Hindawi
Journal of Food Quality
Volume 2017, Article ID 4340869, 14 pages
https://doi.org/10.1155/2017/4340869

Research Article

Transparent Assessment of the Supervision Information in China's Food Safety: A Fuzzy-ANP Comprehensive Evaluation Method

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Received 26 November 2016; Accepted 19 February 2017; Published 20 March 2017

Academic Editor: Egidio De Benedetto

Improving transparency of food safety supervision information can reduce the occurrence of information asymmetry, decrease food safety incidents, and promote socially joint regulation for food safety. In this study, an index system of food safety supervision information transparency (FSSIT) is constructed using the fuzzy-ANP comprehensive evaluation model. Using this system, the FSSIT in China is evaluated. A total of 1651 questionnaires containing 139525 data are collected from food and drug administration (FDA), consumer association (CA), and media at the central, provincial, prefectural, and county levels. Empirical results indicate that the FSSIT achieves a qualified level; however, the works of FDA, CA, and media still present deficiencies. The information transparency in the entirety presents deficiencies and gradually declines when that in the administrative level decreases. The economic development level indirectly determines the transparency level, and the transparency level does not conform to China's current economic development level.

1. Introduction

The State Council of the People's Republic of China issued arrangements on food safety work in 2016, and these provisions put emphasis on improving the information disclosure mechanism, promoting the construction of major information technology projects, and accelerating socially joint regulation for food safety. These arrangements highlight China's attention to food safety and its information transparency.

Information of food safety supervision directly affects the public trust in all kinds of food safety information [1, 2]. In the degree of food safety supervision information transparency (FSSIT), information transparency mainly refers to the fact that stakeholders have convenient access to the information [3, 4], while food safety means food causes no harm to human health [5, 6]. From the perspective of a consumer, transparency of food safety information is the way to achieve its supervision [7]. An important task in supervising transparency of food safety information is the realization of FSSIT [8]. The behavior of food companies can be improved and the possibility of the supervision department dereliction can be reduced through the collective reputation mechanism [9–12].

The gradual development of research on food safety supervision has shown that the information asymmetry of food safety supervision cannot be effectively reduced only by supervision of the government and self-discipline of food companies [13]. An effective solution is to construct a mode of socially joint regulation for food safety such that all food safety supervision subjects can effectively and rationally participate in the governance of food safety [2, 14, 15].

At present, the domestic and international research on FSSIT is very rare. A latest research builds China's index system of food safety supervision transparency to evaluate its level in China's food safety supervision departments [16, 17]. However, the evaluation subjects are supervision departments not social supervision subjects. Moreover, the investigation content does not contain food safety supervision at the county level. Meeting the country's requirements of building a highly efficient and socially joint management system is difficult. Therefore, a comprehensive and systematic study on FSSIT in China is still lacking.

In light of the above considerations, the index system of FSSIT is established in this study using the fuzzy-ANP comprehensive evaluation model and on the basis of the laws and regulations of China's food safety supervision and existing literature analysis. A total of 1651 questionnaires containing 139525 data are collected from food and drug administration (FDA), consumer association (CA), and media (in this paper, food and drug administration (FDA) refers to the government departments responsible for the supervision of food and drug administration, consumer association (CA) refers to the organizations that protect the interests of consumers, and media refers to newspapers, news websites, and the We-media) at the central, provincial, prefectural, and county levels. On the basis of these data, the FSSIT level is evaluated. The rest of the paper is organized as follows. Section 2 presents the setup of the FSSIT index system. Section 3 introduces the fuzzy-ANP comprehensive evaluation model and analyzes its applicability. Section 4 discusses an empirical research based on 1651 questionnaires containing 139525 data from FDA, CA, and media at the central, provincial, prefectural, and county levels. Section 5 discusses and analyzes the results of the empirical study. Finally, Section 6 summarizes and elaborates the conclusions of the study.

2. Construction of Evaluation Index System

FDA, CA, and media are the food safety supervision subjects in China and are the main publishers of FSSIT in the country. The information released by these bodies has wide coverage and high degree of public recognition. Food safety is the most basic livelihood project, but the public's access right to food safety information depends mainly on FDA, CA, and media. In addition, other subjects of food safety supervision still present problems, such as independent supervision and unreasonable supervision system [18]. Therefore, consumer and other supervision subjects of food safety present a limited effect on FSSIT. On this basis, this study evaluates China's FSSIT from three dimensions only: government, CA, and media.

2.1. FSSIT of Government. The government plays a leading role in food safety supervision works such that low level of supervision information transparency negatively affects its reputation [12]. These adverse effects are mainly as follows. First, FDA cannot fully obtain comprehensive information from food companies and implement the supervision work owing to its own conditions [19–22]. Accordingly, food companies may utilize food safety supervision loopholes to harm the interests of consumers [23]. In this case, the supervisees capture supervisors, government supervision becomes disordered [24], and the reputation of FDA becomes damaged. Second, the supervision information of government is relatively nontransparent; thus, FDA easily experiences group trust crisis in case of food safety incident [25–27]. Therefore, the following four aspects can be considered in improving the FSSIT of government.

2.1.1. Food Safety Information Platform of Government. Openness is the basis of transparency. The government sets up an effective food safety information platform that can show the transparency of the supervision process. The platform ensures public's access right to food safety information [28, 29] improves the efficiency of public's access to information [12], and publicizes food safety knowledge [30]. According to the existing research results and the "Food Safety Law of the People's Republic of China" (food safety law hereinafter), the food safety information platform of government should be subdivided into 13 indexes to evaluate FSSIT; these indexes are overall situation of food safety information, guiding information of supervision information, supervision information directory, key supervision information, food safety standard information, food safety risk warning information, information on administrative punishment for food safety issues, qualification accreditation information of food inspection agencies, name list of food safety inspection agencies, name list of production and business licenses, certification information of company quality system, supervision organization structure and personnel information, and food safety credit file information [31–37].

2.1.2. Food Safety Accident Emergency Information of Government. The emergency handling capability of FDA on food safety accidents directly reflects its administrative efficiency [38]. Any serious problem in information transparency of food safety accident can result in vicious rumor of "herd instinct." Therefore, FDA should maintain a sufficient transparency of food safety accident emergency information to reduce the rumor. According to the existing research results and "food safety law," the food safety accident emergency information of government should be subdivided into six indexes to evaluate FSSIT; these indexes are food safety accident classification, accident disposal commanding system and responsibility information, prevention and warning mechanism information, disposal procedure information, emergency safeguarding measure information, and accident investigation and disposal information [31, 34, 35, 38].

2.1.3. Food Safety Sampling Information of Government. China's inspection system of food safety supervision has clearly stipulated that FDA must disclose the inspection results [35]. The sampling information of FDA is a dynamic quality testing content and is the most important information that FDA needs to disclose [31]. According to the existing research results and "food safety law," government food safety sampling information should be subdivided into three indexes to evaluate FSSIT; these indexes are sampling object information, sampling qualified information, and sampling unqualified information [31, 34, 35].

2.1.4. Information for Safeguarding the Government Supervision Mechanism. FDA needs a clear, transparent mechanism to safeguard food safety supervision. This mechanism can promote the responsibility clarification and enhance public awareness on FDA and is an important step to improve the FSSIT of government. According to the existing research

results and "food safety law," the information for safeguarding the government supervision mechanism should be subdivided into five indexes to evaluate FSSIT; these indexes are open management mechanism information of supervision information, annual report for disclosure supervision, report processing information, supervision responsibility mechanism information, and supervision evaluation mechanism information [31, 34, 35, 38, 39].

2.2. FSSIT of CA. Problems in food safety and its supervision are characterized by sociality. However, the traditional model of "single food safety supervision" is monopolized by the government and excludes public supervision; thus, this model presents low supervision efficiency and poor supervision information transparency. According to the empirical study on the American food safety supervision, government supervision insignificantly reduces the outbreak of foodborne diseases [40]. Therefore, the construction of socially joint regulation mode for food safety [41] is an effective way to reduce the probability of food safety problems and improve the entire FSSIT [35]. CA is an important force in socially joint regulation for food safety. Accordingly, this study improves the FSSIT of CA mainly from the following three aspects.

2.2.1. Supervision Information of CA. Participation of CA in food safety supervision can reduce the information asymmetry of food safety and improve the efficiency of public participation [31]. Moreover, CA can use the social punishment effect to produce a deterrent against the illegal behavior of food companies [12]. According to the existing research results and "food safety law," the supervision information of CA should be subdivided into three indexes to evaluate FSSIT; these indexes are supervision mechanism information, supervision organization structure and personnel composition, and supervision evaluation information [27, 31, 35, 39, 42].

2.2.2. Integrity Building Information of CA. The important works of CA are to conduct integrity building [43], regulate the behavior of food companies, and warn consumers through the "black name list system," credit rating, and other means. According to the existing research results and "food safety law," the integrity building information of CA should be subdivided into three indexes to evaluate FSSIT; these indexes are integrity building standard information, name list of accredited company brands, and name list of nonaccredited company brands [27, 31, 35, 39, 42, 43].

2.2.3. Information for Safeguarding the Supervision Mechanism of CA. Sound supervision mechanism must be developed to improve the supervision efficiency of CA. The social supervision function of CA can best embody the supervision role [38]. According to the existing research results and "food safety law," the information for safeguarding the supervision mechanism of CA should be subdivided into five indexes to evaluate FSSIT; these indexes are social supervision function information, annual report for disclosure supervision, management mechanism for disclosing supervision information, supervision responsibility mechanism, and perfect degree and operation situation of food safety information platform [27, 31, 35, 39, 42].

2.3. FSSIT of Media. Media is also an important force in socially joint regulation for food safety. As one of the main publishers of food safety information, media plays an irreplaceable role in the food safety social supervision. Media involves in socially joint regulation to improve the supervision efficiency of food safety [27, 44] and protect the public's access right to food safety information. Therefore, this study improves the FSSIT of media mainly from the following two aspects.

2.3.1. Supervision Information of Media. Media plays a unique role in the exposure of food safety problems. During the "Sanlu milk powder" incident or the "Shuanghui clenbuterol" incident, media expanded the influence through the report in the early stage and then continued to place pressure on the government supervision work by tracking reports in the later stage [27]. According to the existing research results and "food safety law," the supervision information of media should be subdivided into four indexes to evaluate FSSIT; these indexes are food safety incident reports, food safety incident tracking reports, authenticity and impartiality of food safety report, and social supervision function information of media [27, 31, 35, 39, 43].

2.3.2. Food Safety Publicity of Media. The promotion of laws, regulations, standards, and knowledge on food safety relies on media. However, the present performance of media in this area is relatively weak and needs to be strengthened. According to the existing research results and "food safety law," food safety publicity of media should be subdivided into two indexes to evaluate FSSIT; these indexes are publicity of food safety laws and regulations and publicity of food safety standards and knowledge [27, 31, 35, 39, 43].

By combining the experts' opinion (the Delphi expert group consists of 15 experts, including 6 food safety management professors from colleges and universities, 3 FDA experts, 2 food safety media experts, 2 CA experts, and 2 food business experts) using the Delphi method, the index system of FSSIT is constructed and is shown in Table 1.

3. Evaluation Model

The fuzzy-ANP comprehensive evaluation model is composed of the analytic network process (ANP) and the fuzzy comprehensive evaluation method. The ANP compensates the defects of the analytic hierarchy process [45], and the fuzzy comprehensive evaluation method based on the membership theory of fuzzy mathematics effectively evaluates qualitative indexes [46]. Therefore, the fuzzy-ANP comprehensive evaluation model presents many advantages in evaluation and analysis. In the process of food safety supervision, the same food safety supervision subjects exhibit

Table 1: Index system of FSSIT.

Objective	First-level index	Second-level index	Third-level index
FSSIT (A)	FSSIT of government (B_1)	Information platform of food safety of government (C_1)	Overall situation of food safety information (C_{11}) Guiding information for supervision information (C_{12}) Supervision information disclosing directory (C_{13}) Key information of supervision (C_{14}) Standard information of food safety (C_{15}) Warning information of food safety risk (C_{16}) Information on administrative punishment of food safety issue (C_{17}) Qualification accreditation information of food inspection agency (C_{18}) Name list of food safety inspection agencies (C_{19}) Name list of production and business licenses (C_{110}) Certification information of company quality system (C_{111}) Supervision organization structure and personnel composition information (C_{112}) Food safety credit file information (C_{113})
FSSIT (A)	FSSIT of government (B_1)	Food safety accident emergency information of government (C_2)	Food safety accident classification information (C_{21}) Accident disposal organization and commanding system and responsibility information (C_{22}) Prevention and warning mechanism information (C_{23}) Disposal procedure information (C_{24}) Emergency and safeguarding information (C_{25}) Accident investigation and disposal information (C_{26})
FSSIT (A)	FSSIT of government (B_1)	Food safety sampling information of government (C_3)	Sampling object information (C_{31}) Sampling qualified information (C_{32}) Sampling unqualified information (C_{33})
FSSIT (A)	FSSIT of government (B_1)	Information for safeguarding the government supervision mechanism (C_4)	Open management information of supervision information (C_{41}) Annual report for supervision information (C_{42}) Report processing information (C_{43}) Supervision responsibility mechanism information (C_{44}) Supervision evaluation mechanism information (C_{45})
FSSIT (A)	FSSIT of CA (B_2)	Supervision information of CA (C_5)	Supervision mechanism information (C_{51}) Supervision organization structure and personnel composition information (C_{52}) Supervision evaluation information (C_{53})
FSSIT (A)	FSSIT of CA (B_2)	Integrity building information of CA (C_6)	Integrity building standard information (C_{61}) Name list of accredited company brands (C_{62}) Name list of non-accredited company brands (C_{63})
FSSIT (A)	FSSIT of CA (B_2)	Information for safeguarding the supervision mechanism of CA (C_7)	Information of social supervision function (C_{71}) Disclosure annual report of the supervision information (C_{72}) Disclosure management mechanism information of supervision information (C_{73}) Supervision responsibility mechanism information (C_{74}) Perfect degree and operation situation of food safety information platform (C_{75})
FSSIT (A)	FSSIT of media (B_3)	Supervision information of media (C_8)	Food safety incident report (C_{81}) Food safety incident tracking report (C_{82}) Authenticity and impartiality of food safety report (C_{83}) Social supervision function information of media (C_{84})
FSSIT (A)	FSSIT of media (B_3)	Publicity for food safety of media (C_9)	Publicity of food safety laws and regulations (C_{91}) Publicity of food safety standards and knowledge (C_{92})

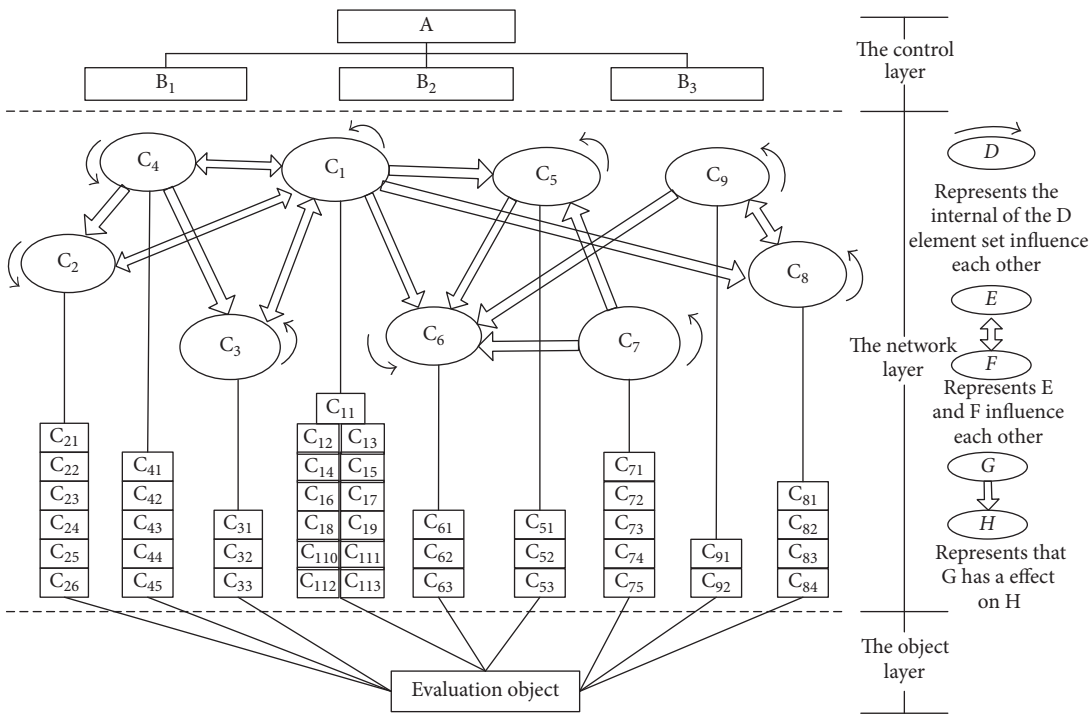

Figure 1: Network structure of ANP of FSSIT.

a clear hierarchy. In other words, the various types of food safety supervision subjects show a significant dependency relationship. Thus, the influencing factors of FSSIT possess a typical level and dependent relationship. Accordingly, the index system of FSSIT forms an organic whole with a hierarchical network structure. A few indexes of FSSIT cannot be directly quantified because they present intervals and fuzzy characteristics on the value. Thus, evaluating FSSIT using the fuzzy-ANP comprehensive evaluation model is highly scientific and applicable.

3.1. Constructing the Network Structure of ANP. In the network structure of FSSIT, the control layer contains the target and criteria; the target is A, and the criteria are the first-level indexes of the index system including B_1, B_2, and B_3. The network layer includes nine sets of elements that correspond to second- and third-level indexes of the index system; these sets are $C_1, C_2, C_3, C_4, C_5, C_6, C_7, C_8$, and C_9. According to the mutual influence relationship within the evaluation index set of elements and between the set of elements and the indexes, the network structure of ANP is constructed and is shown in Figure 1.

3.2. Determination of the Index Weight. With the help of ANP and Delphi expert scoring, the weight of each FSSIT indexes is determined. The specific process is as follows.

Step 1. Build a super matrix. Assume that ANP control layer criterion contains B_s $(s = 1, 2, \ldots, m)$, the network layer contains a set of elements C_N $(N = 1, \ldots, n)$, and C_i contains elements $C_{i1}, C_{i2}, \ldots, C_{in}$, $i = 1, 2, \ldots, N$. According to the criterion of the control layer element B_s, use element C_{j1} of C_j as the subcriterion, construct the judgment matrix based on the scale method of 1–9 as shown in Table 2, and obtain the normalized feature vector $(w_{i1}, w_{i2}, \ldots, w_{in})^T$. Then, test the consistency of the obtained vector; the test passes when CR is less than 0.1; otherwise, the value of the matrix element needs to be adjusted. Similarly, obtain the normalized feature vector

Table 2: Scale method of 1–9 in comparison.

Scale	Definition
1	Element i and element j present the same importance
3	Element i is moderately more important than element j
5	Element i is strongly more important than element j
7	Element i is very strongly more important than element j
9	Element i is extremely more important than element j
2, 4, 6, 8	Median values of the two adjacent judgments
Reciprocal	The importance scale of element j to element i

of other elements, and then obtain a super matrix, denoted as W_{ij}.

$$W_{ij} = \begin{bmatrix} w_{i1}^{(j1)} & w_{i2}^{(j2)} & \cdots & w_{i1}^{(jn_j)} \\ w_{i2}^{(j1)} & w_{i2}^{(j2)} & \cdots & w_{i2}^{(jn_j)} \\ \vdots & \vdots & \ddots & \vdots \\ w_{in_i}^{(j1)} & w_{in_i}^{(j2)} & \cdots & w_{in_i}^{(jn_j)} \end{bmatrix}. \quad (1)$$

The column vector of W_{ij} in this study is the element $C_{i1}, C_{i2}, \ldots, C_{in}$ in C_i. If the element in C_j is unaffected by the element in C_i, then $W_{ij} = 0$. In the same way, the super matrix of other control elements can be obtained. Therefore, the super matrix W under the criterion B_s is obtained as follows:

$$W = \begin{bmatrix} w_{11} & w_{12} & \cdots & w_{1N} \\ w_{21} & w_{22} & \cdots & w_{2N} \\ \vdots & \vdots & \ddots & \vdots \\ w_{N1} & w_{N2} & \cdots & w_{NN} \end{bmatrix}. \quad (2)$$

Step 2. Construct the weighted matrix and weighted super matrix. Under the criterion B_s, the importance of the relative criterion of element C_j $(j = 1, 2, \ldots, N)$ is compared to obtain a normalized row sequence vector $(a_{1j}, a_{2j}, \ldots, a_{Nj})$ such that a weighted matrix is obtained as follows:

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1N} \\ a_{21} & a_{22} & \cdots & a_{2N} \\ \vdots & \vdots & \ddots & \vdots \\ a_{N1} & a_{N2} & \cdots & a_{NN} \end{bmatrix} \quad (3)$$

$$\left(a_{ij} \in [0, 1], \ \sum^{N} a_{ij} = 1 \right)$$

Therefore, the weighted super matrix is constructed as follows:

$$\overline{W} = \overline{W_{ij}} = A \times W = \left(a_{ij} \times W_{ij} \right) \quad (4)$$
$$(i = 1, 2, \ldots, N, \ j = 1, 2, \ldots, N).$$

On the basis of the results of the super matrix and weighted super matrix, the local weight and overall weight of FSSIT indexes can be obtained. The weights used in this study are local weights.

3.3. Determination of Evaluation Rating and Rules. The evaluation rating is assumed as follows: $v = (v_1, v_2, \ldots, v_N)$ $(N = 1, 2, \ldots,$ number of ranks). The evaluation rating is divided into five grades: good, relatively good, general, relatively poor, and poor; the values of these grades are 100, 75, 50, 25, and 0.

3.4. Determination of Fuzzy Relation Matrix. The fuzzy relation matrix is defined as follows:

$$R = \left(r_{ij} \right)_{N \times M} = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1M} \\ r_{21} & r_{22} & \cdots & r_{2M} \\ \vdots & \vdots & \ddots & \vdots \\ r_{N1} & r_{N2} & \cdots & r_{NM} \end{bmatrix}. \quad (5)$$

Among them, R is a member of the index number i of the level number j and r_{ij} = the number of the indicator number i to select the level v_i/the number of participating evaluation.

3.5. Determination of the Comprehensive Evaluation Level. A comprehensive evaluation vector is established by the fuzzy comprehensive operation of the weight set and the fuzzy relation matrix.

$$\begin{aligned} S_i &= W_i \times R \\ &= (w_{i1}, w_{i2}, \ldots, w_{iN}) \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1M} \\ r_{21} & r_{22} & \cdots & r_{2M} \\ \vdots & \vdots & \ddots & \vdots \\ r_{N1} & r_{N2} & \cdots & r_{NM} \end{bmatrix} \\ &= (s_1, s_2, \ldots, s_M). \end{aligned} \quad (6)$$

In the comprehensive evaluation vector of FSSIT, M is equal to 5. Therefore, the final FSSIT score obtained by the weighted average method is $T = 100 \times s_1 + 75 \times s_2 + 50 \times s_3 + 25 \times s_4 + 0 \times s_5$.

4. Empirical Research

4.1. Questionnaire Design. The aims of this study are as follows: evaluate the level of the entire FSSIT, various types of food safety supervision subjects, and different administrative levels and regions in China; explore the existing problems; boost the improvement in food safety management; promote the public's access right to food safety information. On the basis of the FSSIT index system, the questionnaire for FDA, CA, and media is designed. The five-grade classification method is used to score each item in the questionnaire (each item is assigned a corresponding level of five scoring criteria to ensure the objectivity of scoring.); "good" means 100 points, "relatively good" means 75 points, "general" means 50 points, "relatively poor" means 25 points, and "poor" means 0 point (the final FSSIT score rating criteria are as follows: 100 points mean a full mark, 60 points and above are qualified, the score within [0, 30] is poor, the score within [30, 60] is relatively poor, the score within [60, 75] is general, the score within [75, 90] is relatively good, and the score within [90, 100] is well.). We conduct a presurvey to carry out the survey.

Table 3: Test of reliability and validity.

Subject of investigation	Cronbach's alpha	KMO	Bartlett	df	sig
FDA	0.986	0.974	31487.675	351	0.000
CA	0.983	0.943	13869.744	55	0.000
media	0.971	0.899	2311.163	15	0.000

Table 4: Characteristics of different administrative levels.

Administrative level	FDA		CA		Entirety	
	Frequency	Proportion	Frequency	Proportion	Frequency	Proportion
Center	1	0.001	1	0.001	2	0.001
Province	31	0.045	31	0.045	62	0.045
Prefecture	333	0.480	330	0.482	663	0.481
County	329	0.474	323	0.472	652	0.473
Sum	694	1	685	1	1379	1

4.2. Sample. FDA is the government department that is responsible for food safety supervision, according to the 15th provision of Regulations of the People's Republic of China on the Disclosure of Government Information. FDA should initiate in disclosing food safety supervision information, and this information should be accessible to the public. CA can reasonably support the supervision works of government for food safety and reduce the information asymmetry of food safety. Media can use its capability to improve the dissemination of food safety supervision information, deter food companies through the social effect of punishment, and rectify the behavior of food safety supervision department in government with the help of the collective reputation. Therefore, FDA, CA, and media are used as investigation objects in evaluating China's FSSIT.

The survey started from June 2016 to October 2016 and focuses mainly on FDA, CA, and media at the central, provincial, prefectural, and county levels. To ensure the objectivity of the survey results, the survey data were obtained from the official websites of FDA, CA, and media or by the assistance of a telephone survey. The data were collected by the end of September 2016. In this survey, a questionnaire represents a food safety supervision subject. A total of 697 completed questionnaires were obtained from FDA; 3 were invalid and 694 were valid among these questionnaires, and the effective rate was 99.570%. A total of 697 questionnaires were obtained from CA; 12 were invalid and 685 were valid among these questionnaires, and the effective rate was 98.278%. A total of 300 questionnaires were obtained from media; 28 were invalid and 272 were valid among these questionnaires, and the effective rate was 90.667%. Therefore, 1694 questionnaires were completed; 43 were invalid and 1651 were valid among these questionnaires, and the effective rate was 97.462%. Finally, we obtained 139525 valid survey data.

4.3. Data Analysis. In this study, the SPSS software is used to test the reliability and validity of the survey results, as shown in Table 3.

Table 3 shows that the Cronbach's alpha values of FDA, CA, and media are 0.986, 0.983, and 0.971, all of which are above 0.9. Therefore, the measure of FDA, CA, and media presents good internal consistency and stability, and the reliability is quite good. The KMO values of FDA and CA are above 0.9, indicating that the factor analysis is quite good and the validity is quite high. The KMO value of media is above 0.8, indicating that the factor analysis is good and the validity is high.

The characteristics of different administrative levels, geographical regions, and economic regions of FDA, CA, and media are shown in Tables 4–6. (For the convenience of statistics and analysis, the central is compared in statistics; therefore, the central and provincial results appear side by side. At the central level, we only investigate China's Food and Drug Administration (CFDA), China's Consumers Association, and national media, such as People's Daily.)

The survey involves FDA, CA, and media at the central, provincial, prefectural, and county levels. However, when investigating municipalities directly under the central government, we only investigate FDA and CA. No specific subdivision is applied to prefecture and county. The media survey mainly involves the mainstream media and We-media at the central and provincial levels.

4.4. Evaluation and Analysis

4.4.1. Weight Calculation. On the basis of the above weight calculation method and the help of the Super decision software, the weight of the indexes is obtained and is shown in Table 7.

4.4.2. Fuzzy Comprehensive Calculation. On the basis of 1651 questionnaires containing 139525 data from FDA, CA, and media and using the fuzzy-ANP comprehensive evaluation model, the transparency scores of various types of food safety supervision subjects are obtained. The scores in different

Table 5: Characteristics of different geographical regions.

Geographical regions	Province	FDA		CA		Media		Entirety	
		Frequency	Proportion	Frequency	Proportion	Frequency	Proportion	Frequency	Proportion
East China	Shanghai	1	0.001	1	0.001	6	0.022	8	0.005
	Jiangsu	35	0.050	35	0.051	12	0.044	82	0.050
	Zhejiang	32	0.046	32	0.047	15	0.055	79	0.048
	Anhui	23	0.033	23	0.034	8	0.029	54	0.033
	Jiangxi	22	0.032	18	0.026	4	0.015	44	0.027
	Shandong	46	0.066	46	0.067	17	0.063	109	0.066
	Fujian	23	0.033	23	0.034	10	0.037	56	0.034
Total		182	0.261	178	0.260	72	0.265	432	0.263
North China	Beijing	1	0.001	1	0.001	10	0.037	12	0.007
	Tianjin	1	0.001	1	0.001	7	0.026	9	0.005
	Shanxi	23	0.033	22	0.032	6	0.022	51	0.031
	Hebei	32	0.046	31	0.045	7	0.026	70	0.042
	Neimenggu	20	0.029	20	0.029	6	0.022	46	0.028
Total		77	0.110	75	0.108	36	0.133	188	0.113
Central China	Henan	40	0.058	39	0.057	10	0.037	89	0.054
	Hubei	34	0.049	35	0.051	6	0.022	75	0.045
	Hunan	31	0.045	31	0.045	9	0.033	71	0.043
Total		105	0.152	105	0.153	25	0.092	235	0.142
South China	Guangdong	41	0.059	41	0.060	18	0.066	100	0.061
	Guangxi	23	0.033	23	0.034	8	0.029	54	0.033
	Hainan	10	0.014	10	0.015	2	0.007	22	0.013
Total		74	0.106	74	0.109	28	0.102	176	0.107
Southwest China	Sichuan	35	0.050	35	0.051	10	0.037	80	0.048
	Guizhou	13	0.019	13	0.019	2	0.007	28	0.017
	Yunnan	20	0.029	17	0.025	7	0.026	44	0.027
	Chongqing	1	0.001	1	0.001	5	0.018	7	0.004
	Xizang	8	0.012	8	0.012	3	0.011	19	0.012
Total		77	0.111	74	0.108	27	0.099	178	0.108
Northwest China	Shanxi	14	0.020	14	0.020	8	0.029	36	0.022
	Gansu	17	0.024	17	0.025	8	0.029	42	0.025
	Qinghai	12	0.017	12	0.018	3	0.011	27	0.016
	Ningxia	8	0.012	8	0.012	8	0.029	24	0.015
	Xinjiang	40	0.058	40	0.058	7	0.026	87	0.053
Total		91	0.131	91	0.133	34	0.124	216	0.131
Northeast China	Heilongjiang	32	0.046	32	0.047	10	0.037	74	0.045
	Jilin	24	0.035	24	0.035	5	0.018	53	0.032
	Liaoning	31	0.045	31	0.045	11	0.040	73	0.044
Total		87	0.126	87	0.127	26	0.095	200	0.121
Center		1	0.001	1	0.001	24	0.088	26	0.016
Sum		694	1.000	685	1.000	272	1.000	1651	1.000

administrative levels, geographical regions, and economic regions in China are shown in Tables 8–11.

As shown in Table 8, analyzing various types of food safety supervision subjects reveals that the FSSIT of media obtains the highest score and at a general level. The FSSIT of FDA and CA obtains a lower score but at a qualified level. The scores of the various types of food safety supervision subjects show that the FSSIT work in FDA, CA, and media presents a certain degree of loss. In addition, the overall score of FSSIT shows that China's entire FSSIT reaches an acceptable level at present. In other words, China has exerted much effort to improve FSSIT, but a certain extent of work loss still exists. Therefore, each type of of food safety supervision subjects needs to improve the FSSIT work.

Table 6: Characteristics of different economic regions.

Economic regions	Province	FDA		CA		Media		Entirety	
		Frequency	Proportion	Frequency	Proportion	Frequency	Proportion	Frequency	Proportion
East part	Beijing	1	0.001	1	0.001	10	0.037	12	0.007
	Tianjin	1	0.001	1	0.001	7	0.026	9	0.005
	Hebei	32	0.046	31	0.045	7	0.026	70	0.042
	Shanghai	1	0.001	1	0.001	6	0.022	8	0.005
	Jiangsu	35	0.050	35	0.051	12	0.044	82	0.050
	Zhejiang	32	0.046	32	0.047	15	0.055	79	0.048
	Fujian	23	0.033	23	0.034	10	0.037	56	0.034
	Shandong	46	0.066	46	0.067	17	0.063	109	0.066
	Guangdong	41	0.059	41	0.060	18	0.066	100	0.061
	Hainan	10	0.014	10	0.015	2	0.007	22	0.013
Total		222	0.317	221	0.322	104	0.383	547	0.331
Central	Shanxi	23	0.033	22	0.032	6	0.022	51	0.031
	Anhui	23	0.033	23	0.034	8	0.029	54	0.033
	Jiangxi	22	0.032	18	0.026	4	0.015	44	0.027
	Henan	40	0.058	39	0.057	10	0.037	89	0.054
	Hubei	34	0.049	35	0.051	6	0.022	75	0.045
	Hunan	31	0.045	31	0.045	9	0.033	71	0.043
Total		173	0.250	168	0.245	43	0.158	384	0.233
Northeast	Heilongjiang	32	0.046	32	0.047	10	0.037	74	0.045
	Jilin	24	0.035	24	0.035	5	0.018	53	0.032
	Liaoning	31	0.045	31	0.045	11	0.040	73	0.044
Total		87	0.126	87	0.127	26	0.095	200	0.121
West	Neimenggu	20	0.029	20	0.029	6	0.022	46	0.028
	Guangxi	23	0.033	23	0.034	8	0.029	54	0.033
	Chongqing	1	0.001	1	0.001	5	0.018	7	0.004
	Sichuan	35	0.050	35	0.051	10	0.037	80	0.048
	Guizhou	13	0.019	13	0.019	2	0.007	28	0.017
	Yunnan	20	0.029	17	0.025	7	0.026	44	0.027
	Xizang	8	0.012	8	0.012	3	0.011	19	0.012
	Shanxi	14	0.020	14	0.020	8	0.029	36	0.022
	Gansu	17	0.024	17	0.025	8	0.029	42	0.025
	Qinghai	12	0.017	12	0.018	3	0.011	27	0.016
	Ningxia	8	0.012	8	0.012	8	0.029	24	0.015
	Xinjiang	40	0.058	40	0.058	7	0.026	87	0.053
Total		211	0.304	208	0.304	75	0.274	494	0.300
Center		1	0.001	1	0.001	24	0.088	26	0.016
Sum		694	1.000	685	1.000	272	1.000	1651	1.000

Table 9 indicates that the FSSIT of FDA and CA gradually declines when that at the administrative level decreases. The FSSIT scores of different administrative levels show that the food safety supervision works at the provincial level are more standardized than those at the prefectural and county levels. The local supervision works on food safety information transparency present deficiencies. Among them, the work at the county level is the worst. In such a case, the public's panic psychology and "herd instinct" easily occur in case of food safety accident. By contrast, the work at the central level is the most standardized and obtains the highest score.

Table 10 shows that, in the seven geographical regions in China, Eastern and Southern China obtain the highest score and at the general level. North, Northeast, Southwest, Northwest, and Central China obtain a lower score but at a qualified level. However, analyzing Tables 8 and 9 shows that the FSSIT of different geographical regions is mostly at a poor level; this poor performance is due to the poor level of CA at the county level. Comparing the entirety and central level with the seven geographical regions shows that the FSSIT at the central level presents the highest score and achieves a better level. The low scores of each geographical

Table 7: Index weight.

First-level index	Weight	Second-level index	Weight	Third-level index	Weight
B_1	0.328	C_1	0.250	C_{11}	0.097
				C_{12}	0.081
				C_{13}	0.078
				C_{14}	0.097
				C_{15}	0.091
				C_{16}	0.078
				C_{17}	0.065
				C_{18}	0.075
				C_{19}	0.037
				C_{110}	0.081
				C_{111}	0.075
				C_{112}	0.065
				C_{113}	0.081
B_1	0.328	C_2	0.250	C_{21}	0.220
				C_{22}	0.110
				C_{23}	0.127
				C_{24}	0.127
				C_{25}	0.212
				C_{26}	0.203
B_1	0.328	C_3	0.250	C_{31}	0.250
				C_{32}	0.250
				C_{33}	0.500
B_1	0.328	C_4	0.250	C_{41}	0.147
				C_{42}	0.197
				C_{43}	0.255
				C_{44}	0.255
				C_{45}	0.147
B_2	0.260	C_5	0.333	C_{51}	0.500
				C_{52}	0.250
				C_{53}	0.250
B_2	0.260	C_6	0.333	C_{61}	0.260
				C_{62}	0.328
				C_{63}	0.413
B_2	0.260	C_7	0.333	C_{71}	0.286
				C_{72}	0.286
				C_{73}	0.143
				C_{74}	0.143
				C_{75}	0.143
B_3	0.413	C_8	0.500	C_{81}	0.143
				C_{82}	0.286
				C_{83}	0.286
				C_{84}	0.286
B_3	0.413	C_9	0.500	C_{91}	0.333
				C_{92}	0.667

Table 8: Scores of various types of food safety supervision subjects.

Evaluation goal	Score	Grade	Rank	Evaluation goal	Score	Grade	Rank
Media	66.675	General	1	Entirety	56.963	Relatively poor	3
FDA	57.455	Relatively poor	2	CA	40.895	Relatively poor	4

Table 9: Scores of different administrative levels (media includes media bodies at the prefectural and county levels, but they show no specific distinction to those at the central and provincial levels; therefore, this study does not evaluate the FSSIT of media at different administrative levels.).

Evaluation goal	Score of FDA	Grade	Rank	Score of CA	Grade	Rank
Center	95.416	Good	1	80.053	Relatively good	1
Province	83.130	Relatively good	2	67.563	General	2
Prefecture	70.638	General	3	46.605	Relatively poor	3
County	41.588	Relatively poor	4	32.398	Relatively poor	4

Table 10: Scores of different geographical regions.

Geographical area	Score	Grade	Rank	Score of FDA	Score of CA	Score of media
Center	82.770	Relatively good	1	95.415	80.053	75.005
East China	60.648	General	2	58.768	43.011	73.251
South China	60.113	General	3	67.365	56.978	56.333
Entirety	56.963	Relatively poor	4	57.455	40.895	66.675
North China	55.135	Relatively poor	5	51.219	36.828	69.776
Northeast China	55.016	Relatively poor	6	51.098	38.586	68.474
Southwest China	54.250	Relatively poor	7	51.874	29.937	71.451
Northwest China	52.815	Relatively poor	8	60.088	38.032	56.355
Central China	52.315	Relatively poor	9	59.503	40.659	53.952

Table 11: Scores of different economic regions.

Economic region	Score	Grade	Rank	Score of FDA	Score of CA	Score of media
Center	82.770	Relatively good	1	95.415	80.053	75.005
East	59.303	Relatively poor	2	61.314	45.632	66.318
Entirety	56.963	Relatively poor	3	57.455	40.895	66.675
Central	56.952	Relatively poor	4	55.646	42.377	67.169
Northwest	55.016	Relatively poor	5	51.098	38.586	68.474
West	54.242	Relatively poor	6	57.327	35.462	63.624

region affect the entire FSSIT, thereby resulting in a relatively poor but qualified level. This situation reflects that the current overall situation of food safety supervision information is still insufficiently transparent and that the public's access right to food safety information needs to be further improved.

Table 11 shows that, in China's four economic regions, the FSSIT score of the eastern region is the highest, followed by that of the central, northeast, and western regions at a relatively poor level. Although the FSSIT of the four economic regions reach the qualified level, the transparency is still pessimistic. This finding is consistent with the results shown in Table 10. Comparing the entirety and central level with the four economic regions, only the FSSIT at the central level reaches a relatively good level and is affected by the low score of the four economic regions. The entire FSSIT is at a relatively poor level. These findings are consistent with the results shown in Table 10.

In summary, China has exerted much effort to improve FSSIT but presents a certain degree of work loss in the entirety, various types of food safety supervision subjects, and different administrative levels and regions. In addition, the public's access right to food safety information must be further enhanced.

5. Discussion

This study finds that the entire FSSIT work in China presents deficiencies, and those at the county level are serious. Local food safety supervision subjects expand supervision works according to the actual situation of each administrative region, and the released information meets the needs of the local public. However, the survey results show that FSSIT gradually declines when that at the administrative level decreases; this finding is consistent with the conclusions of the study of the Center for Public Participation Studies and Supports [17]. The FSSIT score of FDA, especially the low score at the prefectural and county levels, shows that the works of local FDA still present deficiencies despite the implementation of the 105th, 109th, 113th, 116th, 118th, and 119th "food safety law." Therefore, China's FDA reform exhibits a certain degree of deviation, and the reform fails to construct a unified and authoritative FDA and weakens the power of FDA in a few regions. At the end of 2014, 95% of prefectural and 80% of county level works are independently set up by FDA. By the end of 2015, they reduced to 82% and 42%, respectively; the numbers are still decreasing (source: the latest speech of Bi Jingquan at the CFDA National

Bureau Chief on the consistency evaluation of generic drugs (http://www.cpia.org.cn/news/dt4381833320773.html)). In such a situation, China should perform adjustments to avoid deviating from the original intention of the reform.

From the FSSIT ranking of the different regions, the economic development level indirectly determines the FSSIT level. In general, highly developed economies perfectly conduct the corresponding work, including FSSIT. However, the entire FSSIT score of the different regions does not support this deduction. The detailed analysis shows that China has become the second largest economy in the world and has reached the level of a well-off society. The social construction of the country has also significantly improved. Therefore, the FSSIT in China should be at a good level. However, this study finds a different result. The FSSIT ranking of the different geographical regions meets the economic development ranking. However, the FSSIT level in Eastern and Northern China disagrees with the economic development level. Similarly, the FSSIT of the different economic regions also differs.

The FSSIT score shows that the entire FSSIT is qualified at present but is still in a relatively poor level; this situation is not conducive to ease rumors of "herd instinct" and does not promote healthy development of the food industry. In addition, food safety is ranked first in China's top 10 focus issues for four consecutive years; this phenomenon reflects the current lack of information transparency of food safety. If FDA, CA, and media can timely, accurately, and conveniently release food safety supervision information, then the public's panic can be reduced, the public's awareness of food safety incidents can be enhanced, and the rumors of "herd instinct" can be alleviated. However, as parts of food safety social supervision, CA and media fail to effectively spread food safety supervision information to the public, and FDA imperfectly conducts its works. This situation explains the public's amplification of current food safety issues in China and the public's certain degree of food safety fear and public's distrust of food companies. Among these issues, the most representative is the melamine incident, which triggered a distrust of domestic dairy of the entire society such that a huge loss of domestic dairy industry occurred [47, 48].

This study also indicates that the frequent food safety issues in China are due to the information asymmetry of food safety, which easily leads to adverse selection and moral hazard of food companies [48]. Food safety supervision mainly depends on food safety supervision department of government [13]. In working toward local economic development, local government may come into conflict with food companies [49, 50]. This situation leads to the nontransparency of local food safety supervision information and difficulty in addressing food safety issues. CA and media cannot fully play their supervising roles when under pressure [50], thereby resulting in the lack of FSSIT work. In such a situation, the public's access to food safety supervision information becomes ineffective and the problem food companies cannot be eliminated using the power of the supervision subjects. The cost of compliant food companies is higher than that of the problem food companies; thus, the competitiveness of food companies declines or disappears [12, 26]. In other words, the problem food companies willingly take risk of producing or selling problem food, while the compliant food companies cannot compete with the problem food companies because of cost and profit pressures. Accordingly, the products or sales of compliant food companies can disappear. If compliant food companies shift to producing or selling problem food, then the food safety situation in the entire society can deteriorate. This situation reflects that the difficulty in addressing China's food safety problem is indeed attributed mainly to the information asymmetry of food safety. Specifically, the public cannot effectively distinguish the problem food companies from the compliant food companies. This situation is conducive to adverse selection and moral hazard of the food companies.

6. Conclusion

On the basis of China's "food safety law" and existing literature, an index system of FSSIT is constructed in this study using the fuzzy-ANP comprehensive evaluation model and 1651 questionnaires. Using this system, the entirety, various types of food safety supervision subjects and different administrative levels and regions of FSSIT in China are evaluated. The empirical results are as follows:

(1) China has exerted much effort to improve FSSIT, and the entire FSSIT reaches a qualified level. However, FDA, CA, and media still imperfectly conduct their works, and supervision information asymmetry of food safety occurs. This situation is conducive to adverse selection and moral risk of food companies and cannot ease the rumor of "herd instinct" and promote healthy development of the food industry.

(2) FSSIT gradually declines when that in the administrative level decreases. The work of the local FSSIT presents deficiencies, and those at the county level are serious. This situation also reflects that China's FDA reform exhibits a certain degree of deviation, and the public's access right to food safety information needs to be further improved.

(3) The economic development level indirectly determines the FSSIT level. The current levels of FSSIT and economic development in the country do not match. This problem can be solved by cooperation among the food safety supervision subjects at different administrative levels and regions.

The results of this study not only help enhance the public's awareness on China's FSSIT but also provide a strong reference for the food safety supervision subjects to determine their own shortcomings and improve their work. However, only the data of FDA, CA, and media collected on 2016 are used, and no dynamic comparison is conducted. Therefore, future works can conduct the following tasks: track the original goals; research the continuous changes of FDA, CA, and media; promote various types of food safety supervision subjects to improve their work; and enhance the public's access right to food safety information.

Competing Interests

The authors declare that they have no competing interests.

Acknowledgments

The authors wish to express their gratitude to Song Qinan. This work was supported by the Major Program of National Social Science Foundation of China (no. 12&ZD204), the National Natural Science Foundation of China (no. 71173103 and no. 71501094), Jiangsu Natural Science Foundation (BK20150961), Natural Science Foundation project of the Jiangsu Higher Education Institutions (15KJB120003), and Jiangsu Higher Education Institutions sponsored by Qing Lan Project.

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