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Sustainable Development of Food Processing Enterprises in China

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Abstract: Sustainable development is an eternal topic in the development of human society. The paper seeks to contribute to the adoption of sustainable development practices in the food processing enterprises of China by fostering the capacities of the enterprises. Moreover, the paper aims to contribute to the promotion of sustainable consumption by helping and encouraging consumers in making informed choices of sustainable and eco-efficient produced foodstuffs. We combined with 1015 survey data in 28 areas of China by using AHP model analysis of the sustainable development of food processing enterprises. The results show that, the overall level of sustainable development ability of food processing enterprises in China is not high; paying attention to economic is significantly more important than paying attention to social and environmental aspects. Chinese food processing entities have an acceptable basis for the implementation of sustainable development. But there are still some problems. Finally, some suggestions are put forward to promote the sustainable development of Chinese food processing enterprises.

Keywords: Sustainability Development; Food Processing Enterprise; China

1. Introduction

Sustainable development is a kind of development with equal opportunities and benefits. Although different countries have different models of sustainable development, the principles of equity and sustainability are common. Human economic and social development cannot exceed the carrying capacity of resources and the environment. Sustainable development is a development theory and strategy based on the protection of natural resources and environment, on the condition of stimulating economic development, and on the goal of improving the quality of human life. It is a new concept of development, morality and civilization.

Food is one of the industries where sustainability issues are intrinsically embedded because of the amount and variety of natural resources usage, human requirements for basic nutrition, and communities that depend on food production for survival. However, improving sustainability in the food industry requires engagement of actors worldwide, in order to cope with the challenges of consumer expectations, limited resources, international policies and regulations [1].

"Food is the paramount necessity of people", namely, the food industry is the pillar of the national economy. Food industry represents nowadays a crucial motor for the development of the local economy and society, and as industrial process; it reports serious impacts that threaten its sustainability: (1) food sector entails important environmental impacts; (2) the effect of globalization and the changes in consumers' preferences is contributing to the demise of the traditional production systems and small companies; (3) ethical, health and safe working conditions are not always ensured; (4) the quality of products in the food sector creates a great concern in consumers.

In the food industry, the implementation of sustainability practices has spread and studies have analyzed their impact on performance i.e., quality, efficiency, flexibility and responsiveness [2]. Sustainability performance represents the attainment of a sustainability-attained goal [3]. The sustainability triangle [4] or the three sustainability pillars [5], namely economic, social and environmental, are in constant interaction in the food industry. But enterprises tend to focus on economic sustainable development, rather than on environmental and social sustainable development. With the development of time, companies and researchers have recently pay attention to environmental and social indicators [6–11]. Sustainability is often presented as a goal in businesses, nonprofits and governments; however, measuring the degree to which an organization is being sustainable can be difficult to achieve because beyond economic performance measurement, environmental and social are difficult to quantify [12,13].

1.1. Definition of Sustainable Development

The roots of the sustainable development concept can be found in the emerging environmental consciousness of the 1960s and in the identification of the link between economic development and environmental degradation and pollution. Sustainable development (SD) was used for the first time in the 1980 IUCN report, World Conservation Strategy: Living resources for sustainable development. The perhaps most commonly quoted definition within today's extensive SD literature is the popularization and definition of the concept made by the World Commission on Environment and Development published in 1987 in the report Our Common Future also called the Brundtland Report: Sustainable development is development that meets the needs of current generations without compromising the ability of future generations to meet their needs. (WCED, 1987:43)

In 1991, the International Union for Conservation of Nature (INCN), the United Nations Environment Program (UN-EP) and the World Wildlife Fund International (WWF) jointly issued "Caring for the Earth: A Strategy for Sustainable Living", SD is defined as "improving the quality of human life while living within the carrying capacity of supporting eco-systems", and put forward the nine basic principles of human Sustainable existence.

In November 1991, the International Federation of Ecology (INTECOL) and the International Union of Biological Science (IUBS) jointly held a symposium on sustainable development. SD is defined as: "protect and strengthen the environmental system of production and the ability to update", the meaning of SD is not beyond the environment and system update ability's development.

Edward B. Barbier [14] defined SD as "In the premise of maintaining the quality and the services provided of the natural resources, Increase the net benefit of economic development to the maximum extent".

1.2. Definition on Enterprise Sustainability

As the actor and subject of microeconomic, enterprises are not only the direct creator of wealth, but also principal of resource consumption and environmental protection. The ultimate goal of sustainable development of enterprises is to achieve sustainable development of human society.

As a business approach, Corporate Sustainability aims to create long-term consumer and employee value via two means: For profit: balance with short-term profit and long-term profit, market share; For not profit: As part of natural system, enterprise need to coordinate the resources and capabilities of society by creating a "green" strategy aimed towards the natural environment, taking into consideration every dimension of how a business operates in the social, cultural, and economic environment.

American scholar Brown [15] indicated that "when today's world march towards sustainable development goals with firm steps, whether large or middle and small-sized enterprises, all have their duty and task. Whether can establishment the sustainable development economy, but also influence enterprise's fate". Marketing management master Philip Kotler [16] points out that "the sustainable development company is the company who can constantly promote the benign cycle when facing the changing market environment". GUO YuMing [17] point out that "the sustainable development enterprise

is the enterprise who can dominate resources in the larger scale, seek a bigger market share, continuously overcome and transcend self, so as to obtain a good development in the foreseeable future".

1.3. How to Evaluate Enterprise Sustainability

There are several theories available to describe corporate/enterprise sustainability:

1.3.1. CSR Theory (Corporate Social Responsibility)

The concept of CSR has consistently evolved during the past several decades [18,19]. It has been defined through a range of economic, legal, ethical, and voluntary activities. The social responsibility companies need to assume is not only profit-making, but also actively contribute to social and environmental solutions [20,21].

It is a form of corporate self-regulation integrated into a business model. CSR is a process with the aim to embrace responsibility for the company's actions and encourage a positive impact through its activities on the environment, consumers, employees, communities, stakeholders and all other members of the public sphere who may also be considered stakeholders.

CSR is not only a commercial gesture, but also a requirement when the market economy develops in certain internal stages. At some extent, CSR can make up make up for government intervention and market regulation defects. To build a harmonious society and achieve sustainable economic and social development, Chinese enterprises must fulfil their social responsibilities seriously.

1.3.2. D4S (Design for Sustainability):

'Sustainable products' is the term used to comprehend all kinds of products that have or aim at an improved environmental and social quality, which can be related back to the already mentioned implementation of environmental and social standards. The ultimate aim is to satisfy customers and gain a competitive advantage in the market.

D4S (design for sustainability) (Figure 1), published by Delft University of Technology and UNEP, thinks that the role of sustainability in product innovation includes three key elements: planet, people and profit. These 3 key elements are also referred to as environmental, social and economic.

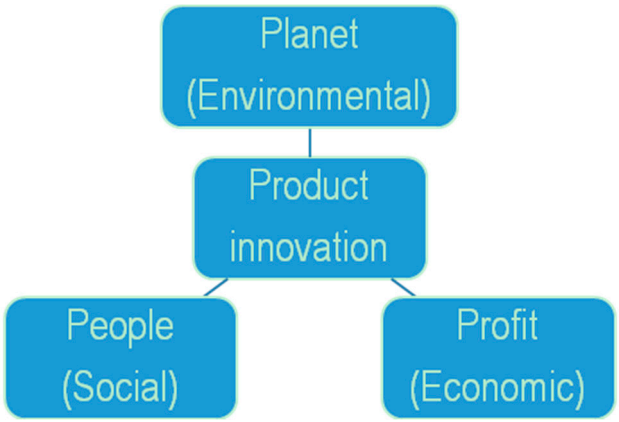

Figure 1. D4S.

1.4. The Dimension of Sustainability Evaluation

Table 1 shows the summary of European environmental policy frameworks and legislations. Compared with other development models, sustainable development does not only emphasize economic growth, but it stresses the importance of a balance between economic growth and environmental protection. Thus, Sustainable development involves the natural, environmental, social, economic, technological, political and other aspects. Many scientists have even made more or less successful attempts to derive a common understanding of SD. Regardless, most of them agreed with

3 dimensions and classically explained as the balancing between environmental, economic and social aspects of development [22]. These three aspects are frequently defined as the three pillars of SD: Economic dimension; Environmental dimension; Social dimension.

Table 1. Summary of European environmental policy frameworks and legislations.

Authors	Research Angle	Dimensions	Source
John Elkington	Corporate social responsibility field	Social, economic, environmental	⟨⟨The Power of Unreasonable People: How Social Entrepreneurs Create Markets That Change the World⟩⟩
CSD(Commission on Sustainable Development)	Sustainable development	Social, economic, environmental, institutional	https://sustainabledevelopment.un.org/csd.html
Delft University of Technology and UNEP	Sustainability in product innovation	Social (people), economic (profit), environmental (planet)	https://www.unenvironment.org/

Many scholars have done much research on the sustainable development of enterprises. Such as Bo Xia et al. (2018) study the sustainable development of construction industry [23]; Anne Elizabeth Fordham et al. (2018) research the corporate social responsibility programs of resource companies [24]; Zhuravlyov, V et al. (2018) study strategic aspects of ensuring sustainable development of gold enterprises of the Russian Federation [25], Bombiak, E et al. (2018) research green human resource management as a tool for the sustainable development of enterprises [26].

1.5. Research Population: Food Processing Enterprises

The food supply chain is mainly composed of farm, manufacturing plant, distribution center, supermarket or retailer, and consumer. Figure 2 shows the structure of a simplified food supply chain.

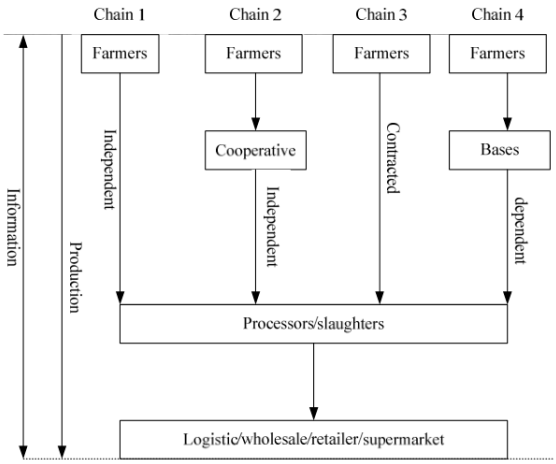

Figure 2. Structure of a Simplified Food Supply Chain.

There is a growing demand for meat aided by the government's prioritization for abundant and cheap food. Increasingly intransigent environmental, health and food safety problems associated with the food industry are beginning to make some Chinese experts, government authorities and consumers question the current approach to food production and consumption. These companies are asked to consider the environmental and social problems present in their entire supply chain.

1.6. Technical Criteria for Indicator Design and Selection

The literature review shows that there are so many technical criteria are common and they stress that an indicator should be:

Specific: Indicators must relate to the desired outcome, i.e. fit the purpose for measuring.
Measurable: Indicators should preferably be open to measurement in a quantitative manner.

Pedagogical: Indicators should be practical and designed for those who are going to use them.
Sensitive: Indicators must readily change as circumstances change.
Reliable: The information that an indicator is providing must be reliable. Data upon which the indicator is based must therefore be collected using a systematic method.
Cost-effective: The cost of accumulating necessary data should not exceed the benefits of using the indicator.

Relevant and Usable: Indicators should show what is needed to know. This includes the need for a clear definition of the objective that the indicators are meant to achieve.

2. Materials and Methods

In this study, a total of 1060 questionnaires were collected, there were 1015 valid questionnaires, the effective rate is 95.75%, and the questionnaire involves 28 areas. By the investigation of the enterprise not only includes the Shuanghui and Yurun such enterprise group, but also includes small family enterprises. Table 2 shows the area distribution of research enterprise for statistics.

Table 2. The area distribution of research enterprise for statistics.

Region	Number	Proportion	Region	Number	Proportion
Anhui	14	1.38%	Jiangxi	25	2.46%
Beijing	41	4.04%	Liaoning	12	1.18%
Fujian	8	0.79%	Inner Mongolia	3	0.30%
Gansu	3	0.30%	Ningxia	1	0.10%
Guangdong	101	9.95%	Qinghai	62	6.11%
Guangxi	7	0.69%	Shandong	58	5.71%
Hainan	1	0.10%	Shanxi	11	1.08%
Hebei	19	1.87%	Shaanxi	6	0.59%
Henan	225	22.17%	Shanghai	77	7.59%
Heilongjiang	4	0.39%	Sichuan	200	19.70%
Hubei	14	1.38%	Tianjin	9	0.89%
Hunan	13	1.28%	Yunnan	3	0.30%
Jilin	7	0.69%	Zhejiang	35	3.45%
Jiangsu	44	4.33%	Chongqing	12	1.18%

After data collection, they need to be transformed and integrated into one value.

Firstly, we will utilize food supply chain experts' opinions about which factors contribute the most to sustainability. The Analytic Hierarchy Process (AHP) is supposed to translate these opinions into importance ratings.

Then, the indicators are weighted by these importance ratings to generate an overall index of sustainability.

Last, stakeholders can use the index to evaluate its processes, and supply chain members can use this approach to guide improvement efforts.

This section should include a detailed description of the last version of the Sustainability Conformity Model, including the following information:

2.1. Detailed Description of the Indicators of the First, Second and Third Level

The model consists of 3 dimensions as the first level indicators: economic, social and environmental. Among them, economic index aims to evaluate the growth of enterprises; the social aspect mainly inspects how the enterprise comply with regulations; what employees composition and the safety production; environmental aspect mainly evaluate the enterprise organization management, production preparation, water management, energy management, waste management and emergency management, etc.

2.1.1. Growth

Growth consists of market share, technology research & development and customer service: the market share means how many percent the key products of the enterprise take in the main sales market; technology R & D refers how many percent the staffs who are engaged in technology research and development are accounted for the number of all staffs; customer service reflects the percent the personnel the staffs who are engaged in the customer service are accounted for the number of all staffs.

2.1.2. Security

Security consists of Product renewal rate, Receivables Turnover Ratio, Product sales rate. Product renewal rate means the speed of product renewal; Receivables Turnover Ratio means Enterprise financing ability and capital security; Product sales rate means the ability of products to meet social needs.

2.1.3. Legal Compliance

Legal Compliance is composed of product traceability capacity, contract compliance rate: the product traceability capacity refers to rate the enterprise products can be traceable; contract compliance rate refers to the rate the contracts are fulfilled without any delay or dissatisfaction.

2.1.4. Staff and Production Safety

Staff and Production Safety means how many percent the trained staffs accounts for the number of all staffs.

2.1.5. Employee Benefits

Employee Benefits means Salary level of staff.

2.1.6. Organizational Management

Organizational Management is composed of environmental and sustainable development report, the environmental protection departments, the enterprises' rules and regulations, Environmental accident emergency plan formulation. Among them, the environmental and sustainable development report examines whether the enterprise issues the report on the environmental and sustainable development; environmental protection departments aims to investigate whether the enterprise set up a special department or section to manage environmental protection; the rules and regulations of the enterprise try to judge whether the relevant chapters on environmental protection; Environmental accident emergency plan formulation evaluates whether the enterprise set up Environmental accident emergency plan formulation.

2.1.7. Production Preparation

Production Preparation is composed of equipment procurement, the procurement of raw materials. Among of them, equipment purchase aims to evaluate if the enterprise considers environmental issues during they purchase production equipment; raw materials procurement refers to whether the enterprise considers the environmental protection requirements for suppliers in the procurement of raw materials production.

2.1.8. Energy and Water Consumption Management

Energy and Water Consumption Management consists of energy-saving measures and energy-saving technology, water saving measures and technology.

2.1.9. Waste Management

Waste Management consists of waste water treatment, waste gas treatment, waste disposal and recycling, wherein the wastewater treatment refers to what kind of technology the enterprise adopt to treat waste water; waste gas treatment refers to which strategies and/or methods the enterprise adopts to reduce gas emissions; waste treatment refers to what kind of measures the enterprise adopts to reduce waste; waste recycling refers to what measures enterprise adopts to treat waste.

2.2. Description of the Indicators

Tables 3–5 show the description of sustainability indicators.

Table 3. Economic sustainability.

Indicator Name	**C_1. Market Share**	
Second Level	B_1. Growth	
Description	This indicator provides an insight on the market occupancy rate of products produced by the enterprise, and the ability enterprises control the market. The expansion of the market share can make enterprises obtain some kind of monopoly, further not only bring monopoly profits but also maintain a competitive advantage.	
Unit rate	Percentage of the company's main products in the main sales market.	
Rating	a. Less than 20% b. 20–40% c. 40–60% d. 60–80% e. More than 80%	0 0.25 0.50 0.75 1
Indicator name	C_2. Technology and Research Development	
Second Level	B_1. Growth	
Description	This indicator provides an insight on R & D ability of enterprises to meet realistic or potential market demand, through certain material and technical route, using appropriate methods and means. For this purpose, this indicator is the percent of the staffs, who engaged in technology research and development, accounts for all employees.	
Unit rate	Percentage of personnel involved in R & D activities.	
Rating	a. Less than 1% b. 1–2% c. 2–3% d. 3–4% e. More than 4%	0 0.25 0.50 0.75 1
Indicator name	C_3. Customer Service	
Second Level	B_1. Growth	
Description	This indicator provides an insight on customer oriented values. Any measures to improve customer satisfaction degree can be considered as the scope of customer service. For this purpose, this indicator accesses the staff percent who engaged in customer service.	
Unit rate	Percentage of personnel involved in customer service.	
Rating	a. Less than 1% b. 1–2% c. 2–3% d. 3–4% e. More than 4%	0 0.25 0.50 0.75 1
Indicator name	C_4. Product Renewal Rate	
Second Level	B_2. Security	

Table 3. *Cont.*

Indicator Name	**C_1. Market Share**	
Description	This indicator provides an insight on product renewal ability of enterprises to meet realistic or potential market demand, through certain material and technical route, using appropriate methods and means. For this purpose, this indicator is the ratio of new product output value to the total industrial output value, so as to reflect the status of the technological innovation results in the upgrading of the enterprise products.	
Unit rate	Percentage of new product output value to the total output value.	
Rating	a. Less than 10% b. 10–20% c. 20–30% d. 30–40% e. More than 40%	0 0.25 0.50 0.75 1
Indicator name	C_5. Receivables Turnover Ratio	
Second Level	B_2. Security	
Description	This indicator provides an insight on receivables turnover ability of enterprises to meet financing ability and capital security, If the company's accounts receivable can be recovered in time, the company's capital efficiency can be greatly improved.	
Unit rate	Percentage of actual payment and should be received.	
Rating	a. Less than 50% b. 50–60% c. 60–70% d. 70–80% e. More than 80%	0 0.25 0.50 0.75 1
Indicator name	C_6. Product Sales Rate	
Second Level	B_2. Security	
Description	This indicator reflect the sale level of product, analysis of production and marketing cohesion, study the degree of products meet the needs of society. Product sales rate can be very intuitive to see the sales of the product, thereby increasing profits.	
Unit rate	Percentage of sales value and total value of out-put.	
Rating	a. Less than 60% b. 60–70% c. 70–80% d. 80–90% e. More than 90%	0 0.25 0.50 0.75 1

Table 4. Social sustainability.

Indicator Name	**C_7. Products Traceability**	
Second Level	B_3. Law Compliance	
Description	This indicator provides an insight on food traceability and risk management and control. For this purpose, this indicator assesses the traceability adoption and implementation to provide the means to trace the products and potential recall across the supply chain, from farm to folk. For this purpose, this indicator accesses the proportion of product can be traceable within one company.	
Unit rate	Percentage of products that can be traced back.	
Rating	a. No traceability system. b. Less than 30% c. Between 30–60% d. Between 60–90% e. More than 90%	0 0.25 0.50 0.75 1
Indicator name	C_8. Contract Compliance Rate	
Second Level	B_3. Law Compliance	

Table 4. *Cont.*

Indicator Name	**C_7. Products Traceability**	
Description	This indicator provides an insight on the ratio of the actual delivery amount stipulated in the contract goods. For this purpose, this indicator assesses the fulfilment of important indicators. Enterprise contract credit rating have third grade nine. Level means: AAA, very good; AA, fine; A, better; BBB, acceptable; BB, general; B, subpar; CCC, poor; CC, bad C, very bad. For this purpose, this indicator accesses contract execution rate at what level.	
Unit rate	Percentage of contract compliance.	
Rating	a. Less than 20% b. 20–40% c. 40–60% d. 60–80% e. More than 80%	0 0.25 0.50 0.75 1
Indicator name	C_9. Academic Education and Skills	
Second Level	B_4. Staffs and Production Safety	
Description	This indicator provides an insight on staff capacity development. For enterprises to be sustainable they must provide conditions for stable employment, internal advancement, capacity development and growth for employees' effective training is to promote the process of the enterprise comprehensive competitiveness. For this purpose, this indicator measures whether employees have opportunities for capacity development and advancement within the enterprise.	
Unit rate	Percentage of personnel receiving training (all staff and new staff)	
Rating	a. 100% of staff does not receive training. b. Between 25% and 50% of staff receives training c. Only new staff receives training. d. Between 50% and 75% of staff receives training e. 100% of staff receives training.	0 0.25 0.50 0.75 1
Indicator name	C_{10}. Salary Level of Staff	
Second Level	B_5. Staffs and Production Safety	
Description	This indicator provides an insight on the level of workers average income. Competitive wages can attract high-quality talents, improve enterprise core competitive ability and work efficiency.	
Unit rate	The level of workers average income in the same area and industry.	
Rating	a. Lowest b. Lower c. The same d. Higher e. Highest	0 0.25 0.5 0.75 1

Table 5. Environmental sustainability.

Indicator Name	**C_{11}. Environmental Evaluation Report and Sustainability Report**	
Second Level	B_6. Organisation Management	
Description	This indicator provides an insight on the commitment of the enterprise with the reporting and communication of the company's sustainability and environmental protection. For this purpose, this indicator assesses the development by the company of sustainability and/or environmental reports that are reports published by a company or organization about the environmental impacts caused by its everyday activities.	
Unit rate	Existence and status of development of the environment evaluation report and/or sustainability report	
Rating	a. Has not published any environment evaluation and sustainability report.	0
	b. Has not published any environment evaluation and sustainability report yet, but is planning to elaborate them.	0.3
	c. Has not published any environment evaluation and sustainability report yet, but currently in the process of developing them.	0.6
	d. Has published environment evaluation and sustainability reports.	1
Indicator name	C_{12} Department of Environmental Protection	
Second Level	B_6. Organisation Management	

Table 5. *Cont.*

Indicator Name	**C_{11}. Environmental Evaluation Report and Sustainability Report**	
Description	This indicator provides an insight on how the enterprises are in accordance with the national laws, regulations, policies, to protect and improve the living environment and ecological environment, prevent and control pollution and other public hazards. For this purpose, this indicator assesses if the enterprise set up a special section or department to manage the environmental issues.	
Unit rate	Status of the environmental protection department	
Rating	a. Has no department responsible for the environmental protection.	0
	b. Has no department responsible for the environmental protection yet, but planning to set it up in the near future.	0.3
	c. The department responsible for the environmental protection is currently under development.	0.6
	d. Has a department responsible for the environmental protection.	1
Indicator name	C_{13}. Enterprise's Regulation and Management System for The Environmental Protection	
Second Level	B_6. Organisation Management	
Description	This indicator provides an insight on development and improvement of management system in enterprise. For this purpose, this indicator assesses if the enterprise establish an adequate management system.	
Unit rate	It is provided enterprise's regulation and guidelines on environment protecting or some evidences to show the efforts for regulation and guidelines by the enterprise.	
Rating	a. Has no regulation and guidelines for the environment protection.	0
	b. Has no regulation and guidelines for the environment protection yet, but planning to establish one.	0.3
	c. Is currently in the process of establishing a regulation and guidelines for the environment protection.	0.6
	d. Has a regulation and guidelines for the environment protection.	1
Indicator name	C_{14}. Emergency Contingency Plan Formulation	
Second Level	B_6. Organisation Management	
Description	This indicator provides an insight on environment affairs response ability. For this purpose, this indicator assesses if the enterprises to set emergency plans of environment.	
Unit rate	Existence of written emergency contingency plans.	
Rating	a. No	0
	b. Yes	1
Indicator name	C_{15}. Equipment Purchase Standard	
Second Level	B_7. Production Management	
Description	This indicator provides an insight on energy-saving awareness for the equipment procurement. For this purpose, this indicator assesses whether the enterprises consider the energy efficiency when purchasing production equipment.	
Unit rate	Percentage of production equipment purchases in which energy efficiency has been considered.	
Rating	a. Never	0
	b. Rarely	0.25
	c. Occasionally	0.50
	d. Often	0.75
	e. Always	1
Indicator name	C_{16}. Material Purchase Standard	
Second Level	B_7. Production Management	
Description	This indicator provides an insight on environmental awareness for raw materials standard. For this purpose, this indicator assesses whether the enterprises consider ecological standards when purchasing raw materials.	

Table 5. *Cont.*

Indicator Name	**C_{11}. Environmental Evaluation Report and Sustainability Report**	
Unit rate	Percentage of raw material purchases in which ecological standards have been considered.	
Rating	a. Never	0
	b. Rarely	0.25
	c. Occasionally	0.50
	d. Often	0.75
	e. Always	1
Indicator name	C_{17}. Water Saving Measures and Technologies	
Second Level	B_8. Energy and Water Management	
Description	This indicator assesses the presence of technologies that have achieved a decrease in water consumption and thus, avoid that enterprise contributes to problematic levels of water scarcity.	
Unit rate	Number of technologies adopted to save water during the last year.	
Rating	a. None	0
	b. One measure or technology	0.3
	c. Two measures or technologies	0.6
	d. More than three measures or technologies	1
Indicator name	C_{18}. Energy Saving Measures and Technologies	
Second Level	B_8. Energy and Water Management	
Description	This indicator provides an insight on energy-saving awareness. For this purpose, this indicator assesses the number of technologies were adopted by the enterprise that have effectively saved energy.	
Unit rate	Number of technologies adopted to save energy during the last year.	
Rating	a. None	0
	b. One measure or technology	0.3
	c. Two measures or technologies	0.6
	d. More than three measures or technologies	1
Indicator name	C_{19}. Waste Water Treatment	
Second Level	B_9. Pollution Management	
Description	This indicator checks the number of written measures and implemented technologies adopted by the enterprise to treat the sewages.	
Unit rate	Number of written measures and technologies adopted to treat waste water by the company with positive results in the water treatment during the last year.	
Rating	a. None	0
	b. One measure or technology implemented	0.3
	c. Two measures or technologies implemented	0.6
	d. More than three measures and technologies	1
Indicator name	C_{20}. Air Pollution Management	
Second Level	B_9. Pollution Management	
Description	This indicator checks the number of written measures and implemented technologies adopted by the enterprise to treat the air emissions.	
Unit rate	Number of written measures and technologies adopted to treat air emissions by the company with positive results during the last year.	
Rating	a. None	0
	b. One measure or technology implemented	0.3
	c. Two measures or technologies implemented	0.6
	d. More than three measures and technologies	1
Indicator name	C_{21}. Solid Waste Treatment	
Second Level	B_9. Pollution Management	
Description	This indicator checks the number of written measures and implemented technologies adopted by the enterprise to treat the solid wastes generated by its operation.	
Unit rate	Number of measures and technologies adopted to treat solid wastes generated by the company with positive results during the last year.	

Table 5. *Cont.*

Indicator Name	**C_{11}. Environmental Evaluation Report and Sustainability Report**	
Rating	a. None	0
	b. One measure or technology implemented	0.3
	c. Two measures or technologies implemented	0.6
	d. More than three measures and technologies	1
Indicator name	C_{22}. Recycle and Comprehensive Utilisation	
Second Level	B_9. Pollution Management	
Description	The generation of wastes and in particular of hazardous wastes creates disposal problems that can cause social problems (health risks, noxious gas), environmental pollution (leaching from inappropriate disposal, gaseous emissions) and economic damage (cost of disposal and rehabilitation). Therefore, waste generation should be reduced to the minimum in value chains.	
Unit rate	This indicator measures all practices and activities that have been implemented to effectively reduce the quantities of, and hazards derived from, waste generated by an enterprise' operations.	
Rating	a. Has no recycle and comprehensive utilisation for the environment protection.	0
	b. Has no recycle and comprehensive utilisation for the environment protection yet, but is planning to establish one.	0.3
	c. Is currently in the process of establishing a recycle and comprehensive utilisation for the environment protection.	0.6
	d. Has a recycle and comprehensive utilisation for the environment protection.	1

2.3. Theoretical Basis: The Analytic Hierarchy Process (AHP)

In this study, AHP [27] was employed to evaluate sustainability factors of Food Processing Enterprises in China. AHP was used because it can designate unquantifiable targets, and it is easier for users to develop decision support systems on it. AHP is a widely used analytical tool for solving multi-criteria decision-making (MCDM) problems [28]. It eliminates bias in decision-making by converting MCDM problems and subjective evaluation into a multilevel hierarchical framework [29].

The hierarchical structure of AHP consists of three levels: (1) the highest level shows the decision purpose, (2) the middle level represents decision considerations, and (3) the lowest level signifies the decision alternatives.

AHP has recently been used to solve problems in a variety of fields, such as Lee Jinhui et al. (2018) use AHP to evaluate sustainable of economy-based and community-based urban regeneration [30]; Park, Keun-Sik et al. (2018) utilize AHP to assess the ship acquisition of shipping companies by sale and purchase activities for sustainable growth [31]; Oudah, M et al. (2018) employ AHP to appraise determinants linked to family business sustainability in the UAE [32]. The AHP procedure in this paper comprises the following steps:

Step 1: Establish a Hierarchy Model.

Combination with previous studies, we established the hierarchical structure model of food processing enterprises in China is shown in Table 6.

Table 6. The hierarchical structure model of food processing enterprises in China.

	First level	Second level	Third level indicators
Sustainability of Enterprises	A_1-Economic Sustainability	B_1-Growth	C_1-Market share
			C_2-Technology and Research Development
			C_3-Customer service
		B_2-Security	C_4-Product renewal rate
			C_5-Asset-liability ratio
			C_6-Product sales rate
	A_2-Social Sustainability	B_3-Law compliance	C_7-Products Traceability
			C_8-Contract Compliance Rate
		B_4-Staff and production safety	C_9-Academic education and skills
		B_5-employee benefits	C_{10}-Salary level of staff
	A_3-Environmental Sustainability	B_6-Organization and management	C_{11}-Environment Evaluation Report and Sustainability Report
			C_{12}-Department of Environmental Protection
			C_{13}-Enterprise's regulation and guidelines on Environment Protection
			C_{14}-Environmental accident emergency plan formulation
		B_7-Production preparation	C_{15}-Equipment Purchase Standard
			C_{16}-Material Purchase Standard
		B_8-Energy and Water management	C_{17}-water saving measures and technology
			C_{18}-energy saving measures and technology
		B_9-Waste management	C_{19}-Waste water treatment
			C_{20}-Air pollution management
			C_{21}-Solid waste treatment
			C_{22}-Waste reduction practices

Step 2: Construct Judgment Matrix.

Table 7 shows the nine importance levels and their assignments given by Saaty.

Table 7. Importance scale meaning table.

Scale	Meaning
1	The two elements have the equal importance
3	The former element is slightly more important than the latter element
5	The former element is essentially more important than the latter element
7	The former element is intensity more important than the latter element
9	The former element is Extremely more important than the latter element
2,4,6,8	The middle value of the adjacent judgment

We chose 5 experts in each aspect of economy, society and environment, compared and sort to the evaluation indexes which we selected can reflect the sustainability of the enterprise, the score of enterprise sustainability as shown in Table 8. The selected experts are representative, authoritative, serious and responsible. The number of experts is related to the number of evaluation indicators. The experts in the economic field are from food processing enterprises, the experts in the social field are from universities and research institutions, and the experts in the environmental field are from the environmental protection departments of the government.

Table 8. Sustainability evaluation index judgment matrix.

Judgment System	A_1	A_2	A_3
A_1	1.0000	2.4607	1.6887
A_2	0.4064	1.0000	0.6553
A_3	0.5922	1.5259	1.0000

Calculation the product matrix of each row element M_i

Calculation 3 times square $\overline{W_i}$, $\overline{W_i} = \sqrt[3]{M_i}$

Calculation the feature vector W_i, $W_i = \frac{\overline{W_i}}{\sum_{i=1}^{n} \overline{W_i}}$

Calculation the maximum Eigen value of the judgment matrix $\lambda_{\max}$, $\lambda_{\max} = \sum_{i=1}^{n} \frac{(AW)_i}{nW_i}$

The result $\lambda_{\max} = 3.0158$

Because the calculation processes of other judgment matrices are the same as the sustainability, it is not listed here.

Step 3: Consistency check.

The consistency index is calculated by *CI*. The smaller the *CI*, the greater the consistency. Using the eigenvector corresponding to the maximum eigenvalue as the weight vector of the influence degree of the compared factor on a factor in the upper layer, the greater the inconsistency is, the greater the judgment error will be. It is therefore possible to measure the degree of inconsistency of A by the size of $\lambda - n$. Consistency index is defined as: $CI = \frac{\lambda - n}{n-1}$.

When $CI = 0$, there is complete consistency; *CI* is close to 0, with satisfactory consistency; the greater the *CI*, the greater the inconsistency.

To measure the size of *CI*, the random consistency indicator *RI* is introduced: $RI = \frac{CI_1 + CI_2 + \cdots + CI_n}{n}$.

The corresponding relation is shown in Table 9.

Table 9. Random consistency index *RI* standard value.

n	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

Considering that the deviation of consistency may be caused by random reasons, when testing whether the judgment matrix has satisfactory consistency, it is necessary to compare *CI* and random consistency index *RI* to obtain the test coefficient $CR = \frac{CI}{RI}$.

Generally, if $CR < 0.1$, the judgment matrix is considered to pass the consistency test; otherwise, there is no satisfactory consistency. After calculation, all the consistency check index is shown in Table 10. The consistency index of each system judgment matrix is less than 0.1. So it is acceptable to judge the consistency of the matrix.

Table 10. Consistency check index.

Judgment System	$\lambda_{\max}$	***CI***	***CR***
$A - B$	3.0158	0.0158	0.0272
$B_2 - C_{3-5}$	3.0001	0.0001	0.0002
$B_3 - C_{6-9}$	4.0088	0.0088	0.0098
$C_1 - D_{1-4}$	4.0059	0.0059	0.0065
$C_6 - D_{11-14}$	4.0042	0.0042	0.0046
$C_9 - D_{19-22}$	4.0042	0.0042	0.0047

Step 4: Total Hierarchical Ordering.

Calculating the weight of the relative importance of all factors at a certain level to the highest level is called total hierarchical ordering. This process is carried out from the highest level to the lowest level. After calculation, the weight distributions are shown in Table 11.

Table 11. Weight of index.

	First level	Second level	Third level indicators
Enterprise sustainability 1.0000	A_1-Economic Sustainability 0.5032	B_1-Growth 0.2956	C_1-Market share 0.0406
			C_2-Technology and Research Development 0.1161
			C_3-Customer service 0.0530
		B_2-Security 0.2076	C_4-Product renewal rate 0.0860
			C_5-Asset-liability ratio 0.0777
			C_6-Product sales rate 0.1299
	A_2-Social Sustainability 0.2198	B_3-Law compliance 0.1395	C_7-Products Traceability 0.1008
			C_8-Contract Compliance Rate 0.0388
		B_4-Staff and production safety 0.0504	C_9-Academic education and skills 0.0504
		B_5-Employee benefits 0.0300	C_{10}-Salary level of staff 0.0300
	A_3-Environmental Sustainability 0.2769	B_6-Organization and management 0.1145	C_{11}-Environment Evaluation Report and Sustainability Report 0.0558
			C_{12}-Department of Environmental Protection 0.0214
			C_{13}-Enterprise's regulation and guidelines on Environment Protection 0.0277
			C_{14}-Environmental accident emergency plan formulation 0.0097
		B_7-Production preparation 0.0496	C_{15}-Equipment Purchase Standard 0.0263
			C_{16}-Material Purchase Standard 0.0233
		B_8-Energy and Water management 0.0565	C_{17}-water saving measures and technology 0.0308
			C_{18}-energy saving measures and technology 0.0257
		B_9-Waste management 0.0563	C_{19}-Waste water treatment 0.0092
			C_{20}-Air pollution management 0.0122
			C_{21}-Solid waste treatment 0.0148
			C_{22}-Waste reduction practices 0.0202

The explanations of the different weights give to each indicator are the next ones:
Sustainable Development Index $A = A_1 + A_2 + A_3 = \sum \text{Weight} * \text{Score}$
The Sustainable Development Index is the sum of Economic (A), Social (B) and Environment (C).

$A_1 = B_1 * 0.2956 + B_2 * 0.2076;$
$A_2 = B_3 * 0.1395 + B_4 * 0.0504 + B_5 * 0.0300;$
$A_3 = B_6 * 0.1145 + B_7 * 0.0496 + B_8 * 0.0565 + B_9 * 0.0563;$
$B_1 = C_1 * 0.0406 + C_2 * 0.1161 + C_3 * 0.0530;$
$B_2 = C_4 * 0.0860 + C_5 * 0.0777 + C_6 * 0.1299;$
$B_3 = C_7 * 0.1008 + C_8 * 0.0388;$
$B_4 = C_9 * 0.0504;$
$B_5 = C_{10} * 0.0300;$
$B_6 = C_{11} * 0.0558 + C_{12} * 0.0214 + C_{13} * 0.0277 + C_{14} * 0.0097;$
$B_7 = C_{15} * 0.0263 + C_{16} * 0.0233;$
$B_8 = C_{17} * 0.0308 + C_{18} * 0.0257;$
$B_9 = C_{19} * 0.0092 + C_{20} * 0.0122 + C_{21} * 0.0148 + C_{22} * 0.0202;$

3. Results

After an individual evaluation of each company, a set of recommendations for each company was developed in order to improve its behavior towards the sustainability.

3.1. Evaluation Framework

The questionnaire is divided into three blocks with regard to the sustainability: Economic Sustainability, Social Sustainability, and Environmental Sustainability. These three Blocks are called first level indexes. Likewise, each Block is divided into different sub-blocks, which are called second

level indexes and which directly contribute to the economic, social or environmental sustainability of the company. Finally, each second level index contains third level indexes or sustainability indicators which permit to assess in a very specific way the sustainability behavior of the company. After answering all the questions in, we will inform the results which show the situation of their companies with regard to the economic, social and environmental sustainability, and with respect to sustainable development in general. The indexes were organized in four levels:

Level 0: Sustainable Development Index, which shows the behavior of the company towards sustainable development in general. Depending on the score obtained, we will get the assessment of this result (Best, Good, Moderate, Limited or Unacceptable). The score for this global index is in Table 12.

Table 12. Sustainable development index result.

Performance	Score
Best	0.8–1
Good	0.6–0.8
Moderate	0.4–0.6
Limited	0.2–0.4
Unacceptable	0–0.2

Level 1: First level indexes, which show the behavior of the company towards the economic, social and environmental sustainability. The scores for this first level index are in Table 13.

Table 13. First Level Index Result.

First Level Index	Best	Good	Moderate	Limited	Unacceptable
Economic sustainability	0.4–0.5032	0.3–0.4	0.2–0.3	0.1–0.2	0–0.1
Social sustainability	0.16–0.2198	0.12–0.16	0.08–0.12	0.04–0.08	0–0.04
Environmental sustainability	0.2–0.2769	0.15–0.2	0.1–0.15	0.05–0.1	0–0.05

Level 2: Second level indexes, which contribute to the economic, social and environmental sustainability of the company. The scores for this second level index are in Table 14.

Table 14. Second Level Index Result.

Second Level Index	Best	Good	Moderate	Limited	Unacceptable
B_1. Growth	0.24–0.2956	0.18–0.24	0.12–0.18	0.06–0.12	0–0.06
B_2. Security	0.16–0.2075	0.12–0.16	0.08–0.12	0.04–0.08	0–0.04
B_3.Law compliance	0.1–0.1395	0.075–0.1	0.05–0.075	0.025–0.05	0–0.025
B_4. Staffs and production safety	0.04–0.0504	0.03–0.04	0.02–0.03	0.01–0.02	0–0.01
B_5. Employee benefits	0.024–0.03	0.018–0.024	0.012–0.018	0.006–0.012	0–0.006
B_6. Organisation management	0.08–0.1145	0.06–0.08	0.04–0.06	0.02–0.04	0–0.02
B_7. Production preparation	0.04–0.0496	0.03–0.04	0.02–0.03	0.01–0.02	0–0.01
B_8. Energy and water management	0.04–0.0565	0.03–0.04	0.02–0.03	0.01–0.02	0–0.01
B_9. Waste management	0.04–0.0563	0.03–0.04	0.02–0.03	0.01–0.02	0–0.01

Level 3: Third level indexes, which permit to assess in a very specific way the behavior of the company with respect to those aspects that directly affect the sustainability of the company, such as energy and water saving measures adopted organization of environmental emergency drills, etc. The scores for this second level index are in Table 15.

Table 15. Third Level Index Result.

Third Level Index	Best	Good	Moderate	Limited	Unacceptable
C_1-Market share	0.0320–0.0406	0.0240–0.0320	0.0160–0.0240	0.0080–0.0160	0–0.0080
C_2-Technology and Research Development	0.0800–0.1161	0.0600–0.0800	0.0400–0.0600	0.0200–0.0400	0–0.0200
C_3-Customer service	0.0400–0.0530	0.0300–0.0400	0.0200–0.0300	0.0100–0.0200	0–0.0100
C_4-Product renewal rate	0.0690–0.0860	0.0520–0.0690	0.0350–0.0520	0.0180–0.0350	0–0.0180
C_5-Asset-liability ratio	0.0600–0.0777	0.0450–0.0600	0.0300–0.0450	0.0150–0.0300	0–0.0150
C_6-Product sales rate	0.1000–0.1299	0.0750–0.1000	0.0500–0.0750	0.0250–0.0500	0–0.0250
C_7-Products Traceability	0.0800–0.1008	0.0600–0.0800	0.0400–0.0600	0.0200–0.0400	0–0.0200
C_8-Contract Compliance Rate	0.0320–0.0388	0.0240–0.0320	0.0160–0.0240	0.0080–0.0160	0–0.0080
C_9-Academic education and skills	0.0400–0.0504	0.0300–0.0400	0.0200–0.0300	0.0100–0.0200	0–0.0100
C_{10}-Salary level of staff	0.0240–0.030	0.0180–0.0240	0.0120–0.0180	0.0060–0.0120	0–0.0060
C_{11}-Environment Evaluation Report and Sustainability Report	0.0400–0.0558	0.0300–0.0400	0.0200–0.0300	0.0100–0.0200	0–0.0100
C_{12}-Department of Environmental Protection	0.0160–0.0214	0.0120–0.0160	0.0080–0.0120	0.0040–0.0080	0–0.0040
C_{13}-Enterprise's regulation and guidelines on environment protection	0.0200–0.0277	0.0150–0.0200	0.0100–0.0150	0.0050–0.0100	0–0.0050
C_{14}-Environmental accident emergency plan formulation	0.0080–0.0097	0.0060–0.0080	0.0040–0.0060	0.0020–0.0040	0–0.0020
C_{15}-Equipment Purchase Standard	0.0200–0.0263	0.0150–0.0200	0.0100–0.0150	0.0050–0.0100	0–0.0050
C_{16}-Material Purchase Standard	0.0200–0.0233	0.0150–0.0200	0.0100–0.0150	0.0050–0.0100	0–0.0050
C_{17}-Water saving measures and technology	0.0240–0.0308	0.0180–0.0240	0.0120–0.0180	0.0060–0.0120	0–0.0060
C_{18}-Energy saving measures and technology	0.0200–0.0257	0.0150–0.0200	0.0100–0.0150	0.0050–0.0100	0–0.0050
C_{19}-Waste water treatment	0.0080–0.0092	0.0060–0.0080	0.0040–0.0060	0.0020–0.0040	0–0.0020
C_{20}-Air pollution management	0.0100–0.0122	0.0075–0.0100	0.0050–0.0075	0.0025–0.0050	0–0.0025
C_{21}-Solid waste treatment	0.0100–0.0148	0.0075–0.0100	0.0050–0.0075	0.0025–0.0050	0–0.0025
C_{22}-Waste reduction practices	0.0160–0.0202	0.0120–0.0160	0.0080–0.0120	0.0040–0.0080	0–0.0040

3.2. General Overview of the Results

The overall level of sustainable development ability of food processing enterprises in China is not high; pay attention to economic is significantly higher than to social and environmental aspects. In researched enterprise, only 8% scored more than 0.8 points, 13% score between 0.6 to 0.8 points, 45% score between 0.4 to 0.6 points, 32% score between 0.2 to 0.4, 2% score below 0.2. The sustainable development ability of Economic under ignore the weight score significantly higher than social and environmental aspects, many enterprises score almost close to zero in the aspect of social and environmental.

R & D investment is insufficient, the proportion of scientific research personnel is low, the yield rate of new product is difficult to guarantee. R/r ratio in researched enterprise, 77% of the company is less than 1%, 18% of the company is between 1% and 4%, 4% of the company is between 4% and 7%, less than 1% of the company is between 7% and 10%, there are only three companies reached 10%, product update cycle is long and slow, new product yields low.

Labor contract signing rate is not high, staff lack of production training, product traceability ratio is low, production and product safety is difficult to be guaranteed. In researched enterprise, only 18% has signed labor contracts with all employees, most companies hire employees based on market changes, elasticity of demand is very big, did not sign labor contract with employees; Only 14% of the companies regularly train all employees on skills and safety, 72% of the enterprises production train only for new employees on skills and safety, 14% of the companies did not train employees; 83% of the enterprise's products cannot be traced, 11% of the enterprises product traceability rate below 40%,

5% of the enterprises product traceability rate is between 40% and 80%, less than 1% of the enterprise product traceability rate more than 80%.

The environmental management is chaotic, the emphasizes to environmental protection in production preparation stage is not enough, the energy-saving and water-saving lag in technology and lack of measures, the waste is wanton emissions, the recycling utilization rate is extremely low, the environmental emergency management vacuum. In researched enterprise, 24% had set a special environmental management department, 11% had release the EIA report, 39% had formulate environmental regulations, 57% did not put energy consumption as an important indicator when purchasing production equipment, 67% did not put ecological standards as an important indicator when purchasing raw materials, 93% did not use energy-saving and water-saving technologies, 99% did not deal with waste gas, 70% did not deal with waste water, 60% did not deal with solid waste, 11% recycled waste. Almost 100% have not formulated an emergency plan for environmental accidents.

4. Discussion

According to the data obtained from the questionnaires, it can be said that the Chinese food processing entities have an acceptable basis for the implementation of sustainable development. But there are still some problems, the following suggestions are made.

First of all, focusing on R & D investment, and new product upgrading, the market gradually radiates development can make enterprise possess growth. Set up R & D department to collect user needs and translate them into new products, and implement better and more sustainable production and processing technology. Sell more products to existing users and seek potential users through effective means. Develop online sales model. Secondly, the reasonable capital structure and make production plan according to the market conditions can make enterprise possess safety. Third, abide by relevant laws and regulations, sign labor contracts with employees, provide competitive compensation and necessary training on safety production and production skills, product can be traceability. Implement the training plan for all employees of the enterprise, improve the ability building of new employees, and set up the ability building plan to train them with necessary production skills. Fourth, pay attention to environmental protection work, set up the special environmental protection department and administrative staff, release the EIA report, set out strictly environmental regulations and environmental accident emergency plan, did not pass an energy consumption detail of the entire production process from production equipment and raw materials procurement to waste disposal. Update all environmental laws, policies and regulations affecting enterprises and ensure compliance. Organize publicity activities to make all employees aware of the importance of protecting the environment. Report the status of enterprise environmental protection regularly. Set up a staff suggestion box to provide suggestions on how to improve the environmental sustainability of the enterprise. Encourage suppliers to provide green raw materials and reward them. Test and monitor the water-saving and energy-saving equipment regularly. Adopt at least one water-saving and energy-saving technology every two years to systematically reduce water and energy consumption.

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