Forecasting on China’s Water Demand by Industry in 2021

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Abstract. Forecasting of demand for water in advance is critical for water supply planning. The paper made water consumption analysis by industry in China. With multiple regression analysis, time series analysis and expert experience methods, the water demand by industry in China in 2021 was forecasted. The results show that the total demand of water in China in 2020 will be about 598.06 billion cubic meters, slightly less than that in 2020. Among them, the agricultural water demand would account for about 61.1%, the industrial water demand account for about 19.6%. For the domestic and the environmental water demand, the proportion would be 15.1% and 4.2% respectively.

1. Introduction

As the foundation of life, water is an indispensable basic resource for national economic development, crucial for more inclusive and sustainable development. China severely lacks water resources. Water shortage, the main water problem, had become the most significant factor restricting the economic and social development of China, and would make the economic growth rate decreased by 1%-2% in China, even higher than the impact of the increase of energy prices and a decline in foreign investment. The analysis of water consumption by industry and forecasting of the water demand will provide a scientific reference for water supply planning, which is of great significance to the macro-control of the contradiction between supply and demand of water resources and the realization of the coordinated development of economic and social elements and water resources. There have several researches on water demand forecasting with a fuzzy model [1], a CCNN model [2], a SVM model [3], a genetic algorithm model [4], a GRA-BP neural network model [5], a machine learning model [6] etc. However, these models generally need more data to have high prediction accuracy, and lacking conducive analysis for how the factors affecting the water demand. Some research applied multivariate prediction model [7, 8], and there are also some models taking the inherent law of water consumption and time trend into account [9, 10, 11, 12]. Considering available data and the feasibility of application of the forecasting methods, multiple regression analysis, time series analysis and expert experience methods were applied in this paper to forecast water demand by industry in China in 2021.

2. Water consumption analysis

In 2019, the total water consumption in China was 602.12 billion cubic meters, 0.57 billion cubic meters more than that in 2018. Compared with 2018, agricultural and industrial water consumption...
decreased by 1.08 and 4.40 billion cubic meters respectively, while domestic water consumption increased by 1.18 billion cubic meters and ecological environment water supplement increased 4.87 billion cubic meters. In 2019, per capita water consumption in China dropped to 431 cubic meters from the peak value of 456 cubic meters in 2013, with 11 provinces (or municipalities) including Tianjin, Beijing, Shanxi, and Shandong having a per capita water consumption of less than 300 cubic meters.

Figure 1. China’s water consumption by industry

2.1. China’s agricultural water consumption

From 2000 to 2019, China's agricultural water consumption increased in the first few years and then decreased, reaching a peak of 392.15 billion cubic meters in 2013, then it reduced year by year to 368.23 billion cubic meters in 2019, which accounted for 61.2% of the total water consumption compared with 68.8% in 2000, indicating that the agricultural water consumption efficiency of China had significantly improved. In 2019, the average water consumption per mu of farmland irrigation was 368 cubic meters, declining from 479 cubic meters in 2000, and the effective utilization coefficient of farmland irrigation water in China was 0.559, 0.005 more than that in 2018, and 0.14-0.25 lower than that of Israel, the United States and European countries. According to the planning target, the national high-efficiency water-saving irrigation area will reach about 369 million mu by 2020, accounting for more than 32% of the irrigation area. The national water-saving irrigation project area will reach about 700 million mu in 2020. These actions will further promote the improvement of agricultural water use efficiency in China.

2.2. China’s industrial water consumption

From 2011 to 2019, the share of industrial water consumption in China's total water consumption has shown a slight decrease year by year, accounting for 20.8% in 2019, a 0.8 percentage point lower than that in 2018. High-water-consumption industries, including thermal power (including dc cooling
power generation), steel, textile, papermaking, petrochemical and chemical industries, food and fermentation, and so on, accounted for about half of total industrial water consumption. In 2019, water consumption per 10,000 yuan of industrial added value in China was 38.4 cubic meters, lower 2.9 cubic meters than that in 2018.

From 2011 to 2019, China's water consumption in the iron and steel industry decreased in the first few years and then increased, reached 2.74 billion cubic meters in 2019. The new water consumption per ton of steel had declined from 4.07 cubic meters to 2.87 cubic meters, decreasing by about 29.6%. The water reuse rate increased from 97.4% to 98.0%, rising by 0.6 percentage points. China's new water consumption in the paper industry had declined from 4.559 billion cubic meters in 2011 to 2.898 billion cubic meters in 2015. Water consumption per 10,000 RMB of output value had dropped from 67.4 cubic meters to 40.6 cubic meters, decreased by 39.76%. Affected by prevention and control measures of the COVID-19 epidemic, some industrial enterprises' production and operation were significantly affected in 2020. Industrial water consumption will be reduced in 2020.

![Figure 3. water consumption per 10,000 yuan of industrial added value in China](image)

2.3. China’s life water consumption

![Figure 4. China’s Per capita water consumption in urban and rural households (Unit: liter)](image)

China's total population had increased from 1236.26 million to 1400.05 million from 2000 to 2019, the urban population increased from 394.49 million to 848.43 million, and the urbanization rate rose from 31.9% to 60.6%. In 2019, per capita water consumption in urban and rural households was 225 and 89 liters per day respectively. Affected by the COVID-19 epidemic, residents spend more time at home in 2020 than in previous years. Water consumption for immunization and sanitation was increased due to the need for epidemic prevention and control. At the same time, with the growth of population in China, the accelerating urbanization process, and the improvement of residents' quality of life, it is expected that the domestic water will continue to increase in 2021.
2.4. China’s ecological environment water consumption

From 2004 to 2008, the total ecological environment water supplement in China gradually increased from 8.2 billion cubic meters to 12.0 billion cubic meters, and then fluctuated between 10.0-12.0 billion cubic meters. After 2015, the amount of ecological environment water supplement increased year by year and reached 24.96 billion cubic meters in 2019, accounting for 4.1% of the total water consumption. During the 14th Five-Year plan period, more attention will be paid to the protection and restoration of water ecology and the harmony between humans and water. It is expected that the ecological environment water supplement will be further increased.

3. China’s water demand forecasting

Considering China’s economic growth, the adjustment of industrial structure, urbanization process and the fluctuation of water efficiency in different industries, China’s total water demand and four components of it was forecasted with regression analysis, time series analysis and expert experience methods.

It is predicted that in 2021, the total water demand in China will be about 598.06 billion cubic meters, slightly less than that in 2020. As for the four kinds of water demand, the agricultural water demand will be about 365.45 billion cubic meters in 2021, accounting for 61.1% of the total water demand. The industrial water demand will be about 116.97 billion cubic meters, accounting for about 19.6 percent of the total. The domestic water demand will be about 90.20 billion cubic meters, with a proportion of 15.1% of the total. And the ecological environment water supplement will be about 25.44 billion cubic meters, with a proportion of 4.2% of the total.

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