Agricultural Food System Transformation on China’s Food Security

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With the development of economy, the definition of food security has undergone a series of changes. The connotation of food security has undergone changes from macro total amount to micro individual, from production to livelihood, and from objective index to subjective perception. Food security is associated with poverty, and food diversity, cultural acceptance, malnutrition and child mortality, environmental and climate impacts, agricultural land use structure, energy and water resource constraints, and other influencing factors have been gradually taken into consideration as influences.

Keywords: food security ; agri-food system transformation ; coupling degree

1. Introduction

Since 1990, the international grain output has grown at a rapid rate of 2.6 percent. In 2021, the global grain output was about 2.8 billion tons, and the disposable per capita grain was about 305 kg. At the same time, however, 193 million people in 53 countries experienced a food crisis, an increase of about 26% over 2020 [1]. On the one hand, this is influenced by exogenous factors as COVID-19, extreme climate disasters, and other factors in agricultural production [2]. On the other hand, this is also due to endogenous economic structural problems, such as growing grain consumption for biomass energy and increasing grain consumption for meat production. It is estimated that, in 2021, the global biofuel production will reach 151.3 billion litters (119.4 million tons) [3], which consuming approximately 198 million tons of grain [4]. Meanwhile, the global demand for feed grain is about 10.05 billion tons [4]. It is suggested that energy and meat production consume more than 40 percent of the world’s total grain production.

Global meat consumption has been on the rise for the past 50 years. Specifically, global meat consumption increased from 287 million to 324 million tons in the decade 2010–2019, an increase of about 12.8 percent [5]. In terms of total consumption in 2019, East Asia, the Americas, and Europe have the highest level of meat consumption, reaching 100 million tons, 90 million tons, and 55 million tons, respectively [6]. These three regions account for the vast majority of global meat consumption. In terms of per capita consumption, the per capita meat consumption of the United States, Australia, and Argentina all exceeded 100 kg [6], ranking as the top three countries in the world in 2019. In addition, total and per capita meat consumption in Africa and South Asia is lower than the world’s average, and the local agri-food system lacks resilience. It is difficult to effectively guarantee the nutrition and health of the people in Africa and South Asia, and some people have been on the brink of hunger for a long time.

2. Agricultural Food System Transformation on China’s Food Security

The research on food security has a long history and is still receiving high attention at the international scope. With the development of economy, the definition of food security has undergone a series of changes. The connotation of food security has undergone changes from macro total amount to micro individual, from production to livelihood, and from objective index to subjective perception [7]. Food security is associated with poverty, and food diversity [8], cultural acceptance [9], malnutrition and child mortality [10], environmental and climate impacts [11][12], agricultural land use structure [13], energy and water resource constraints [14][15], and other influencing factors have been gradually taken into consideration as influences. Food security has developed into a comprehensive concept including food supply, food production, fairness in food distribution, natural environment, nutrition and health, and economic and social development status.

Recently, the impact of the agri-food system transformation on food security has drawn widespread attention. The agri-food system is a generalized food system, that includes the R&D, production, circulation, consumption, nutrition, resources, environment, and other links of agricultural value chain. It also includes the economic, social and ecological results generated by the operation of the system as well as the policy, legal system and social and cultural environment

that maintain the its operation [1][2]. The adjustment of residents' food consumption structure is the driving force of the agri-food system transformation, and the increase of meat consumption is one of the most important trends of the transformation in the past 20 years. Both developed countries and areas, such as the United States, the European Union, and Australia, and emerging economies, such as China, Brazil, and India, experienced significant growth in meat consumption demand after 2000 [4]. Feed grain, as a raw material for meat production, is also an important part of the agri-food system. As mentioned above, the growth of feed grain consumption has increased the demand for grain ration, which has seriously endangered global food security. Therefore, special attention needs to be paid to the impact of the transformation of the agri-food system, marked by the growth in demand for meat, on food security. Moreover, food fraud is gradually becoming an important issue in food security. In the dairy industry, despite the continuous progress of detection technology, fraud techniques have become more refined in some cases. In the foreseeable future, food fraud remains a significant threat to resident nutrition and health [16][17].

The core issue of food security research varies for different countries. For developing countries, urban agriculture development and urban poverty reduction [18], biotechnology development [19], and the revenue driving effect of horticultural exports [20] can improve the food security situation. Conversely, the decline in R&D and infrastructure investment [21] has a negative impact on the food security situation in developing countries. Compared with developing countries, developed countries have more adequate food supply. Even if developed countries suffer from lower food self-sufficiency, they can also meet their needs through the international market. However, the fluctuation of international food prices should not be underestimated. High food prices will also put pressure on developed countries with high food dependence on foreign countries. Recently, the food self-sufficiency rate of the UK has been declining, and the food imports have been increasing. However, the impact of the decline of its own self-sufficiency on British food security is not as serious as the political and economic situation as the main source countries of food imports of the UK is stable [22][23].

China has long since had a tight balance between grain supply and demand. Ensuring a high self-sufficiency rate for grain has always been at the core of China's grain production, and it also plays a pivotal role in world food security. The growth of feed grain production cannot meet the rapid growth of meat production in China, which eventually results in the import of large quantities of feed raw materials [24]. The growth of meat consumption has put great pressure on China's grain self-sufficiency. Adequate attention should also be paid to the impact of the transformation of China's agri-food system on food security.

With the increase of meat consumption, the grain demand structure of China ushered in a significant adjustment. From 2000 to 2021, China's grain demand increased from 430 million tons to 820 million tons, an increase of 94 percent. In terms of grain demand structure, the proportion of grain ration consumption decreased gradually, and the proportion of feed grain consumption increased rapidly. The proportion of residents' grain ration demand decreased from 44% in 2000 to 35% in 2021, while the proportion of feed grain demand increased from 20% to 33% in the same period. The consumption of grain ration gradually decreased and was replaced by the consumption of feed grain. From the perspective of subdivided varieties, the phenomenon of demand structural differentiation is still obvious, and different varieties have their own emphasis. Corn crop has been mainly used for feed consumption, and grain ration consumption accounts for only a small proportion. Wheat and rice are mainly consumed by residents, but the proportion of residents' grain ration consumption has gradually decreased, and feeding consumption has continuously increased. From 2000 to 2021, the proportion of rice feeding consumption increased from 4% to 10%, and the proportion of wheat feeding consumption increased from 4% to 21%. The adjustment of household food consumption structure directly reflects the change of grain demand structure.

Figure 1 illustrates the logical relationship between the transformation of the agri-food system and food security in the context of the adjustment of Chinese residents' food structure. Regarding the international situation, the outbreak of COVID-19, frequent extreme weather events, and other factors have combined to increase the international food prices, causing the China's agri-food system to face more risk and uncertainty.

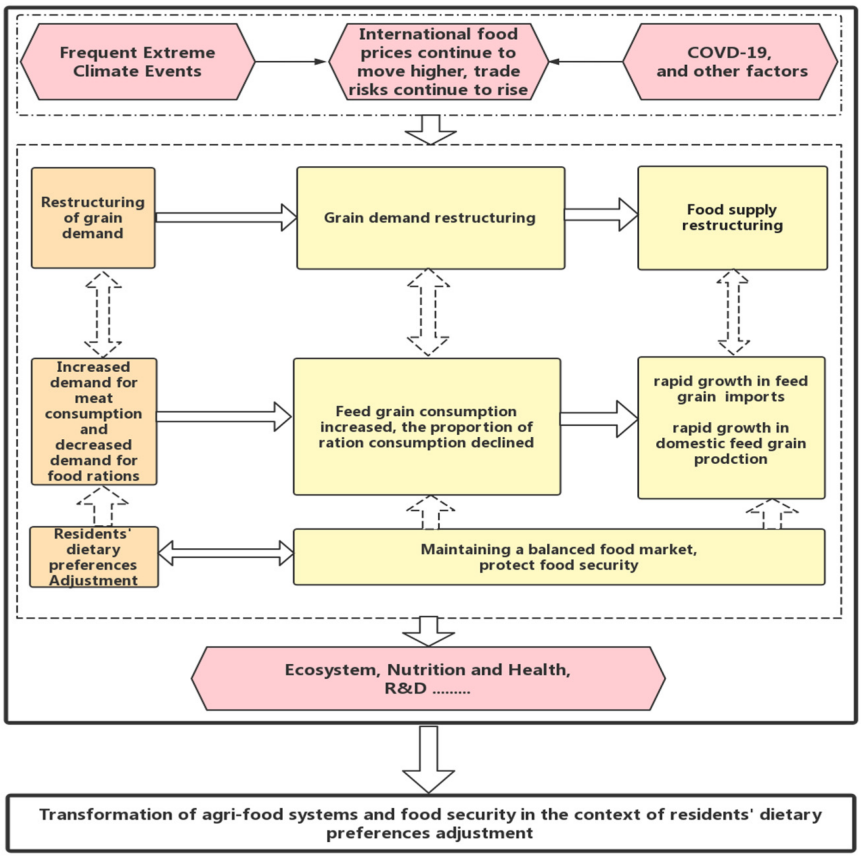

Figure 1. The logical between the transformation of agri-food system and food security.

Within China, as mentioned above, the increase of household income leads to the adjustment of the food consumption structure, with a decrease in grain ration consumption and an increase in meat consumption. As one of the main food raw materials, the adjustment of food consumption structure is bound to be transmitted to the food market through the adjustment of input factors, which is reflected in the gradual decline in the proportion of grain ration consumption and the increase in feed grain consumption year by year. From the perspective of grain supply, the adjustment in grain production structure lags behind the adjustment of demand structure. Although the feed grain output increases significantly, it lags behind the growth of demand, and the import of feed grain obviously increases. Specifically, from 2000 to 2021, the domestic corn output increased from 110 million tons to 272.5 million tons, while the international trade changed from a net export to net import of 28.35 million tons. In the same period, the soybean output only increased from 15.41 million tons to 16.4 million tons, while the import volume increased from 10.42 million tons to 96.52 million tons. Feed grain import has become a key issue to ensure a higher self-sufficiency rate of grain in China.

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