritional standards, the possible reason is that with the improvement of living standards, people eat vegetables more and more in pursuit of nutritional, but also pay attention to the quality of vegetables and science and technology continues to progress also makes the market to appear a variety of new products to attract the residents of the eyeballs of vegetables. (3) Meat. Meat intake of the population is higher than the nutritional balance value, probably due to the fact that more and more people are having their staple food replaced by meat, and the increasing number of obese people also inversely indicates that the current meat intake of the population is too large (4) Milk. Residents' milk consumption is lower than the nutritional level, probably because China's production of dairy products is small, while dairy products are relatively expensive and not essential, the lower income group may choose not to consume. (5) Aquatic products. The consumption of aquatic products is higher than the intake when nutrition is balanced, probably because people's incomes are increasing, the level of aquatic product processing is improving, and residents are gradually increasing their consumption of aquatic products and processed aquatic products.

Overall, the structure of China's food consumption over the next five years does not meet nutritional standards, and the inefficiency of food consumption has not im-

proved, which will seriously constrain and affect national health. Therefore, taking food consumption under the goal of balanced nutrition as the standard, allowing nutrition to guide production and production to guide supply, and optimizing the current food supply is an important task in the implementation of the "Healthy China 2030" Plan.

5 Recommendations and conclusions

After identifying the problems in China's food consumption, it is important to choose a reasonable path of optimization and regulation. Since the adjustment of food demand includes both regulation directly targeting the consumption of food rations, as well as regulation of food for feed, seed and industry, optimization and regulation should not only target the food market, but also the raw food market. At the same time, food consumption not only depends on the purchasing power and preference of consumers, but is also closely related to the supply side of agricultural products to a large extent. Therefore, the path of China's food structure optimization should not only take into account the adjustment of the demand for food and food-based products, but also pay attention to the regulation of supply. The optimization path arrangement idea of "combining supply and demand, two-layer regulation" is proposed, and the overall policy framework design for food supply and demand is based on this principle.

5.1 Demand control

With the rapid development of the economy, people's living standards continue to improve, the structure of food consumption continues to change, people's demand for meat, eggs, milk continues to increase, and even excessive consumption of meat products and other dietary unscientific, irrational nutritional mixing, which leads to the prevalence of chronic diseases in our country, the rate of obesity continues to rise, appearing to the residents of the decline in physical fitness trend. A variety of ways should be taken to strengthen the promotion of healthy living, such as the use of the mass media, grass-roots organizations and other means to vigorously popularize nutritional knowledge and healthy living habits, and the formation of scientific food consumption concepts and lifestyles in order to reduce the demand for food rations.

5.2 Demand control

From the conclusions of the study, it can be seen that there is a nutritional surplus and an imbalance in food consumption and an irrational dietary structure in China's food consumption expectations. Some foodstuffs exist above the level of food consumption under the nutritional objectives, such as meat and oil, which can be guided by using the price mechanism. Because of the special characteristics of necessities and agricultural products, it is not easy to use direct price restrictions, which would harm the interests of farmers or consumers, but to use price incentives such as subsidies to

guide the formation of a reasonable consumption and production layout. The introduction of differentiated subsidies, with dairy products being given more subsidies than meat products in the production sector, especially more than pork, gives the supply side an incentive to spontaneously produce dairy products with higher nutritional value and to consume meat products that cause nutritional overload.

6 Conclusions

This paper uses the ration data for the next five years to compare with the amount of rations under the nutritional standard, finds out the problems of China's current food consumption, and gives suggestions about the structure of supply and demand under the premise of considering the whole situation, in order to be of some help to the future research in this field. However, due to the small prediction interval of the data in this paper, there may be some errors between the data and the reality, and it is hoped that in the future, more accurate data processing means can be used to eliminate the interference and compare the existing data with the real data before giving more accurate suggestions.

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