

## Research Article

### The Evaluation Index System Establishment of the Food Security in Developing Country

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**Abstract:** In this study, we have a research of the evaluation index system establishment of the food security in developing country. The developing country should consider the food production, consumption and storage, food trade and self-support rate, average food amount and the food of the poor, the quantity security of food and the quality security of food, the cost and benefit of food security, the relation between stationary security and dynamic stationary of the food, and establish the food security evaluation index system based on the above. The index should include the gross index of food, the individual index of food security, the fluctuating index of food security, the food's quality index and the index related to the self-support.

**Keywords:** Evaluation index, food security, quality index quantity index

#### INTRODUCTION

The definition of food has the special and general meanings: the special meaning refers to cereals, including rice, corn, barley, wheat, sorghum; the general meaning refers to the sum of all the agricultural production of food crops. In addition to cereals, beans, potatoes, sometimes food includes rapeseed and food also was called as "grain" in ancient China-apparently the special meaning. According to recent data released by the National Bureau of Statistics, the top three planting area and production of food crops are rice, wheat and corn. Therefore, the customary food can be understood as cereals, the internationally accepted "GRAIN" (Hu, 2004).

In recent years, the large food concept is more popular. The so-called "large food" is a kind of food that can be eaten and transmitted into the required nutrition material for human body (Chen, 2001). This concept is consistent with that of the international general food and reflects that the concept is changing and developing, at the same time it also provides new ideas to better solve the food problem in developing countries (Gong, 2001).

Food security has always been paid more attention by governments around the world and we usually understand it as a basic balance between food supply and demand. "Rome Declaration" was adopted at the World Food Summit in 1995 and it made theoretical criterion of food security around the world and further clarified the meaning of food security (Xu, 2001). The declaration pointed out that the food is the only source for human survival and everyone enjoys the basic right to free from hunger (Xiao, 1996). We will realize food security until everyone can obtain sufficient, safe and nutritious food physically and economically to meet

their active and healthy dietary needs and food preferences at any time. Therefore, food security should include the following connotations: first, quantity security. That is through the number of active and stable growth of grain production, to meet the solving problem of human hunger (Peng, 1998). Second, nontoxic. That is through the development and application of advanced biotechnology to minimize the residues of toxic and hazardous substances in soil and food products and reduce, eliminate harm to human health and effectively maintain the sustainable developing environmental conditions of food production. Third, high-nutritional value (Ma, 1998). That is relying on the development and application of genetic engineering technology and advanced processing technology to improve the content of mineral elements and vitamins and other substances in food products to meet the basic needs of human health (Ding, 1999).

Food security is a complicated and comprehensive concept and it is closely related to a country's economic degree. Every country has its own opinion towards food security, in general, developed countries focus on the overall balance, macro regulation and control in order to achieve its food security strategy; developing countries often tend to emphasize the development of food production, appropriate restrictions on consumption and seek a basic balance of total grain output (Wu, 2001). Therefore, we should take full account of the impact of food quality on the level of comprehensive security before we evaluate and assess food security. As far as the developing countries' food security is concerned, the meanings of the latter two aspects-improve food quality, has more urgent and practical significance (Wu, 2002; Xiao, 2005).

China is a developing country and the Chinese government adhered to the “food is basic” in a very long period of time and committed to the improvement of food gross production, to solve the people “food problem”. And even some times, government officials at all levels focused on food production. Through decades of efforts, China's food problem had a fundamental change and this problem has been solved successfully. The White Study on “China's food problem” proposed by the State Council Information Office pointed out: To 1995, China's grain total output ranked first in the world and three times more than that of 1949, 380 kg per capita and reached the world average level and the food self-sufficiency rate was over 95%. China not only threatens world food security, but also makes greater contributions to the world's food development.

With China's economic development, the connotation of the concept of food security is constantly changing. In the past, the reference to food security only refers to keep food in our country, without declining in food quality and quantity and it was just a part in food circulation. Since the reform and opening up, our national economy has grown rapidly and food supply and demand contradiction have been basically solved and even appeared a new problem, such as “excess”. In this context, the CPC Central Committee and State Council put forward the concept of food security and proposed to establish a food security system in line with the requirements of the socialist market economy. “Food security” reversed the blind pursuit of the concept of production and further emphasized the concept of food security in terms of structure, quality, which starts from the overall situation of national economic security and it accord with the current fact and be more scientific.

In this study, we have a research of the evaluation index system establishment of the food security in developing country. The developing country should consider the food production, consumption and storage, food trade and self-support rate, average food amount and the food of the poor, the quantity security of food and the quality security of food, the cost and benefit of food security, the relation between stationary security and dynamic stationary of the food, and establish the food security evaluation index system based on the above. The index should include the gross index of food, the individual index of food security, the fluctuating index of food security, the food's quality index and the index related to the self-support.

#### **FOOD SECURITY PROBLEM PAID ATTENTION BY DEVELOPING COUNTRIES**

**Food production, fluctuation and storage:** The issue of food security in developing countries not only considers the relationship of food production and storage, but also takes into account the risk of

fluctuation of grain output caused due to natural disasters. On one hand, due to the special nature of food production, natural disasters cannot be avoided and every year they produce some of the affected area. Every few years, there will be a major disaster, resulting in food production, or a large area of cut-off, so that food production to a greater fluctuation. On the other hand, food is a kind of product which is produced according to the seasons with year-round consumption period and regional product consumed around the world. Thus creating a grain circulation space and time intervals and the asymmetry between production and consumption. Due to the existence of this asymmetry, adequate food storage is very necessary.

For developing countries with meeting the people the basic survival needs as the primary goal of food security, quantity security is the top priority of food security, therefore, sufficient food storage is particularly important. Through appropriate food storage, we can ensure the safe supply of food. Food storage has a certain cost, so it must ensure that a reasonable number of storage, both to ensure security of supply and to ensure food security in the minimum cost.

**Food trade and self-supply rate:** When we consider the relationship between food trade and self-sufficiency rate and we also take into account fluctuations in the international market prices, as well as the embargo the risks. Without considering the political conditions, developing countries can rely on the international market to ensure national food security and fully benefit from the process of trade liberalization. But the international grain market price fluctuations, the embargo often happens. Food is essential for human survival supplies and indispensable. If developing countries are totally dependent on international food markets to ensure national food security and may will the risk of food security evolved into a country's political risk. Once the international grain market price fluctuates, it will rapidly spread to their necessities' prices, the price index will change the lives of ordinary people will be greatly affected. If the embargo happens, it will be a serious threat to national security. The developing countries may lose speak and initiative rights in bilateral or multilateral relations, even can lose the independence of sovereignty and be limited by food exporting countries. Therefore, developing countries' dependence on foreign trade and food self-supply rate should have a reasonable proportion.

**Average food amount and food security of the poor:** In developing countries, due to the unbalanced nature of the distribution of wealth, so there is always a certain number of poor people. Food security issue of the poor is unique in developing countries. Food security issue

of the poor includes the food quantity security and food quality security. Food quantity security refers that the poor can get the amount of food they need; food quality security refers that the poor can get enough nutrition and energy every day.

On one hand, the low income of the poor leading to their food needs cannot be guaranteed, although the community has a sufficient food supply (total security), even though per capita food supply is safe, but the food is not safe for a part of the crowd according to this condition. On the other hand, the raising level of residents' incomes and purchasing power leads to the change of the structure of food consumption and the impact of this change on food security is usually manifested in two aspects. One is that the increasing of animal food and other indirect food consumption increase the pressure on food supply. The other one is that due to resource constraints or market hysteresis, changes in the structure of food production can't keep up with changes in consumption structure, resulting in the structural contradictions in the grain supply and demand. Therefore, developing countries not only consider and make the development of national food security policy and take full account of the total food security and average amount security, but also consider the poor people's food security and economic development resulting from structural food security problem.

**Food quantity security and food quality security:**

We should consider the food quantity security and at the same time we should also take into account the food quality security. We must ensure the food provided must be non-toxic, high-nutrition, healthy and safe food. In recent years, inferior quality and excessive pesticide levels of food supply damaging consumers' health issues have frequently occurred. People urgently need safe food, health food and nutritious food. The food provided must be safe, healthy, nutritious green food.

In developing countries, the theoretical community and relevant government departments in the study of "food security" pay much attention on food quantity security issue; while slightly ignore the food quality security. Food quantity security is the basic, primary and must be addressed issue, but with the improvement of people's living standard, people's requirements to the quality, nutrition and environmental protection of provided food are also increasing. Therefore, food nutrition, non-toxic and high quality is one of the main problems of developing countries in solving food security issues to be considered at this stage.

**Food security cost and benefit:** Food security benefit can be understood as a means of ensuring food security

likely to be reflected out of the socio-economic benefits and non-economic benefits. Economic benefits refers to the actual economic benefits of food security and non-economic benefits refers that the whole residents against the risk of hunger as well as a state may have against the embargo and the international market of food fluctuations, political risk under the assurance of food security.

Food security cost refers to a country or region to ensure food security and investment in the areas of food production, circulation, distribution and consumption of the economic costs and opportunity costs. It mainly concludes:

- Ensuring the input and output of food security, such as financial support to agricultural infrastructure provided by government, protection costs on food prices by government, financial subsidies of circulation, the loss of food market and trade-distorting and potential loss of industrial opportunity and loss of international trade opportunities and the cost of food regulation, etc
- The loss caused by the imbalance of food supply and demand, which is food insecurity, excessive security or a certain degree of imbalance between supply and demand. It consist the foreseeable loss of society brought about by the food insecurity and the loss brought about by food surplus

Reasonable solution to the problem of food security, assurance of the balance of costs and benefits of food security is another important issue in developing countries in addressing food security issues must be considered. In solving food security issue, the developing countries must give full consideration to the benefits of food security, ensure food security may pay the cost and ensure national food security at a reasonable cost.

**Food stationary security and dynamic security:** The concept of food both contains the stationary and the dynamic meanings. The stationary concept refers to the food security of a certain time and a certain region. The dynamic one refers to the long-term, world-wide concept of food security and with different levels of economic development, its connotation is also changing. Food security of developing countries is part of the world food security, therefore, when developing countries consider their food security issues, they must observe and study the state and trends of world food security, the status and role of food security of developing countries in world food security system, especially the favorable conditions, constraints and the measures to be taken that world food security give

developing countries'. In addition, when the developing countries consider solving the problem of national food security, they should get help from their own histories and more investigation and reflection on past history, experiences, lessons at the same time.

### THE INDEX SYSTEM OF FOOD SECURITY

Index system of food security includes quantitative index, food fluctuation index, food self-sufficiency index and quality index (non-toxic, high nutrition). Quantitative index includes gross index and individual index. Gross index refers to the total grain production, total food consumption and the level of food storage. The individual index includes per capita share of food and food guarantee level of low income class. Food security fluctuation index includes fluctuations in grain yield coefficient, total grain output fluctuation coefficient and the international market prices fluctuation coefficient. Food self-sufficiency index include food trade dependence and food self-sufficiency rate. Food quality index includes food nutritious and non-toxic. Some important index can be explained as follows:

**Food output:** The gross output of food production depends on natural resources, factor inputs, production costs, the scale of land management and agricultural technology, etc. Natural resources, especially the quantity and quality of land and water resources, play a very important role in food production. Resource endowment on the condition of the difference cause different levels of national food security.

Under the premise of the same technical conditions, the reduction in quantity of a country's resources means the decline of country's gross food output and supply. The decrease in the level of agricultural production means that the same input can only get less food production. Rural labor, fertilizer, agriculture, electricity, agricultural machinery and other inputs for food production are enormous.

Unscientific use of factors of production or prices, may lead to the rising cost of food production. When costs rise by more than income margin of increase, farmers will be waived or reduced food production, leading to increased food insecurity. Increase or decreases of the scale of land management and technological advances in agriculture have a direct impact on food security. Agricultural technology innovation and promoting the application of new technologies have been the most important factors to increasing production, thereby enhancing the level of food security.

**Food storage level:** Food storage is the amount of food storage which can get from the previous year harvest of crops (including imports) in beginning of the new crop year; it is also called as "carry-over storage". Carry-over storage includes reserve storage and turnover storage. The most important measure adopted by the

FAO of the United Nations is that carryover stocks at the end of a crop year should be at least 17 to 18% of annual consumption, in other words, two months of consumption. Turnover storage is 11-12% and reverse storage is 5-6%, respectively among them. But the restrictions set up by the above conclusion are:

- It can be able to fully mobilize and easy to get when crops get poor harvest
- 17-18% of the minimum level of storage is only to prepare for a severe crop failure, without considering two consecutive years or more years of an emergency situation and the consecutive number of years an accumulation of food shortage
- In estimating the level of security storage, we will take into account the substitutability between the three kinds of grains of wheat, rice and coarse grains
- That the future grain supply and demand trends and the same changes as in the past are based on the estimated time-series data

And FAO believes that for developing countries to determine the reasonable limit of grain stocks can be considered from several angles:

- **Safe limit:** That is the number of storage to be able to guarantee the supply needs in the event of natural disasters and other emergencies, generally the difference between the perennial yield and minimum yield as a storage standard
- **Economic limit:** That is inventory of food cost being less than or equal to the cost of imported food. If the export products earning foreign exchange are found to be more beneficial, we can reduce domestic food stocks and use part of the credit imports to meet domestic food security

**Per capita grain availability:** The ultimate goal of food security is to ensure that any person at any time, survival and health food. Per capita the amount is an important index to measure food security. The per capita share of grain is higher and the higher the level of food security is. Studies have shown that in accordance with the College of Preventive Medicine and National Bureau of Statistics: from Food Nutrition and Health Status of Seven Provinces published in 1994 by China Statistics Press, each port is 0.681 kg of other coarse grains of per capita cereal demand every day to survive as a standard of China's minimum requirement, an annual average of 248.56 kg of the level of demand for food can basically guarantee the safety of each survival nutrient levels will be lower than the standards recommended by the health sector. If the food supply per capita is less than 248.56 kg, you can be sure the absolute food crisis or the absolute famine. 360 kg per capita is the minimum occupying level which can guarantee citizens' protein needs; otherwise there will be social panic below this level. About 400 kg per capita can basically guarantee to every citizen of our

country to achieve the basic requirements of the FAO on food security and nutritional food security of the majority of citizens can be protected and can also withstand a maximum cut of 50 years the threat posed to food security, food production capacity or the ability to supply at this level will basically eliminate the shadow of the food crisis. China's grain per capita basically reached this level in 1996 and 1997, so the food is the safest state in the history and it also made a landmark achievement. Through analyzing the per capita share of food over years, we can see that during 22 years after the reform and opening up, the largest food gap year was 1981, 1980 and food per capita was 325 kg. The year's foods relatively surplus were 1996 and 1998 and per capita of food was 410 kg. The basic balance of food surplus and deficiency year were 1993 and 1995, the per capita share of grain was 385 kg.

**Fluctuation of food output coefficient:** Food production is the main source of food supply. Food production is impacted by natural conditions, resources, material inputs, scientific and technological progress, climate and other factors. Some of them are uncontrollable factors result in the fluctuation of food output. The amplitude of fluctuation of grain output is the most important indicator of food security.

**Food dependency of trade:** It is net imports of food from the international market, accounting for the percentage of the total demand of the domestic food

that is to meet a country's gross food demand. If we use  $f(x)$  to express a country's gross food supply (including the production and carryover) in a certain period of time and  $f(d)$  express the gross food demand, the country's food trade dependence on  $Y$  will be expressed as:

$$Y = [f(d)-f(s)]/f(d) \times 100\%$$

From another perspective, food dependence on trade reflects the level of food self-sufficiency  $\beta$  and it can be expressed by the formula  $\beta = \frac{f(s)}{f(d)} = 1 - Y$ . Most economists believe that  $Y \leq 5\%$  or  $\beta \geq 95\%$ , which reaches a sufficiently high level of food security;  $Y \leq 10\%$  or  $\beta \geq 90\%$ , which reaches an acceptable level of food security. China's law stipulates that China's grain self-sufficiency rate must be maintained above the 95% level, thus reducing the trade dependence can be avoided by the larger impact of the international market, but also reduce the extent of food insecurity.

**The level of per capita owned food of low-income groups:** Hunger and poverty exist in countries around the world in varying degrees. Compared to the developed countries, the poor in developing countries are relatively more. In the case of a certain food supply, the level of a country's food security depends mainly on the degree of satisfaction of food needs of low-income groups. A country's overall food supply has a surplus

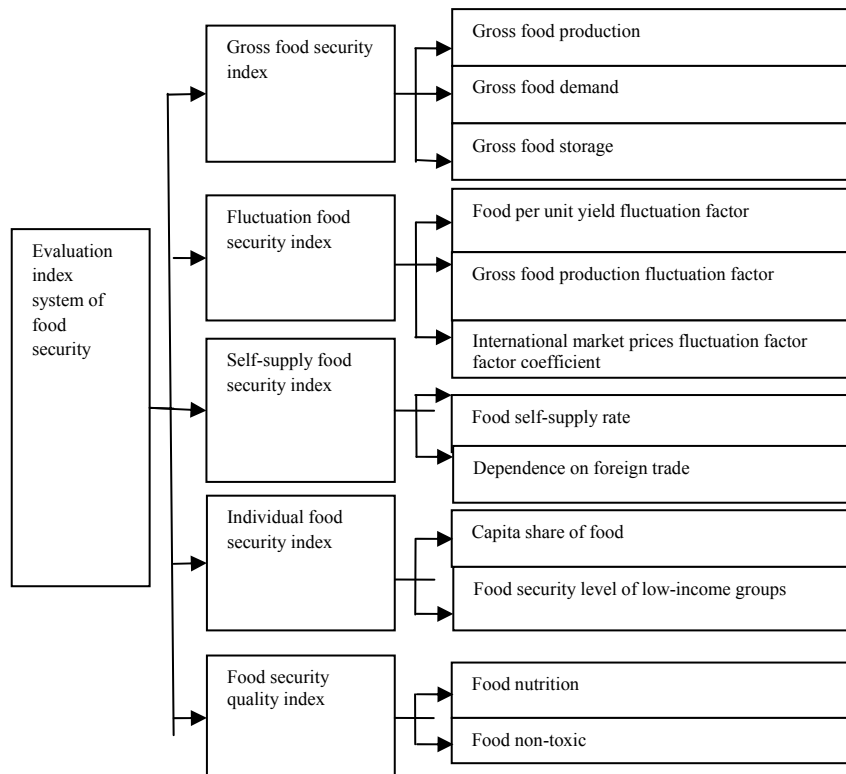


Fig. 1: Evaluation index system chart on food security in developing countries

while the low-income people may have enough to eat or nutritional deficiencies. And increasing low-income sectors of the food supply can significantly improve a country's level of food security. Suppose that a country's chronically undernourished people form a muster  $T$  and their calorie intake below the normal requirement  $D^n$  and then the amount of food gap of chronically undernourished people  $G_i$  can be expressed as:  $G_i = D^n - D_i$   $i \in T$ . In that formula,  $D_i$  is a person's calorie intake. Thus the country's food gap in the amount of the total number of ( $G$ ) is  $G = \sum G_i$ . Typically, the degree of food insecurity  $I$  can use the number of undernourished proportion  $m$  of total population  $n$  to represent. Or the ratio of the absolute number of undernourished people food shortfall  $G$  with their actual requirements cannot be expressed,  $I = m/n$  or  $I = G/(m \times D)$ . Accordingly, the country's level of food security  $A$  should be  $A = 1 - I$ . Figure 1 shows evaluation index system chart on food security in developing countries.

## CONCLUSION

**Food security adheres to self-sufficiency-based approach:** Food security in developing countries must adhere to long-term self-sufficiency as the characteristics of food security strategy. Developing countries are at a disadvantage in international trade, international political arena and over-reliance on the country's food security policy is easy to lose the initiative in international trade. For food indispensable and irreplaceable natures, in some exceptional circumstances, food shortages may become the country's economic or political chips and make themselves at a disadvantage in the multilateral and bilateral negotiations.

This strategy has its own special historical reasons. Firstly, since the founding of the PRC, China has been in the international situation of Cold War confrontation of the two groups for a long period and the objective international situation made that we cannot be with the help of the international grain market to help solve the problem of domestic food. Secondly, due to limited financial resources, we have not been allowed to import too much food for a long time, especially before the reform and opening up. Lastly, due to the complex for every food shortage of thousand-year tradition and long-term stagnant, the rapid population increase and the situation of food shortage on the conditions of food production in the long-term plans for economic and institutional constraints, which makes us constantly strengthen self-sufficiency strategies for food security awareness. Though after reform and opening up and with the gradual establishment and development of the socialist market economic system, our government did a big adjustment on food security strategies of self-

sufficiency in the past and gradually give up the executive order on food production, forced cultivation, canceled ration of food consumption and the purchase and sale system and then released the food market and increased food imports. Overall, the strategic orientation of our government on the issue of food security has not been fundamentally changed.

**Achieving food security following the principles of security priority and efficiency:** Due to developing countries' more vulnerable economic and political status, the excessive dependence on foreign trade and fear of a threat to national security, before considering the establishment of a food security strategy, developing countries should consider the country's political, economic realities and potential safety and take into account the benefits on this basis. But they cannot ignore the country's political and economic security for pursuing the benefits.

**Mostly considering food security of the poor:** The large number of poor people is the typical phenomenon of developing countries. Developing countries should give full consideration to the food security of the poor when they draw up the food security strategy. In addition to considering the total amount of security and per capita grain possession of security, developing countries should consider the food security of poor people and make some special food security plan for the poor to ensure that the food security plan of the poor should be the important part of food security strategy of developing countries.

**Food securities mostly considering food security quality:** When developing countries make food security strategy, they should mostly consider food security quantity. Theoretical and academic field topics have proposed their various suggestions and countermeasures aiming at food security quantity. With the increasingly serious pollution of our living environment, the continuous vicious of food production process, people pay more and more attention to and worried about the food quality, nutrition, environmental protection and other quality problems. Thus, with the changes in the environment, developing countries in the development of food security strategy should also be appropriate to adjust the food security policy research priorities and developing countries should take food quality and safety issues into important food safety issues to consideration.

**Food security mostly considering food structural security:** The balance of the structure of food supply and demand is an important issue in developing countries cannot be ignored. With the improvement of the level of incomes and living standard, as well as the

level of demand, people's demand for food is also showing a trend of multi-level, high quality and higher demand for the quality of the food provided. It shows as the increasing proportion of the food needs of high-quality nutrition, health, environmental protection. Therefore, the developing countries in the development of food security strategy must also take into account the structure of demand and supply structure of the food balanced and consistent.

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