

Optimization of the Food System based on Equity and Efficiency

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Abstract

The food system that based on equity and efficiency is built. Efforts are made in two aspects to improve the proposed model. One is to complete each target of the food systems, which are the supply and the demand of food, the price stability, the balance among the interests, the quality, the safety, and the low carbon development. The other is to minimize the cost of the system operation.

Keywords

Food System; Equity; Efficiency; Linear Regression.

1. Introduction

1.1. Background

The United Nations Food and Agriculture Organization (FAO) in 2001 defined food security as follows: "Food security exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet the dietary need and food preferences for an active and healthy life." By this definition more than one billion people lack food security, including many in poverty areas of high-income countries. As population growth continues, urbanization increases, and energy costs rise food systems will have to evolve to assure sustainability and to provide food security[1].

1.2. Previous Research

The underlying problems of the global food system have long been evident. Although the world's total food production has slightly exceeded total demand, large numbers of people are still underfed or even starving to death. According to the latest "State of Food Security and Nutrition in the World" report, 820 million people were already hungry every day in 2018, and one third of the population lacked essential nutrients. Under the circumstances, both life and death carry huge economic costs, including lost income and soaring public debt. According to a sustainability research article published online on October 10, 2018 in Nature, scientists have built a model of a global food system. Studies show that if no action is taken to face changes in population and income levels, the impact of the food system on the environment could rise by 50-90% between 2010 and 2050. The researchers analyzed several mitigation approaches to environmental impacts and concluded that a combined approach would have to be taken to have an effect. As a result, the environmental pressures may be relieved by 2050 [2].

2. Assumptions

Before analyzing the presented models, some reasonable assumptions are made as follows:

- All the food in the world today is enough to feed all the people in the world today.
- Developed countries have enough food to ensure that domestic food can feed all people and export surplus food to developing countries that lack food.

● A country's food supply has two main sources: food production and imports of food.

3. The Model: The Food System

3.1. The Food System based on Equity and Efficiency

Based on the precious research, we establish a model that includes demand, supply and quality safety of food. Equity and efficiency have always been a subject of debate. The system of government arrangement is the only way to reach it. It is a form to remedy market failure includes equity and efficiency objectives. Among them, the efficiency goals includes supply and demand balance, and the equity objectives, includes price stability, balance of interests, quality safety and low carbon development.

The system of government arrangement and control of food is the adjustment of food production and circulation. It is different from unified purchase and marketing in the past, also different from food planning and management, but a form of expression to make up for the market defects. In this way, the government can promote food production and control food circulation to achieve the basic balance of food supply and demand, to maintain food basic price stability, to guarantee national food security, to promote food production and to achieve the quality safety and low carbon development[3].

The goal of the system can be divided into two angles such as longitudinal and horizontal studies. We can see Figure 1 for details.

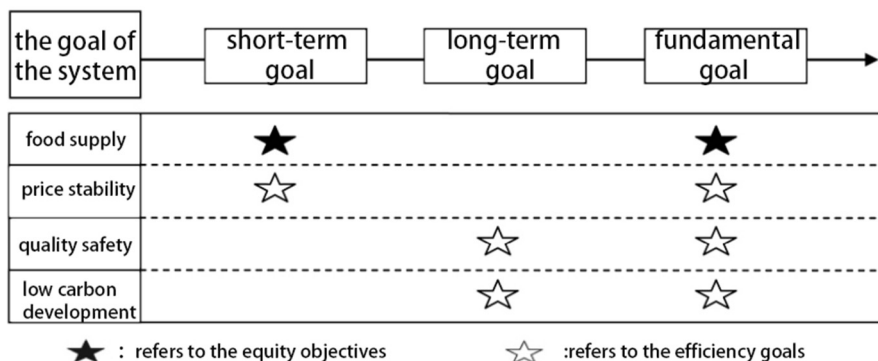


Figure 1. The target of the food- control system

According to longitudinal study, goals include short-term goal, long-term goal and fundamental goal. The short-term goal is to ensure an adequate supply of food in the market and avoid sharp changes of food prices. The long-term goal is to protect arable land, to increase the overall capacity of food production and ensure national food security. The fundamental goal is to maintain the basic balance of food supply and demand, to stabilize food prices, to promote economic growth and increase farmers' incomes.

From the perspective of the horizontal dimension, the goal includes four aspects. They are food supply, price stability, quality safety and low carbon development. To guarantee food supply is to guarantee the basic balance of food supply and demand. Stabilizing prices is to control and keep grain prices within a reasonable range through policy adjustment. Quality and safety are so important that we need to seek the quality of food to reach the international standard above, mainly aimed at the problems of food safety. To reduce carbon dioxide emissions is a higher demand for food production and sales. It is to minimize energy consumption and carbon emissions in the entire chain of food production and sales so as to achieve the purpose of low carbon and environmental protection.

Based on this we designed a food system including four fields of main form of economic, regulatory methods, operating environment and operating mechanism, as indicated in Figure 2.

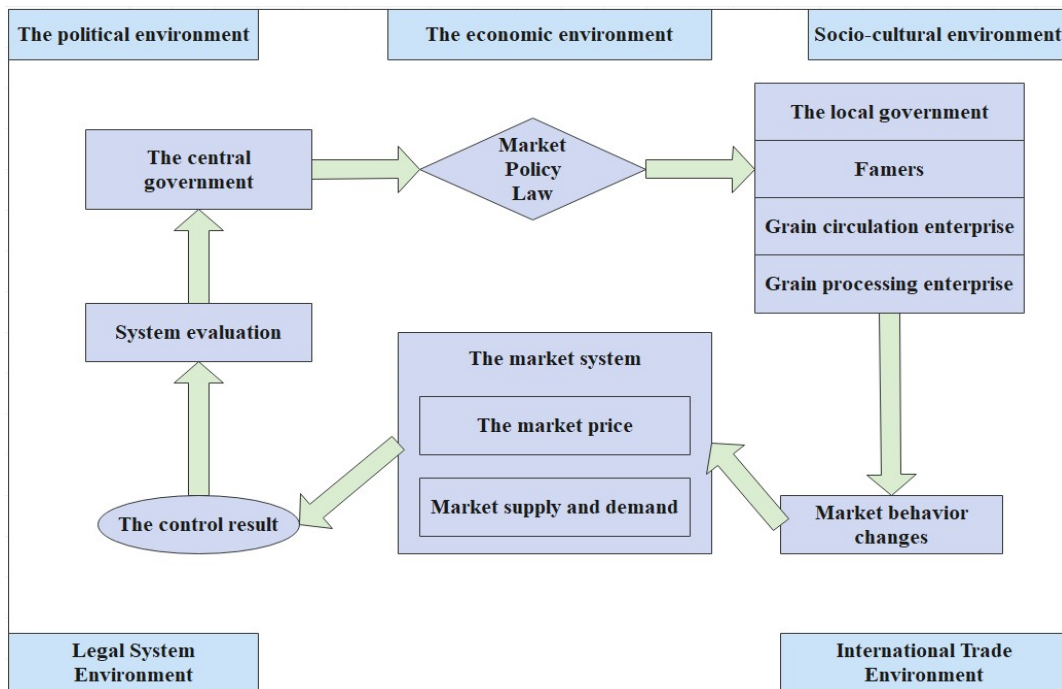


Figure 2. Schematic diagram of food control system architecture

The economic main body of the food system includes two parts:

First, the main body of regulation is the central government, provincial governments and cities. Second, the object of regulation is the food market, including food production, producers (farmers), food processors (processing enterprises), food delivery operators (circulation enterprises) and consumers of food (citizens).

Environment refers to the general term including physical, economic, informational and interpersonal facts out of the system.

There is a close interdependent relationship between the systems and environment, therefore, the operation of the food system will inevitably be affected by a lot of politics and economics.

The environmental analysis of the food system learns from The PEST analysis method and has been improved into the PES-Li method, that is, the environmental factors are divided into Politics, Economy, Society, Legal and System and International Trade in five aspects [4].

3.2. The Operation of the Food System

To achieve optimal system, two things need to be done:

One is to complete each target of the food system, which are supply and demand, price stability, quality and safety and low-carbon development.

The other is to minimize the cost of system operation (this cost is not easy to measure, but is expressed as supply-demand balance cost, price stability cost, quality and safety cost and low-carbon development cost for convenience of expression).

The food system is a system. In order to maximize the utility of a system, it should reach the following equation:

$$\min C = C_1 + C_2 + C_3 + C_4$$

$$s. t. \begin{cases} \text{supply and demand balance} \\ \text{price stability} \\ \text{quality security} \\ \text{low carbon development} \end{cases}$$

Where C , C_1 , C_2 , C_3 and C_4 represent the total regulation cost, supply and demand balance cost, price stability cost, quality and security cost and low-carbon development cost respectively.

In the formula, the goals of the four aspects are as follows:

Balance of supply and demand: it includes not only the overall balance of supply and demand of food, but also the balance of various regions and the complementary balance of various food products.

Price stability: there are two criteria for a reasonable price. One is that farmers should not be undercut by food prices, so that farmers' income from prices is in balance with social wages. The other is to keep prices below an equilibrium price without hurting the people. Taking together, according to these two prices, we can get a "reasonable price belt" that meets the income expectations of farmers and the spending capacity of urban residents.

Quality safety: the safety of food quality mainly considers the gap between national standards and international standards.

Low carbon development: Emphasis on less input of chemical fertilizers and pesticides in food production. [5]

Finally, we gave an analytical framework of the system based on the principle of minimizing the cost.

4. Conclusion

The strategy is came up on what would be the most efficient way to optimize the food system for equity and sustainability. From ecological perspective, this paper constructs a theoretical model of sustainable food security to solve some problems. The model suggests ways to make the current food system fairer and more responsive to the people in hungry.

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