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Construction and Application of Comprehensive Evaluation Index System on Food Security

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Abstract: Starting from comprehensive and systematic characteristics of food security, the comprehensive evaluation system of food security covering the fields of production, distribution, exchange and consumption is established which is used to evaluate Chinese food security from 1978 to 2010. The results show Chinese food security level continuously improves in fluctuations and gradually stabilizes, but is still in mild alert status which needs to be concerned about. The main direction of next stage policy control is to ensure food security and increase farmers' income.

Key words: Food security, comprehensive evaluation, index system

INTRODUCTION

Food security is always an important part in national security system and it is of great significance to accurately judge the situation of national food security and objectively analysis the risk of food security for the developing country with the most population like China. It is the logic premise of taking response measures and making policy to compose scientific and reasonable food security evaluation system and specifically evaluate food security degree in various stages. The paper tries to propose a comprehensive evaluation system of food security covering the fields of production, distribution, exchange and consumption which is used to evaluate Chinese food security from 1978 to 2012 and corresponding policy suggestions.

FOOD SECURITY

Food security is defined on three occasions by the United Nations Organization (FAO) which is widely received by international community and it is its essence that "everyone can enjoy sufficient food at any time, fulfilling needs and favor of healthy life". Proceeding with it, domestic and international economic theorists and real sectors adopt various methods, trying to provide the quantity index of food security.

International representative methods: (1) Food safety factor, proposed by World Food Conference in 1974, thinks that it is food security when food reservation is more than 7%, (2) Population proportion of malnutrition, proposed by FAO, thinks that it is unsafe when national population of malnutrition is more than 15%, (3) 7 index method of Committee on World Food Security, comprehensively considering factors such as consumption, health and nutrition and (4) Questionnaires of United States Department of Agriculture, divided into three categories and 18 questions, directly investigate and analyze individuals. Methods of (1) and (2) actually belong to single-index analysis which is easy to operate and make international comparison, however, can't reflect comprehensiveness and systematicness of food security issue. Methods of (3) and (4) pay more attention to "terminal", that is personal consumption link, ignoring the links of production and distribution and making personal surveys with subjective factors (Korale-Gedara *et al.*, 2012; Marsden, 2012; Naylor and Falcon, 2010).

Since 1994, Lester Brown published an article named "Who will feed China", it has set off a craze of food security research in China and formed a number of research results on food security evaluation. Representatives are: (1) 4-index simple average method (Zhu, 1997), adopts four indexes of food production volatility, food reserves rate, food self-sufficiency rate and per capita occupancy of food and weights of four indexes are accordant, the greater the total index, the higher the level of food security (Zhu, 1997), (2) Sustainable evaluation index system of food security (Lv and Gu, 1999), food security index system composed of agricultural production and resource efficiency, economic efficiency, resource utilization, as well as resources and environmental quality (Lv and Gu, 1999), (3) Five-index weighted average method (Ma *et al.*, 2001), adopts score values of supply and demand balance index of food and dietary energy, volatility index of food production, the ration of food reserves and demand, food international trade dependency coefficient and price

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stability of food and food markets to weight and average (Ma *et al.*, 2001), (4) four-index weighted average safety coefficient method (Liu, 2004), adopts per capita occupancy of food, food output fluctuation coefficient, food reserves rate and food imports rate to explain food security and obtain comprehensive coefficient using method of weighted mean (Liu, 2004) and (5) Comprehensive index system of production, consumption, circulation and trade (Gao, 2005), on the basis of the range and value reference, adopts method of weighted mean to obtain food security comprehensive index from 1978-2004 (Gao, 2005). These research methods are useful and worth learning from. However, on the whole, the researches of domestic scholars lay particular stress on supply, some consider consumption and circulation, but invariably ignore distribution link (Zhu, 2011). It is obviously not to well reflect comprehensiveness and systematicness of food security, not to well respond to implication evolving trends of food security, not to emphasize food security issue caused by benefit distribution of planting subject. In addition, it is with obvious subjective color for the determination of index weight.

DETERMINATION OF COMPREHENSIVE EVALUATION INDEX SYSTEM ON FOOD SECURITY

Food security is a complex system, for most countries, the risk profiles of food system on various aspects or links are not always consistent, that is to say, there are relative unsafe links or factors always existing in a national food system which may show high security on some links, while in other links show low security. The inconsistency of security situation on food system of different links makes us hard to make the overall judgment of a national food security situation. To solve the contradiction, the introduced comprehensive index of food security coefficient is divided into three levels. The first level is comprehensive indexes, representing food security comprehensive level shown in food security comprehensive index. The second level is main index, representing the level of food security on main aspects and there are five main indexes including safety index of production link, distribution link, exchange link and consumption link. The third level is group index, reflecting the basic contents of each main index and measuring each specific index of food security level. And there are 9 items. The frame of evaluation index system on food security set in terms of above three levels is shown in Fig. 1.

Economic implication and calculation methods of each index
Safety index of production link: Considering food security safety evaluation index, the primary issue is whether the amount of food reaches the basic needs for people's living. Production is the basic of distribution, exchange and consumption and the most important link ensuring food security. The improvement of food comprehensive production capacity is the fundamental way and solution to achieve food security.

Per capita occupancy rate of food x_1: Per capita occupancy rate of food can reflect a country's food security level to some extent. Calculation equation is: Per capita occupancy of food rate x_1 = Q/S. In which, x_1 is per capita occupancy rate of food, S is the food security requirement, Q is per capita occupancy of food. In different historical periods and conditions, food security requirements will vary.

FAO believes that it will be safe if per capita occupancy of food reach 400 kg in a country and less than 400 kg may endanger food security. An experience
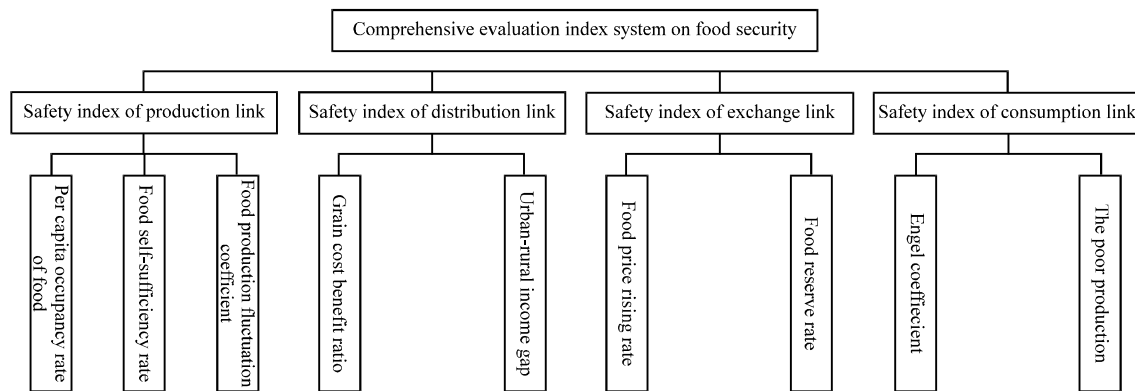

Fig. 1: Frame of evaluation index system on food security

data can obtain by weighted average calculation according to Chinese population portion, physical consumption degree of laboring population, dietary nutritional standards, food structure and nutrition heat relationship, actual consumption habits and other factors, namely, the minimum security of Chinese per capita occupancy of food is 370 kg. We adopt 400 kg of per capita occupancy of food as the safety line, 370 kg as the basic safety line and 350 kg as the food and clothing line.

Food self-sufficiency rate x_2: Food self-sufficiency rate is the ratio of total food output and total food consumption of a country or an area in a certain period:

$$\text{Food self-sufficiency rate} = 1 - \frac{\text{Net food imports}}{\text{Total grain production} + \text{Net food imports}}$$

$$= \frac{\text{Total grain production}}{\text{Total grain production} + \text{Net food imports}}$$

Due to different national conditions, there is no uniform standard of food self-sufficiency rate accepted by countries. Most economists believe that food self-sufficiency rate over 95% means the country has already achieved food self-sufficiency, or achieved a sufficiently high food security level; if only food self-sufficiency rate is over 90%, that is, it has reached acceptable food security level.

Food production fluctuation coefficient x_3: Because food production is influenced by nature, supply and demand, economic policy and other multiple factors, food production will fluctuate between the years as time goes by (or named variation), its fluctuation size reflects the degree of food production of current period deviating from food production of long-term trend and food security degree to some extent. Fluctuation size can be shown by coefficient of variation (or instability coefficient).

$$\text{Food production fluctuation coefficient} = \frac{\text{Actual production} - \text{Trends in production}}{\text{Trends in production}}$$

Method of regression or 5 year average method can be adopted to predict production trend. In general, the greater the fluctuation coefficient, the farther the deviation trend production of total food production, the worse the stability, the lower the food security level; the smaller the fluctuation coefficient, the less the deviation trend production of total food production, the higher the stability, the higher the food security level.

Safety index of distribution link: "Protect the enthusiasm of food producers and promote food production", it is an important part for ensuring food security to fully mobilize the enthusiasm of food production main body which is the aspect previous studies ignore.

Grain cost benefit ratio x_4: Grain cost benefit ratio is the important index reflecting profitability. The ratio of grain cost benefit ratio grain plant net profit and total cost, that is, grain cost benefit rate = net profit/total cost. The higher the index, the smaller the price paid for net profit by farmers, the better the cost control, the strong the profitability. Food security is directly manifest as too little food, rooting in farmers' income has not been well protected when there is too much food. After food harvest in 1996, though China has launched the policy of protective purchasing price, farmers' grain benefit has been declining since 1996, income per mu in 1996 is 146 yuan which has dropped 65 yuan at a decrease of 31% compared with that in 1995 and has fallen to a negative value, a loss of growing grain. The total food output, having declined for continuous five years, has fallen to 430.7 million tons which decreases 81.6 million tons in 1998, a drop of 15.93% and food security is severely affected. Therefore, it is key to ensure the basic grain income of farms for solving food production problem.

Urban-rural income gap x_5: Urban-rural income gap = urban residents' disposable income/rural residents' net income. In a certain period of economic development, the problem of urban-rural income gap is objectively existed. However, if not properly handled, on the one hand, it will affect the enthusiasm of farmers' production; on the other hand, uneven distribution of food will be caused.

Safety index of exchange link: Exchange is the intermediate of production and consumption, exchange efficiency and its stability will directly affect food availability, affecting the realization of food security. With the development of market economy and the accelerating process of global economic integration, influence of domestic and international food market on the food security of a country will become bigger and bigger, especially with the acceleration of urbanization in China, the importance of construction and management on future food market is more prominent. Perfect food management system, smooth circulation channels, adequate supply and stable price are the important aspects ensuring food security.

Food price rising rate x_6: Relative stability of food price is to ensure food supply and demand balance and is a basic condition for achieving food security. If food prices are too low, it will affect supply and inhibit future food production; if food prices are too high, it will affect demand; especially reduce the purchasing power of the poor.

Food reserve rate x_7: Food reserve level of a country reflects the country's ability withstanding food security risk, usually measured by food reserve rate. FAO had proposed a minimum reserve level ensuring global food security, that is to say, the world's grain reserves should occupy at least 17-18% of world grain demand as food security reserve, of which 5-6% is buffer stock (backup inventory), 12% is cycle inventory (supply inventory). General point of view, too low food reserve rate may threat food security, while too high will result in higher reserve cost. It is unsafe if the food reserve rate of a country is lower than 17% and less than 14% will be in a state of emergency.

China's food reserve rate is taken as state secrete that will not be disclosed. According to expert estimates, since 1950s, food reserve rate shows a rising trend, annual average 14.6% in 1950s, 13.3% in 1960s, 14.7% in 1970s, 20.2% in 1980s, 34.8% in 1990s and recent food reserve rate is above 40%7. Chinese reserve rate is much higher than the standard of FAO. Premier Wen Jiabao has said publicly in early April 2008, China is in adequate food stock, about 150 million to 200 million tons, in terms of 500 million tons total consumption, the stock rate is as high as 30-40%, 2 times of 17-18% of proposed rate by FAO.

Safety index of consumption link: Security of consumption link pays more attention to "availability" of food which reflects sociality, but also the basic requirements to ensure stability. Try to eliminate living consumption level differences of regional residents including the differences between different regions and urban and rural villages, reduce the proportion of the poor and ultimately achieve the food security of the whole social residents.

Engel coefficient x_8: Engle coefficient reflects the proportion of food consumption in total consumption and can indirectly express the proportion of food consumption in household consumption.

There are separated Engle coefficients of urban and rural residents in the available statistics, we adopt weighted average to calculate and calculation equation is $R = E_1R_1+E_2R_2$, in which R_1 and R_2, respectively refer to Engle coefficient of urban and rural residents and E_1 and E_2 the population proportion of urban and rural residents.

The poor proportion x_9: The poor proportion reflects the food security level of low-income rank. In the circumstance of certain food supply, increasing food supply of low-income rank will significantly improve the food security level of a country. We mainly use the index

that the proportion of low-income rank in total population as the basis for analysis, because poverty and hunger are always linked. Overall, low-income rank refers to the group living below the poverty line with the unresolved problem of food and clothing. Poor people in China are mainly concentrated in rural areas; therefore, rural poverty rate can be used instead.

EVALUATION OF FOOD SECURITY: 1978-2010

Determination of index weight: Delphi and AHP methods are comprehensively adopted to determine the weights of main index and group index. According to evaluation requirements, use Delphi method to design a set of research and consulting tables and invite related practitioners and experts to provide necessary qualitative analysis of information. Then ask experts to score the importance of each index in terms of the consulting table. With respect to the comprehensive index of food security, the corresponding four main indexes of next level, that is, the importance of safety index of production link, distribution link, exchange link and consumption link. Through several rounds of adjustment, repeated consultancy and modification, evaluations of 4 main indexes are relatively consistent.

In order to facilitate quantification and adopt the same scale, according to 1-9 and its bottom scale method and multiple comparisons, the value of judgment matrix elements in the consulting table. Then, adopt the above method and AHP to calculate the weight of each index.

Relative to comprehensive index Z, the comparison test matrix of each main index Y_1-Y_4 composed in terms of expert's opinion. And calculate the maximum characteristic root of the matrix with consistency check. After logic consistency test, calculate the weight. The calculation results are shown in the Table 1.

Relative to each main index, because of the small number of group indexes, we assume that group indexes are equivalent to the influence efficiency of the main indexes.

As a result, we can obtain the calculation formula of comprehensive evaluation index on food security, namely:

$$z = 0.4550Y_1+0.1411Y_2+0.1411Y_3+0.2627Y_4$$

Table 1: Comparison test matrix and weights of each index of Y_1-Y_4

Z	Y_1	Y_2	Y_3	Y_4	W
Y_1	1	3	3	2	$W_{Y1} = 0.4550$
Y_2	1/3	1	1	1/2	$W_{Y2} = 0.1411$
Y_3	1/3	1	1	1/2	$W_{Y3} = 0.1411$
Y_4	1/2	2	2	1	$W_{Y4} = 0.2627$

Where:

$$Y_1 = 1/3X_1 + 1/3X_2 + 1/3X_3$$
$$Y_2 = 1/2X_4 + 1/2X_5$$
$$Y_3 = 1/2X_6 + 1/2X_7$$
$$Y_4 = 1/2X_8 + 1/2X_9$$

Determination of index value range and standard: The numerical values of group index determine the value range and standard according the different characteristics of positive and negative index. There are several occasions: Firstly, the influence of group index value on food security is monotonous. The more per capita occupancy of food and grain cost benefit ratio, the more benefit the realization of food security targets. The less urban-rural income distance, comprehensive Engel coefficient and the poor proportion, the more secure the food security. Secondly, the optimal range of group index value, less or more than the corresponding range, is not good for the realization of food security targets. Food-sufficiency rate, grain production fluctuation coefficient, food price rising rate and food reserve rate belong to this type of index.

Based on the above understanding and analysis, we can determine the values and standards of various group indexes, as shown in the Table 2.

Determination of food security alert district: In theory, the value range of comprehensive index Z on food security is $0 \leq z \leq 1$, the higher the index, indicating safer and it is in the optimal state when the index is equal to 1. As mentioned above, food security involves the links of production, distribution, exchange, consumption and other aspects; it may show a high level of security in some areas while lower in other areas. Comprehensive evaluation index of food security can help us make the overall judgment on food security situation of a country. Therefore, a systematic approach is adopted to ensure the

alert district, warning condition and alert degree (Table 3) and entirely evaluate the characteristics and changing rules of food security.

Evaluation of food security situation in China: First of all, according to the analysis of group index, actual numerical values of nine group indexes from 1978 to 2010 are given, as shown in Table 4.

The original data table of 1978-2010 comprehensive evaluation of food security is shown in Table 4. Secondly, contrast the table of "range and standard of food security group index", obtain standard value of each group index, then get the comprehensive evaluation index of food security in terms of aforementioned weight calculation and identify warning condition (Table 5).

Based on the above calculation and analysis, we can draw the variation trend of comprehensive index on food security from 1978 to 2010 (Fig. 2) and further analysis the characteristics of food security evolution in China.

According variation trend of comprehensive index on food security, we can draw the following conclusions: Firstly, since 1978, the overall level of food security in China has continuously improved and gradually stabilized. Food security in China is in the light warning state on the whole which needs to be concerned about. On one hand, a dominant issue of food security does not exist in China; on the other hand, it exists a gap to reach absolute food safety state. The average from 1978 to 1979 is 0.52, 0.63 from 1980 to 1989, 0.67 from 1990 to 1999 and 0.71 from 2000 to 2001. Comprehensive evaluation index of food security is constantly rising and food security degree is gradually improved. Especially since 2005, comprehensive evaluation index of food security tends to stabilize and basically remain around 0.75.

Secondly, there are obvious fluctuations in the improvement process of food security degree, not monotonically but gradually increasing. Since 1978, the

Table 2: Range and standard of food security group index

X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	Evaluation
<0.5	<50;>145	<-7;>10	<10	>3.9	<-16;>18	<8;>46	>0.75	>16	0.1
0.5-0.6	55-60;140-145	-7-6;9-10	10-15	3.6-3.9	-16-14;16-18	8-10;44-46	0.7-0.75	14-16	0.2
0.6-0.7	60-65;135-140	-6-5;8-9	15-20	3.3-3.6	-14-12;14-16	10-12;42-44	0.65-0.7	12-14	0.3
0.7-0.8	65-70;130-135	-5-4;7-8	20-25	3.0-3.3	-12-10;12-14	12-14;40-42	0.6-0.65	10-12	0.4
0.8-0.9	70-75;125-130	-4-3;6-7	25-30	2.7-3.0	-10-8;10-12	14-16;38-40	0.55-0.6	8-10	0.5
0.9-1.0	75-80;120-125	-3-2;5-6	30-35	2.4-2.7	-8-6;8-10	16-18;36-38	0.5-0.55	6-8	0.6
1.0-1.1	80-85;115-120	-2-1;4-5	35-40	2.1-2.4	-6-4;6-8	18-20;34-36	0.4-0.5	4-6	0.7
1.1-1.2	85-90;110-115	-1-0;3-4	40-45	1.8-2.1	-4-2;4-6	20-22;32-34	0.3-0.4	2-4	0.8
1.2-1.3	90-95;105-110	0-1;2-3	45-50	1.5-1.8	0-2;2-4	22-24;30-32	0.2-0.3	1-2	0.9
>1.3	95-105	1-2	>50	<1.5	0-2	24-30	<0.2	<1	1.0

Table 3: Alert district, warning condition and alert degree of food security

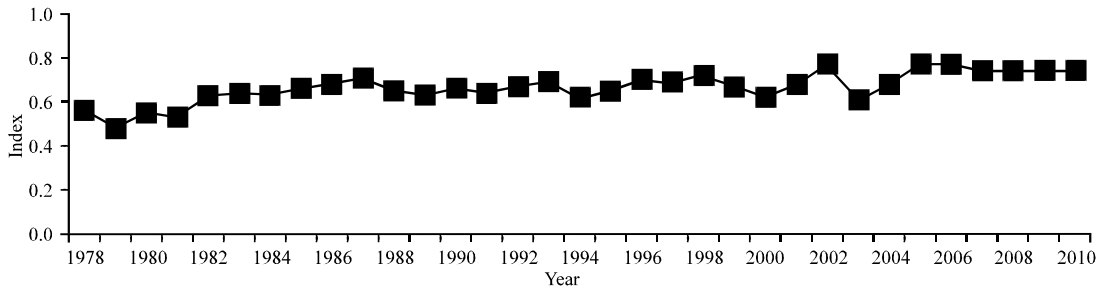| Alert district	$0.9 < Z \leq 1$	$0.8 < Z \leq 0.9$	$0.6 < Z \leq 0.8$	$0.4 < Z \leq 0.6$	$Z \leq 0.4$
Warning condition	Absolute safety	Safety	Light warning	Middle warning	Heavy warning
Alert degree	0	-1	-2	-3	-4
Measure	Maintenance	Improvement	Concentration	High concentration	Emergency action

Fig. 2: Variation trend of comprehensive index on food security from 1978 to 2010

Table 4: Original data of comprehensive evaluation index on food security from 1978 to 2010

Year	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9
1978	0.8615	0.9777	-0.17	-3.73	2.57	0.7	14.7	65.87	30.7
1979	0.9263	0.9688	6.10	4.71	2.53	30.5	14.7	62.71	28.8
1980	0.8829	0.9645	-2.09	13.15	2.50	7.9	20.2	60.85	26.8
1981	0.8838	0.9600	-5.49	21.59	2.24	9.7	20.2	59.25	18.5
1982	0.9499	0.9597	-1.24	30.02	1.98	3.8	20.2	60.26	17.5
1983	1.0229	0.9712	4.49	38.46	1.82	10.3	20.2	59.36	16.2
1984	1.0617	0.9834	6.09	46.90	1.84	12.0	20.2	58.92	15.1
1985	0.9749	1.0088	-3.69	55.34	1.86	1.8	20.2	56.73	14.8
1986	0.9919	1.0043	-0.88	53.53	1.95	9.9	20.2	55.42	15.5
1987	1.0047	0.9784	2.01	51.71	1.98	8.0	20.2	55.22	14.3
1988	0.9668	0.9797	-3.52	49.90	2.05	14.6	20.2	53.33	11.1
1989	0.9846	0.9760	-2.32	44.64	2.10	26.9	20.2	54.72	11.6
1990	1.0624	0.9826	4.96	39.37	2.20	-6.8	34.8	57.59	9.4
1991	1.0223	0.9941	-0.54	22.30	2.40	-6.2	34.8	56.58	10.4
1992	1.0269	1.0043	-0.56	26.86	2.58	5.3	34.8	56.34	8.8
1993	1.0469	1.0175	1.62	51.70	2.80	16.7	34.8	55.92	8.3
1994	1.0094	1.0097	-3.88	79.68	2.86	46.6	34.8	56.36	7.7
1995	1.0467	0.9615	-1.43	69.59	2.71	29.0	34.8	56.13	7.1
1996	1.1200	0.9795	4.13	40.05	2.51	5.8	34.8	54.01	6.3
1997	1.0858	1.0031	-0.61	27.30	2.47	-9.8	34.8	52.39	5.4
1998	1.1149	1.0039	3.22	20.66	2.51	-3.3	40.1	50.50	4.6
1999	1.0968	0.9997	4.62	6.90	2.65	-12.9	40.1	48.95	3.7
2000	0.9893	1.0009	-3.41	-0.89	2.79	-9.8	40.1	45.59	3.5
2001	0.9619	0.9819	-2.07	11.25	2.90	1.5	40.1	44.12	3.2
2002	0.9648	1.0021	0.58	1.31	3.11	-1.4	40.1	42.94	3.0
2003	0.9035	0.9988	-6.12	9.07	3.23	2.2	40.1	42.15	3.1
2004	0.9790	0.9634	0.34	49.69	3.21	26.5	40.1	43.23	2.8
2005	1.0034	0.9576	1.52	28.84	3.22	1.4	40.1	41.72	2.5
2006	1.0267	0.9529	0.34	34.83	3.28	2.5	40.1	39.81	2.3
2007	1.0287	0.9595	-1.38	38.49	3.33	6.4	40.1	39.98	1.6
2008	1.0787	0.9337	1.46	33.14	3.31	7.0	35.0	40.97	4.2
2009	1.0776	0.9156	-0.13	32.04	3.33	5.7	35.0	38.82	3.8
2010	1.1045	0.8949	0.59	33.77	3.23	11.7	35.0	38.40	2.0

change of food security degree has generally passed four periods: from 1978 to 1987, comprehensive evaluation index of food security has decreased from 0.56 in 1978 to 0.48 in 1979 and gradually increased to 0.71 in 1987; from 1987 to 1998, it has decreased from 0.71 in 1987 to 0.63 in 1989 and gradually increased to 0.72 in 1998; from 1998 to 2002, it has decreased from 0.72 in 1998 to 0.62 in 2000 and gradually increased to 0.77 in 2002, the optimal state over the same period in the history; from 2002 to 2010, it has decreased from 0.77 in 2002 to 0.68 in 2004 and gradually increased to 0.77 in 2005 and tends to stabilize and remain around 0.75 or so.

Thirdly, at present, the biggest factors affecting food security in China are mainly in the fields of distribution and exchange. Specially, three factors, grain cost benefit rat, urban-rural income gap and food price rising rate, can largely explain the changes of comprehensive evaluation index on food security. The indexes of production and consumption are relatively stable which has little impact on the change of comprehensive evaluation index on food security. This prompts us it should make overall plans and take all factors into consideration to ensure food security, the current focus needed to adjust are mainly the fields of distribution and exchange, especially for the field of distribution. It should be noted that food production has been more than 500 million tons for consecutive four years, but food increase is not sustainable if we cannot solve the problem of distribution and exchange. A

Table 5: Standard value of comprehensive evaluation index and comprehensive index on food security

Year	X1	X2	X3	X4	X5	X6	X7	X8	X9	Z	Warning condition
1978	0.5	1.0	0.8	0.1	0.6	1.0	0.5	0.3	0.1	0.56	Middle warning
1979	0.6	1.0	0.5	0.1	0.6	0.1	0.5	0.4	0.1	0.48	Middle warning
1980	0.5	1.0	0.6	0.2	0.6	0.7	0.8	0.4	0.1	0.55	Middle warning
1981	0.5	1.0	0.3	0.4	0.7	0.6	0.8	0.5	0.1	0.53	Middle warning
1982	0.6	1.0	0.7	0.6	0.8	0.9	0.8	0.4	0.1	0.63	Light warning
1983	0.7	1.0	0.7	0.7	0.8	0.5	0.8	0.5	0.1	0.64	Light warning
1984	0.7	1.0	0.5	0.9	0.8	0.4	0.8	0.5	0.2	0.63	Light warning
1985	0.6	1.0	0.5	1.0	0.8	1.0	0.8	0.5	0.2	0.66	Light warning
1986	0.6	1.0	0.8	1.0	0.8	0.6	0.8	0.5	0.2	0.68	Light warning
1987	0.7	1.0	0.9	1.0	0.8	0.6	0.8	0.5	0.2	0.71	Light warning
1988	0.6	1.0	0.5	0.9	0.8	0.3	0.8	0.6	0.4	0.65	Light warning
1989	0.6	1.0	0.6	0.8	0.7	0.1	0.8	0.6	0.4	0.63	Light warning
1990	0.7	1.0	0.7	0.7	0.7	0.6	0.4	0.5	0.5	0.66	Light warning
1991	0.7	1.0	0.8	0.4	0.6	0.6	0.4	0.5	0.4	0.64	Light warning
1992	0.7	1.0	0.8	0.5	0.6	0.8	0.4	0.5	0.5	0.67	Light warning
1993	0.7	1.0	1.0	1.0	0.5	0.2	0.4	0.5	0.5	0.69	Light warning
1994	0.7	1.0	0.5	1.0	0.5	0.1	0.4	0.5	0.6	0.62	Light warning
1995	0.7	1.0	0.7	1.0	0.5	0.1	0.4	0.5	0.6	0.65	Light warning
1996	0.8	1.0	0.7	0.8	0.6	0.5	0.4	0.6	0.6	0.70	Light warning
1997	0.7	1.0	0.8	0.5	0.6	0.5	0.4	0.6	0.7	0.69	Light warning
1998	0.8	1.0	0.8	0.4	0.6	0.8	0.4	0.6	0.7	0.72	Light warning
1999	0.7	1.0	0.7	0.1	0.6	0.4	0.4	0.7	0.8	0.67	Light warning
2000	0.6	1.0	0.5	0.1	0.5	0.5	0.4	0.7	0.8	0.62	Light warning
2001	0.6	1.0	0.6	0.2	0.5	1.0	0.4	0.7	0.8	0.68	Light warning
2002	0.6	1.0	0.9	1.0	0.4	0.9	0.4	0.7	0.8	0.77	Light warning
2003	0.6	1.0	0.3	0.1	0.4	0.9	0.4	0.7	0.8	0.61	Light warning
2004	0.6	1.0	0.8	0.8	0.4	0.1	0.4	0.7	0.8	0.68	Light warning
2005	0.7	1.0	1.0	0.5	0.4	1.0	0.4	0.7	0.8	0.77	Light warning
2006	0.7	1.0	0.9	0.6	0.4	0.9	0.4	0.8	0.8	0.77	Light warning
2007	0.7	1.0	0.7	0.7	0.3	0.7	0.4	0.8	0.9	0.74	Light warning
2008	0.7	0.9	1.0	0.6	0.3	0.7	0.7	0.7	0.7	0.74	Light warning
2009	0.7	0.9	0.8	0.6	0.3	0.8	0.7	0.8	0.8	0.74	Light warning
2010	0.8	0.8	0.9	0.6	0.4	0.5	0.7	0.8	0.8	0.74	Light warning

profound lesson in the history has proved this problem; food cost benefit rate begins declining in 1996 and falls to negative in 2000, meanwhile, total food output has declined for consecutive five years, severely affecting food security.

CONCLUSION AND RECOMMENDATIONS

Starting from comprehensiveness and systematicness of food security, the paper composes a comprehensive evaluation system including production, distribution, exchange and consumption and evaluates the food security situation from 1987 to 2010 in China according to it. The results show that food security level in China is constantly improved in fluctuations, gradually trend to stabilize, but still in light warning state and need to be concerned about. From four links of production, distribution, exchange and consumption, the current crux of the problem is mainly concentrated in the field of distribution; it is the main direction of policy control in the next stage to further ensure the linkage system of food security and increasing farmers' income and it is worth trying practice to establish

the subsidy system of food comprehensive income in China and improve comparative profit of farmers.

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