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Constructing a Hierarchical Agribusiness Framework in Chinese Belt and Road Initiatives under Uncertainty

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Abstract: As a result of China launching its belt and road initiatives, an increasing number of firms are searching for an approach to developing sustainability. In particular, agribusinesses are encountering difficulties exploring decisive practices for sustainable food in a context involving diverse stakeholders. To clarify these differences in expectations between agribusinesses and their stakeholders, this study employs vague sets associated with interpretive structural modelling to develop a framework for agribusinesses and their customers. A comparison of these two frameworks reveals that the government still plays a key role in motivating sustainable food development in terms of establishing the relevant regulations and processes. Moreover, the customer is the final stakeholder that must be taken into account by agribusiness. Both agribusinesses and customers are concerned about health and safety considerations in sustainable food. Further details related to this context are addressed in the present study.

Keywords: sustainable food; stakeholder theory; agribusiness; vague interpretive structural modelling

1. Introduction

In recent years, the Chinese government has established several regulations to simultaneously achieve economic growth, reduce environmental impacts and enhance social expectations under its belt and road initiatives. Specifically, relevant policies and regulations are being established that require compliance from agribusinesses [1,2]. To ensure that agribusinesses fully conform to the regulations, they have reconnected with their points of origin—farmers and agricultural products—for monitoring and assessment. Thus, Chinese agribusinesses have played an important role by taking responsibility for distributing knowledge, environmental awareness and methods to ensure that the points of origin can fulfil regulations and prevent negative impacts on the environment [3]. In addition, agribusinesses are also responsible for preventing environmental impacts through their own operational management [4,5]. Pursuing sustainable food (Several terms related to sustainable food are being discussed in China, e.g., "green food", "organic food" and so on, but none can fully express the concept of sustainable food. Thus, this study proposes a precise definition to address this gap. 'Sustainable food' refers to food that complies with standards and regulations, has no additives, and involves the use of no toxic or harmful substances during the entire production process. It requires quality control from field to table to ensure that it simultaneously meets all environmental, social and economic criteria) production thus becomes a major practice that must balance economic, environmental and social considerations. However, the field still lacks concern for its stakeholders, which may generate inefficient practices among agribusiness.

Agribusiness has found it difficult to identify an appropriate model to launch sustainable food practices because it requires cooperation with diverse stakeholders [6]. Stakeholder theory provides a new concept to illustrate the effects of management: it shows that the needs of shareholders can be satisfied without fulfilling the needs of stakeholders [7,8]. The most important function of this theory is that it distinguishes the different needs among stakeholders and then identifies the appropriate activities to respond to their needs. Generally, the term 'stakeholders' refers to customers, employees, shareholders, communities and other subjects [9]. When considering sustainable food, all of these subjects have their own opinions. However, most studies focus on a single stakeholder when discussing sustainable food [10]. Although several studies perceive the significance of stakeholders, they still conduct their analysis solely from the viewpoint of agribusinesses [11]. To overcome these gaps, this study proposes vague interpretive structural modelling (VISM), which integrates vague sets and modelling to develop comparison frameworks.

Vague sets are used to reduce the uncertainty of assessments. Subsequently, interpretive structural modelling (ISM) enables the simplification of complex issues into a structural framework. Such a framework offers an important way for agribusinesses to identify problems [12]. A structural framework offers precise guidelines for agribusinesses to launch efficient and effective sustainable food practices with limited resources. The appropriate structural framework can enhance the accuracy of decision making and strategy [13]. Although structural and/or hierarchical frameworks have been widely developed and applied to solve decision-making problems, there is still a complex interrelationship within the problem. Thus, Shi et al. [14] developed a closed-loop hierarchical framework to consider these interrelationships to improve corporate sustainable development in the manufacturing industry. Subsequently, Tseng and Bui [15] proposed a novel approach to construct a framework to search for industrial symbiosis in the textile industry. Nevertheless, the field still lacks a precise framework to guide agribusinesses in launching sustainable food practices.

Therefore, the objective of this study is to adopt stakeholder theory in association with sustainable food practices to structure frameworks that allow comparison between customers and agribusiness to identify their differences, improve practices and offer a basis to support the theory. The frameworks are compared so that customers and agribusinesses can understand the difference in perceptions between them; this will break through the current viewpoint that only focuses on the firm's side and provide more quantitative data to support the development of sustainable food production while considering the customer. In addition, the proposed method reduces the uncertainty of assessment and considers the degree of hesitancy of the evaluator to improve the quality of decisions. The remainder of this study is organized into five sections. Section two delivers a comprehensive literature review to support the main points of this study. A detailed discussion of VISM computations and the proposed analytical procedures are addressed in section three. Section four introduces the case and analytical results. Section five presents the theoretical and managerial implications. The conclusions, research limitations and suggestions for future study are provided in the final section.

2. Literature Review

This section includes four subsections. The first part introduces the background of stakeholder theory. The second part presents the relevant literature in terms of sustainable food and gives a precise definition of sustainable food. The proposed method and measures are presented in the third and fourth parts, respectively.

2.1. Stakeholder Theory

The origin of the stakeholder concept arises from the field of company management, introduced by Freeman and defined as "any group or individual who affects or is affected by the decisions and the achievement of corporate objectives" [16]. It is one of the broadest definitions in the literature. Later, Thompson et al. [17] defined stakeholders as "the group who has the relationship with the organization". Johnson and Scholes [18] suggested that "stakeholders are those individuals or groups

who depend on the organization to fulfil their own goals, also the organization depends on them in return". For a company, stakeholders include customers, suppliers, employees, and the local community. The basic practical idea of stakeholder theory is that the success of a company is highly dependent on smooth cooperation with its stakeholders [19]. Stakeholder theory recognizes that within any organizational context, there are various individuals and groups who support and influence the organization, and they are reciprocally supported and influenced [16,20]. Stakeholder theory requires managers to consider all the stakeholders in their unique operational setting and to ensure ethical, equitable and successful relationships among the organization, individuals, and networks of stakeholders.

Stakeholder theory accepts the existence of different ideas about the optimum performance of a company and the varied abilities of different stakeholders to influence organizational activities [21]. The different roles and advantages in organizational operations require stakeholders to function optimally to achieve common interests. For instance, suppliers share information about the production process, and they work with other suppliers to reduce costs and improve product quality [22]. Thus, companies establish a good relationship with their suppliers by providing high quality products and services to customers and motivating employees to improve their performance [23]. In addition, governments must increase the support and transparency of activities by promoting stakeholder engagement [24]. Subsequently, customers embrace company policies or participate in the user-led innovation process to contribute added value [25].

Many researchers have applied this theory in multiple fields by clarifying the behaviour and expectations among different stakeholders. Zaharia & Zaharia [26] showed that such clarification can enhance the positive relationship between social performance and financial performance. Thus agribusiness must realize that stakeholders' interests are a priority for reaching common goals. Manders et al. [27] adopted this perspective to examine the flexibility of the food supply chain among supplier, manufacturer, logistic service provider and retailer. Allaoui et al. [28] considered several stakeholders by investigating the sustainable development among an agri-food supply chain. To maximize the performance and overcome the gaps for promoting sustainable food under belt and road initiatives, this study utilizes stakeholder theory to identify the expectations between agribusiness and customers.

2.2. Agribusiness

As a result of food shortages and climate change, agribusiness strives to launch sustainable food practices to ensure humanity's survival. This approach can be traced to 1957 when Davis and Goldberg [29], (p. 136) defined agribusiness as "the sum of all operations involved in manufacture and distribution of farm supplies, production operations on the farm, and the storage, processing, and distribution of farm commodities." Agribusiness is used to convey an aggregate view of agriculture and its business-related activities, covering the multiple functions and processes that are involved in modern food production and distribution [30], (p. 77). To reflect the situation of modern agribusiness, Zylbersztajn [31] attempted to analyse the origin, evolution and perspective among agribusiness systems by exploring the guidelines.

Many businesses are pursuing sustainability, and agribusiness is not an exception. Agribusiness strives to launch sustainable food practices to promote competitive advantage. Dlamini et al. [32] used Porter's theory to identify the factors that affect agribusiness competitiveness in Swaziland. Adenle et al. [33] explored the key drivers and risk factors underlying agribusiness competitiveness in developing countries, taking Nigeria as a case to conduct an in-depth analysis. Behzadi et al. [34] adopted a supply chain management view to review the relevant literature on quantitative risk management models for agribusiness. Shekhawat et al. [35] developed the process and structure of agribusiness and agro-processing in Uttar Pradesh.

However, attempts to strengthen agribusiness cannot overlook the stakeholders. Thus, several studies have tried to address the relationship between stakeholders and agribusiness. Geldes & Felzensztein [36]

conducted a study to explore the relationship between different stakeholders (i.e., other companies, providers, clients) and agribusiness. Mueller & Theuvsen [37] determined consumer attitudes towards corporate social responsibility in agribusiness and found that the government's participation in a company's corporate social responsibility has the greatest impact on consumer attitude. Although these studies have attempted to explore the relationship with diverse stakeholders, there is still a lack of a precise framework for agribusinesses to improve sustainability. Thus, this study proposes VISM associated with sustainable food practices in developing a hierarchical structure for guiding the agribusinesses that are part of China's belt and road initiatives.

2.3. Proposed Method

Decision-makers' judgements are often vague and uncertain and cannot be expressed with exact numbers. It is more rational for decision-makers to adopt imprecise linguistic terms to express their judgements. Fuzzy set theory offers the possibility of processing data and information that involve the subjective characteristics of human nature in the decision-making process [38]. Zhang et al. [39] indicated that, to some degree, vague sets have a more powerful ability to process fuzzy information than fuzzy sets. Zeng et al. [40] agreed that vague set theory is becoming increasingly popular in addressing decision-making problems because it has a more powerful expressive ability than fuzzy numbers, and it retains the ability of vague-valued fuzzy measures to model among indexes. Vague set theory improves the description of the objective, real world and is thus a promising tool to address inexact, uncertain or vague knowledge [41,42]. Therefore, vague sets can overcome the barrier of imprecise information, providing an essential tool for decision-makers to evaluate respondents' information [43].

ISM is used to transform unclear, poorly articulated mental models into visible, well-addressed models [44,45]. The purpose of using ISM is to analyse complicated issues according to systematic and logical thinking supported by the judgement of experts [46,47]. Mathiyazhagan et al. [48] emphasized that experts' practical experience and knowledge can be used to decompose a complicated system into several sub-systems (elements) and construct a multilevel structural model. Zhang et al. [49] used ISM to analyse the relationship between the factors that impact a network reconfiguration. Shen et al. [50] examined and evaluated the factors that affect the implementation of an emission trading system in the building sector based on a hierarchical structure. These studies have shown that ISM has been applied in a wide range of fields to overcome real-world problems.

ISM requires experts to make the judgements in exploring the guidelines of sustainable food development. However, these judgements include considerable uncertainties, which cannot be directly utilized in numerical computation. To address this gap, vague sets are proposed. Subsequently, building a hierarchical structure can help to identify the differences between agribusiness and customer. These differences enable the provision of evidence in supporting the establishment of government regulations as well as leading agribusiness to improve its current performance in sustainable food practices.

2.4. Proposed Measures

Agribusiness aims to achieve sustainable food production and consumption, which is driven by the customers (A1). Gao et al. [51] indicated that individual lifestyle, diet, consumption habits and food preferences influence the selection of food. Grunert et al. [52] found that customers are willing to pay a higher price to buy sustainable food (C1), which can promote agribusiness in its production of relevant products. As a result of customers' environmental awareness, there has been a rapid increase in concern about the attributes of food with regard to environmental friendliness (C2). Moreover, health and safety considerations are part of the customer considerations (C3) that motivate agribusiness in its selection of materials and processing methods to achieve sustainable food production modes [53]. Subsequently, the better taste (C4) and better quality (C5) of sustainable food not only obtain more customers, but can also promote the consumption of sustainable food [51].

The government (A2) plays an important role among stakeholders with a greater capacity to influence the food processing and dietary habits among the entire population. Thus, the government must ensure safety among the procedures of each food item that is produced, and then encourage the population to select healthy foods to prevent the negative impacts on the environment and to increase the public's health and welfare [54]. By establishing relevant regulations (C6), the government can require food suppliers to meet standards and maintain quality from raw materials to the end product [55]. Furthermore, developing sustainable label certification (C7) through government approval will increase the credibility of sustainable food as well as promote customers' confidence in selection and competition in the market [56]. Although the government has several relevant regulations and certification systems have been launched in the current market, the government still must collect comprehensive data to improve its food safety certification systems (C8) to continuously mitigate any claims that emerge [57]. To ensure the beginnings of sustainable food production achieves the proper standards, the government provides subsidies and loans (C9) to support farmers to adopt environmentally friendly cultivation to guarantee that the beginning of food production is sustainable [58]. Next, tax reductions for the sale of sustainable food (C9) are an effective and efficient instrument to push the public towards choosing sustainable food [59].

The supplier (A3) can generate competitive advantage while cooperating closely with other stakeholders [19]. Thus, agribusinesses can increase the connection with their suppliers to ensure that social and environmental efforts run smoothly. During the production procedure, suppliers must comply with food quality standards (C11) and reduce the occurrence of risk (C12) to ensure the food supply [60]. Suppliers must also develop knowledge management in food production processes (C13) to trace the use of pesticides and other inputs [61]. A food traceability system (C14) that records data provides information to suppliers, such as origin, to promote food security and quality control, which can be considered to be a competitive advantage [62]. In addition, suppliers should pay more attention to natural resource management (C15) and the use of certified plant material (C16) to reduce environmental hazards and ensure food quality [63,64].

To increase financial returns and cut operational costs while launching sustainable food practices, agribusiness (A4) activities are particularly important, especially strengthening collaboration with suppliers (C17). This relies on the measurements of sustainability in terms of sustainable food development [65]. However, risk management (C18) plays a significant role in the operation management of agribusiness, especially for social sustainability issues, such as health and human risks [66]. To prevent risk occurrences, the use of safe facilities (C19) is important in launching sustainable food practices [67], as it ensures the safety and health of labourers. Once labourers feel that agribusiness considers them to be an asset, labour productivity can be improved (C20) to increase economic growth [68]. Agribusiness can also engage a price competition strategy (C21) to expand market share in promoting economic growth; however, it must consider company reputation (C22). Based on the above discussion, the proposed measures are listed in Table 1.

Table 1. Proposed measures.

Aspects		Criteria
Customer (A1)	C1	Willingness to pay higher price when selecting sustainable food
	C2	Environmental awareness
	C3	Health and safety considerations
	C4	Taste of sustainable food
	C5	Quality of sustainable food
Government (A2)	C6	Establishing relevant regulations
	C7	Developing sustainable label certification
	C8	Improving food safety certification systems

Table 1. *Cont.*

Aspects		Criteria
	C9	Offering subsidies and loans for developing sustainable food
	C10	Offering tax reductions for selling sustainable food
Supplier (A3)	C11	Compliance with the standards in producing sustainable food
	C12	Reducing risk occurrence in production
	C13	Developing knowledge management in sustainable food production processes
	C14	Implementing food traceability systems
	C15	Natural resources management
	C16	Using certified plant material
Agribusiness (A4)	C17	Strengthening collaboration with suppliers
	C18	Food risk management
	C19	Using safe facilities
	C20	Improving labour productivity
	C21	Price competition
	C22	Company reputation

3. Research Method

3.1. Vague Sets

Within fuzzy set theory, the object Q is attributed to V. Therein, V represents a discourse universe; Q is the degree of membership, which is expressed in a pointed-based value between 0 and 1. Nevertheless, there is a disadvantage in that the theory only considers a single membership value with positive support [69]. This omits the negative concerns that reflect the real problem. Hence, vague sets are proposed to overcome this weakness by adopting the concept of interval-based membership. This concept allows the acquisition of vague information [70]. The following definition is used to transform qualitative information into a quantitative computation that captures the negative considerations.

Definition 1. *Let $S = s_1, s_2, \cdots s_i$ represent a discourse universe. Then, vague set G is contained in the discourse universe S with truth-membership function tr_G and false-membership function fa_G, as shown in the following equations.*

$$S = [s_i, tr_G(s_i), 1 - fa_G(s_i)] | s_i \in S \quad (1)$$

$$tr_G : S \to [0,\ 1] \quad (2)$$

$$fa_G : S \to [0, 1] \quad (3)$$

where $tr_G(s_i)$ expresses the lower bound membership degree obtained from the s_i information. $fa_G(s_i)$ is the lower bound rejection of s_i and holds the information in opposition to s_i. In addition, the s_i membership degree must fulfil the rule $tr_G(s_i) + fa_G(s_i) \leq 1$. Therefore, s_i's membership degree within vague set G is constrained by the sub-interval $[tr_G(s_i), 1 - fa_G(s_i)] \to [0,\ 1]$; thus it can be rewritten as $s_i = [tr_G(s_i), 1 - fa_G(s_i)]$ [71,72].

Definition 2. *Assume $x = [tr_x, 1 - fa_x]$ and $y = [tr_y, 1 - fa_y]$ represent two vague values among S. The distance between x and y are generated in accordance with fuzzy set theory as shown below.*

$$\Delta(x, y) = |tr_x - tr_y| + |fa_x - fa_y| + |\pi_x - \pi_y| \quad (4)$$

where $\pi_x = 1 - tr_x - fa_x$, $\pi_y = 1 - tr_y - fa_y$.

Definition 3. *Let $z = [tr_z, 1 - fa_z]$ become a vague value in S; the degree of hesitancy can be defined through the following equation.*

$$d(z) = tr_z + tr_z \times (1 - tr_z - fa_z) \quad (5)$$

3.2. Vague Set Associated with ISM

Suppose there are q sets of criteria $(C = C_1, C_2, \cdots, C_q)$ in a multi-criteria decision-making problem. These are assessed by ω experts denoted as $A^n = \left[\alpha_{op}^{\omega}\right]_{q\times q}$; therein, $\alpha_{op}^{\omega} = [\ell_{op}, u_{op}]$ represents the transformed vague numbers as shown in Table 2. Accordingly, the individual vague matrix for assessing the q sets of criteria are expressed as the following equation.

$$C^{\omega} = \left[\alpha_{op}^{\omega}\right]_{q\times q} = \begin{array}{c} \\ C_1 \\ C_2 \\ \vdots \\ C_p \end{array} \begin{array}{c} \begin{array}{cccc} C_1 & C_2 & \cdots & C_o \end{array} \\ \begin{bmatrix} 1 & \alpha_{21}^{\omega} & \cdots & \alpha_{o1}^{\omega} \\ \alpha_{12}^{\omega} & 1 & \cdots & \alpha_{o2}^{\omega} \\ \vdots & \vdots & \ddots & \vdots \\ \alpha_{1p}^{\omega} & \alpha_{2p}^{\omega} & \cdots & 1 \end{bmatrix} \end{array} \tag{6}$$

where $\alpha_{op}^{\omega} = [\ell_{op}, u_{op}]$.

Table 2. Linguistic scales for transferring vague numbers.

Linguistic Terms	Linguistic Preferences	Contrasting Vague Numbers $[\ell_{op}, u_{op}]$	α	β
NI	No Influence	$[0.1 - \alpha \times \varepsilon,\ 0.3 + \beta \times \varepsilon]$	0.5	0.5
VL	Very Low Influence	$[0.3 - \alpha \times \varepsilon,\ 0.3 + \beta \times \varepsilon]$	0.5	0.5
HI	High Influence	$[0.7 - \alpha \times \varepsilon,\ 0.7 + \beta \times \varepsilon]$	1.0	0.0
VH	Very High Influence	$[0.9 - \alpha \times \varepsilon,\ 0.9 + \beta \times \varepsilon]$	0.5	0.5

Note: ε represents the hesitancy degree; 0.2 is adopted in this study.

The degree of hesitancy is computed and the benefit b_p and cost c_p scores are identified through the following equations:

$$b_p = max\left[\ell_{op}, u_{op}\right] = max\left[\left(\ell_{1p}, u_{1p}\right), \left(\ell_{2p}, u_{2p}\right), \cdots, \left(\ell_{op}, u_{op}\right)\right] \tag{7}$$

$$c_p = min\left[\ell_{op}, u_{op}\right] = min\left[\left(\ell_{1p}, u_{1p}\right), \left(\ell_{2p}, u_{2p}\right), \cdots, \left(\ell_{op}, u_{op}\right)\right] \tag{8}$$

Then, "group utility" $\mathcal{g}_o$ and "individual regret" $\mathcal{r}_o$ are acquired by adopting the equations below:

$$\mathcal{g}_o = \sum_{p=1}^{q} \varepsilon_p \frac{\Delta\left|b_p,\ d(op)\right|}{\Delta\left|b_p, c_p\right|},\ o = 1, 2, 3 \cdots, q \tag{9}$$

$$\mathcal{r}_o = \max_{p} \varepsilon_p \frac{\Delta\left|b_p, d(op)\right|}{\Delta\left|b_p, c_p\right|}, o = 1,2,3 \cdots, q \tag{10}$$

$$\Delta\left|b_p,\ d(op)\right| = \left|\ell_{op} - \max_{1\le o\le q} \ell_{op}\right| + \left|u_{op} - \max_{1\le o\le q} u_{op}\right| + \left|\pi_{op} - \overline{\pi}_{op}\right| \tag{11}$$

$$\Delta\left|b_p, c_p\right| = \left|\max_{1\le o\le q} \ell_{op} - \min_{1\le o\le q} \ell_{op}\right| + \left|\max_{1\le o\le q} u_{op} - \min_{1\le o\le q} u_{op}\right| + \left|\overline{\pi}_{op} - \underline{\pi}_{op}\right| \tag{12}$$

therein, $d(op) = tr_{op} + tr_{op} \times \left(1 - tr_{op} - fa_{op}\right)$, $o, p = 1, 2, 3 \cdots, q$; $\overline{\pi}_{op} = 1 - \max_{1\le o\le q} \ell_{op} - \max_{1\le o\le q} u_{op}$; $\underline{\lambda}_{op} = 1 - \min_{1\le o\le q} \ell_{op} - \min_{1\le o\le q} u_{op}$. ε_p represents the weighting vector of aspects, which must satisfy $\varepsilon_p \ge 0$, $\sum_{p=1}^{\omega} \varepsilon_p = 1$.

The "profit ratio" pf_o is obtained by adopting the following equation:

$$pf_o = \theta \times \left[\frac{\left(\mathcal{g}_o - max\ \mathcal{g}_o\right)}{\left(min\ \mathcal{g}_o - max\ \mathcal{g}_o\right)}\right] + (1 - \theta) \times \left[\frac{\left(\mathcal{r}_o - max\ \mathcal{r}_o\right)}{\left(min\ \mathcal{r}_o - max\ \mathcal{r}_o\right)}\right], o = 1,2,3 \cdots, q \tag{13}$$

where θ represents the weighted years of work experience to create the strategy for maximizing group utility; commonly, θ is set up as 0.5.

Once the profit ratio matrix of each expert has been obtained, then the following equation assists in generating the aggregating matrix p_g.

$$p_g = \sum pf_o/\omega = [\widetilde{p}_{ab}]_{q\times q} \tag{14}$$

The aggregating matrix must be transferred into binary code to compute the threshold number through the following equations.

$$p' = \left[\sum_{a=1}^{q}(\widetilde{p}_{ab})/q\right]_{q\times 1}$$
$$\text{If } \widetilde{p}_{ab} \geq p', \text{ the value is considered to be 1, otherwise, it is 0.} \tag{15}$$

$$p^* = \left[\sum_{b=1}^{q}(\widetilde{p}_{ab})/q\right]_{1\times q}$$
$$\text{If } \widetilde{p}_{ab} \geq p^*, \text{ the value is considered to be 1, otherwise, it is 0.} \tag{16}$$

Subsequently, the binary reachability matrix can be expressed as

$$p^r = [p^r_{ab}]_{q\times q} \tag{17}$$

The reachability $(\overline{p})$ and antecedent $\left(\overline{\overline{p}}\right)$ set are classified as follows:

$$\begin{array}{c}\text{If } p^r_a = 1, \overline{p} = \left\{p^r_1, p^r_2, \cdots, p^r_a\right\},\ a\epsilon p \\ \text{If } p^r_b = 1, \overline{\overline{p}} = \left\{p^r_1, p^r_2, \cdots, p^r_b\right\},\ b\epsilon p\end{array} \tag{18}$$

Adopting the following equation explores the intersection set p^s,

$$p^s = \overline{p} \cap \overline{\overline{p}} \tag{19}$$

where $p^s = \left[p^s_{ab}\right]_{q\times q}$.

Finally, driving power dr is acquired by the following equation:

$$dr = \left[\sum_{b=1}^{q} p^s_{ab}\right]_q = [p^s_b]_q \tag{20}$$

3.3. Proposed Analytical Procedures

1. Purifying the proposed measures—the initial proposed measures are collected from a comprehensive literature review to maintain reliability. Then, an expert group is consulted regarding these measures to enhance their validity and ensure that the real problem is accurately reflected. A questionnaire is developed to assess the relationships based on the experts' knowledge and experience.
2. Converting the response into a vague number—to simplify the transformation, taking Equations (1)–(6) develops the transformed vague number before transforming the response. Subsequently, all transformations can be contrasted with Table 2.
3. Obtaining the intersection set—once the individual vague matrices are gathered, applying Equations (7)–(14) generates the aggregating matrix. Next, utilizing Equations (15)–(17) shifts these values into binary codes. Equations (18) and (19) can assist in obtaining the intersection set.
4. Contracting the framework—this procedure applies Equation (20) to identify the driving power and then selects the highest driving power to structure the first level. The framework relies on repeating this procedure until all levels are finalized.

4. Results

4.1. Case Background

The agribusiness case (JASM) focuses on the largest agribusiness in the city of Panjin, Liaoning Province, China. Although it is an agribusiness, this company is striving to launch sustainable food practices to improve the lives of farmers and customers. Currently, it has a staff of 150 and 6 food divisions, which are devoted to exploring critical practice in offering sustainable food and establishing an assessment system. Furthermore, JASM has also formed its own sustainable food brands and progressively established a food certification system with tracing information. The central idea is to generate continuous improvement until reaching the highest level of quality in terms of products, processes and services. Currently, the Chinese government is aggressively pushing for sustainable development in many fields, and JASM is enabling an opportunity to catch up. It is cooperating with the government to increase their effect in the northeast of China and simultaneously attain economic growth, environmental protection and social expectations.

As a leading agribusiness in Panjin, JASM invests substantial resources in the promotion of sustainable food. For instance, it has established its own internet platform so that customers can trace the origin of products, even allowing the origin to be physically observed through webcams. Although these activities can enhance firm reputation and earn customers' trust, it still faces a critical situation in identifying customer perceptions of the practices to determine their effectiveness. JASM has insufficient ability to balance economic, environmental and social aspects. In addition, a precise framework for developing sustainable food is still lacking, which increases the difficulty of recognizing the situation. Thus, this study adopts VISM to assist in creating a precise framework to allow comparison between the customer and the firm. By comparing the customers' and JASM's frameworks, JASM is able to see the performance of current practices and to better arrange its resources to fulfil customer needs.

4.2. Results

Step 1: Finalizing the proposed measures

This study collected the initial proposed measures from the literature review to increase reliability and consulted with an expert group containing 11 experts from directors to senior managers with at least five years working experience in JASM to refine these measures. Subsequently, these final measures were used to formulate the questionnaire to identify the interrelationships between agribusiness and customers. For the customer portion, this study selected 10 customers who shopped in JASM's retail store, often with at least three years' membership with JASM.

Step 2: Transferring responses into vague numbers

Upon receiving the responses from the experts and the customers, these results are stated in linguistic terms that require transformation into contrasting vague numbers by applying Equations (1)–(6), as shown in Table 2. Table 3 shows the assessment results from the expert 1. The transformation results are presented as $I = [0.4,\ 0.6]$.

Step 3: Obtaining the aggregating matrix

These vague numbers compute the benefit and cost scores by applying Equations (7) and (8) and then follow with Equations (9)–(14) to acquire the aggregating matrix. Subsequently, adopting Equations (15) and (16) transforms the aggregating matrix into a reachability matrix with binary code as presented in Table 4.

Step 4: Generating intersection set with driving power

Once the reachability matrix is obtained, applying Equations (17)–(20) generates the intersection set and driving power. Table 5 presents the intersection set with driving power from the experts' assessments.

Step 5: Structuring the hierarchical framework

Based on Table 5, the higher driving power is selected to construct the framework. Then, the higher driving power can take 11 into account in formulating level 1, as highlighted in grey in Table 5. This procedure is repeated until the structure is completed by arranging all of the criteria into the figure. Figure 1 presents the agribusiness framework of JASM.

Step 6: Constructing the customer framework

The above five steps are repeated to acquire the customer framework (as presented in Figure 2).

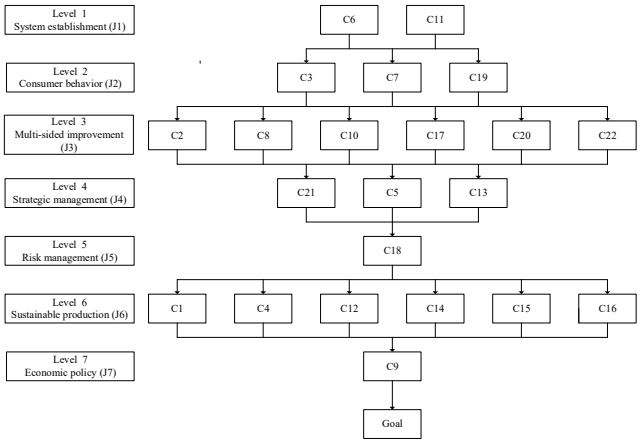

Figure 1. The framework from the JASM experts.

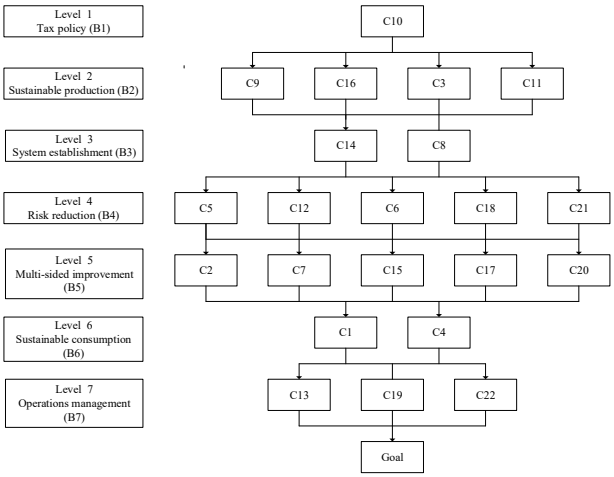

Figure 2. The framework from JASM customers.

Table 3. The sample of assessment results from expert 1.

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22
C1	1	I	I	I	I	NI	VHI	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
C2	I	1	I	I	I	I	I	NI	VHI	NI	NI	NI	VHI	I	VL	I	NI	NI	NI	I	HI	NI
C3	VHI	VHI	1	VHI	VHI	VL	VHI	NI	NI	NI	I	I	NI	VHI	VHI	VHI	VHI	VHI	VHI	VHI	VL	NI
C4	NI	VHI	VHI	1	NI	VL	I	I	NI	NI	I	I	NI	HI	I	I	I	NI	VHI	VHI	VL	VL
C5	I	NI	VHI	VHI	1	VL	NI	VL	VL	VHI	VHI	VHI	NI	VL	VL	VHI	NI	VHI	VL	VL	VHI	VHI
C6	VHI	I	VHI	VHI	NI	1	VHI	VHI	VHI	HI	VHI	NI	NI	VHI	I	I	I	HI	I	NI	VHI	VHI
C7	VHI	NI	NI	NI	VHI	NI	1	NI	NI	NI	I	VHI	VHI	VHI	NI	NI	VHI	NI	VHI	VHI	NI	NI
C8	NI	I	NI	NI	NI	NI	NI	1	I	I	I	NI	VHI	NI	VHI	VHI	NI	VHI	VL	NI	VHI	NI
C9	VHI	VHI	NI	NI	VHI	NI	NI	NI	1	VHI	NI	NI	NI	I	NI	NI	VHI	VHI	NI	VHI	VL	NI
C10	VL	VL	VHI	NI	VHI	I	NI	VHI	VHI	1	VL	VL	VHI	VHI	VHI	VHI	VL	HI	I	NI	NI	NI
C11	I	I	I	NI	I	NI	NI	NI	VHI	I	1	NI	NI	NI	VL	VL	VL	VL	I	I	I	NI
C12	I	NI	VHI	VHI	NI	NI	NI	NI	I	I	I	1	NI	VHI	NI	NI	VHI	NI	I	NI	NI	VHI
C13	NI	NI	NI	VHI	VL	I	I	NI	I	VHI	VL	VHI	1	NI	I	I	VHI	I	NI	NI	VHI	VHI
C14	VL	VHI	NI	I	VHI	NI	NI	VHI	I	NI	NI	NI	NI	1	I	VHI	VHI	VHI	VL	VHI	NI	NI
C15	VHI	NI	VHI	NI	NI	NI	VHI	VL	HI	HI	I	I	NI	VHI	1	NI	NI	NI	NI	VHI	VHI	NI
C16	VHI	NI	I	NI	VL	I	NI	NI	NI	NI	NI	VHI	NI	HI	I	1	I	I	NI	I	I	NI
C17	VL	VHI	VHI	HI	NI	NI	NI	VHI	VL	VL	VHI	VHI	NI	I	NI	VHI	1	VHI	VL	VHI	NI	HI
C18	NI	VHI	VHI	VHI	NI	VHI	I	NI	VHI	NI	NI	VHI	VL	VHI	VHI	NI	NI	1	NI	VHI	NI	VHI
C19	VHI	I	NI	VHI	NI	NI	NI	I	NI	NI	VHI	VHI	VHI	NI	NI	NI	I	NI	1	VHI	I	VHI
C20	VL	NI	NI	VHI	VHI	VHI	VL	I	VHI	VHI	VL	VL	VHI	VHI	NI	I	NI	I	NI	1	NI	NI
C21	VHI	VHI	NI	NI	VHI	VHI	VHI	NI	VHI	VL	VL	VHI	VHI	VHI	NI	VL	VHI	VHI	VL	I	1	HI
C22	I	I	NI	I	NI	NI	VHI	VHI	VL	VHI	I	NI	VHI	VHI	HI	VHI	I	I	I	NI	VHI	1

Table 4. Reachability matrix from the experts.

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22
C1	1	1	0	0	0	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1
C2	1	1	1	0	1	0	0	1	1	0	0	0	0	0	1	1	1	0	0	1	1	1
C3	1	1	1	1	0	0	0	1	0	0	0	1	1	1	1	1	0	1	1	1	0	0
C4	0	0	1	1	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1
C5	0	0	1	1	1	0	1	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1
C6	0	1	0	0	0	1	1	1	1	1	1	0	0	1	1	1	0	1	0	0	0	0
C7	1	0	0	1	0	0	1	0	0	0	0	0	1	1	0	1	1	0	1	1	1	0
C8	0	1	0	0	0	1	0	1	0	1	1	1	1	0	1	1	0	0	1	1	0	0
C9	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	1	1	0	1	0	0
C10	0	0	1	0	1	1	0	1	0	1	0	1	0	0	1	1	0	0	0	1	0	0
C11	0	0	0	1	1	1	0	0	1	0	1	0	1	1	0	1	1	0	0	0	1	1
C12	0	1	0	0	0	1	1	0	0	0	0	1	0	1	0	0	1	0	0	0	0	1
C13	1	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
C14	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	1	1	0	0
C15	1	0	1	0	1	0	0	1	1	1	1	0	0	0	1	0	0	0	0	1	1	1
C16	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0
C17	1	1	1	0	0	0	0	1	1	0	1	0	0	0	0	1	1	1	1	1	0	1
C18	1	1	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0
C19	1	1	1	0	1	1	0	0	0	1	0	1	1	0	0	0	0	0	1	1	1	1
C20	0	0	1	1	0	1	1	1	1	1	0	1	0	0	0	0	1	0	0	1	0	0
C21	1	1	0	0	1	1	1	1	1	0	0	1	1	1	0	0	0	1	0	0	1	1
C22	1	0	0	1	1	0	1	0	0	0	1	1	0	0	0	1	1	1	1	0	1	1

Table 5. Intersection set with driving power from experts.

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	Driving Power	Level
C1	1	1	0	0	0	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	7	
C2	0	1	1	0	1	0	0	1	0	0	0	0	0	0	1	1	1	0	0	0	1	1	9	
C3	1	1	1	0	0	0	0	0	0	0	0	1	0	1	1	1	0	1	1	1	0	0	10	
C4	0	0	1	1	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	6	
C5	0	0	1	1	1	0	1	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	7	
C6	0	1	0	0	0	1	1	1	1	1	1	0	0	1	1	1	0	1	0	0	0	0	11	1
C7	1	0	0	1	0	0	1	0	0	0	0	0	1	1	0	1	1	0	1	1	1	0	10	
C8	0	1	0	0	0	1	0	1	0	1	1	1	1	0	1	1	0	0	1	0	0	0	10	
C9	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	1	1	0	1	0	0	6	
C10	0	0	1	0	1	1	0	1	0	1	0	1	0	0	1	1	0	0	0	1	0	0	9	
C11	0	0	0	1	1	1	0	0	1	0	1	0	1	1	0	1	1	0	0	0	1	1	11	1
C12	0	1	0	0	0	1	1	0	0	0	0	1	0	1	0	0	1	0	0	0	0	1	7	
C13	1	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	4	
C14	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	1	1	0	0	5	
C15	0	0	1	0	0	0	0	1	1	1	1	0	0	0	1	0	0	0	0	0	1	1	8	
C16	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	4	
C17	1	1	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	1	0	0	0	1	8	
C18	1	1	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	7	
C19	1	0	1	0	1	0	0	0	0	1	0	1	1	0	0	0	0	0	1	1	1	1	10	
C20	0	0	0	1	0	1	0	1	1	1	0	1	0	0	0	0	1	0	0	1	0	0	8	
C21	0	0	0	0	0	1	1	1	1	0	0	1	0	1	0	0	0	1	0	0	1	0	8	
C22	1	0	0	1	1	0	1	0	0	0	1	1	0	0	0	1	1	1	0	1	1	1	10	

5. Implications

5.1. Theoretical Implications

The results reveal that the government (A2) is considered to play a critical role in developing sustainable food by both agribusinesses and customers. Agribusinesses expect the government to establish relevant regulations (C6) for sustainable food that they can treat as a checklist to easily ensure that products, processes and services reach a sustainable food standard. Customers prefer to purchase sustainable food at a lower price through government tax reductions for selling sustainable food (C10). Because customers are a price-sensitive group, they believe that the government can take responsibility for both controlling the market price and ensuring the quality of sustainable food. Thus, the results show that the government has a direct effect on the relationship between agribusinesses and their customers under stakeholder theory. In addition, China's government has adopted a planned economy, thus several agribusinesses also play the role of "Gong Xiao She" in northern China and act as a bridge to link farmers, the market and the government [3]. For this reason, in northern China, customers and agribusiness expect the government to improve the related policies and regulations to certify sustainable food and guarantee quality and health.

Customer (A1) considerations, especially health and safety considerations (C3) appear in the second level in both the agribusinesses' and the customers' framework. This indicates that agribusinesses suffer from customer pressure, which requires them to offer products with higher quality, zero chemicals and that maintain the environment. This indicates that the customer must be a priority when developing sustainable food. Several studies have noted that customers prefer lower prices [19]; however, the results of this study imply that customers will be willing to pay higher prices to choose sustainable food that is healthy and safe. The results reveal a different phenomenon, which may occur due to industry features. For instance, customers would like to select an automobile with a lower price [73]; however, they prefer to select sustainable food with higher price and quality. This result also indicates that customers are increasing their environmental awareness in terms of food [74]. Hence, once agribusinesses have the capability to conform to government regulations and requirements, firms will next need to take into account customer considerations.

Although the frameworks for agribusinesses and customers show existing differences, the results uncover the common points under stakeholder theory. These findings allow agribusinesses and the food industry to invest their resources into several focal stakeholder groups to search for a balance for practicing sustainable food production. Moreover, the current studies indicate that the government plays a key role in sustainable development, regardless of industry [3,75]. In other words, the practices of agribusinesses are influenced by the attitudes and motivations of the government. Subsequently, agribusiness must consider the customers' responses to satisfy their needs. If agribusiness cannot respond in time, it might generate food scandals, such as the horsemeat scandal in the UK. In this case, BBC News emphasized putting customers first [76]. In this study, the supplier becomes the last stakeholder, which is different from other proposed supply chain studies due to the industry features, as mentioned above. Comparing the frameworks creates a basis for enhancing the understanding of sustainable food under stakeholder considerations.

5.2. Managerial Implications

Considering practice, the results show that agribusinesses must establish their system (J1) in the first level. Although JASM invests substantial resources in developing its platform, there is still a gap in developing a sustainable food system to comply with regulations and requirements. This shortage may lead to lost customer loyalty and trust in the future. However, the customer framework indicates something different: the customer does not care about the system. Customers feel that tax policy (B1) generates a higher price for sustainable food. Because the customer group is price sensitive, it expects the government to take responsibility for controlling the market price by reducing taxes to motivate agribusinesses to offer sustainable food. To prevent this misunderstanding, agribusinesses

must establish a complete system, including trace-back functionality, and be able to comply with government regulations and requirements in delivering a transparent price. Transparency means that the firm offers detailed information so that the customer understands the price component.

In the second level, agribusinesses attempt to shift their focus onto customer behaviour (J2), which covers health and safety considerations, by developing sustainable label certification and using safe facilities. This finding demonstrates that once agribusinesses are able to conform to the related standards, the customer is their next objective. JASM uses its platform to predict the preferences of its customers and then suggests the relevant products. Moreover, it strives to develop its own certificates and standard operating processes to guarantee the quality of its products. Nevertheless, customers consider sustainable production (B2) to include health and safety considerations, offering subsidies and loans for developing sustainable food, compliance with the standards in producing sustainable food and using certified plant material. This result demonstrates that the customer attempts to recognize the standard of the agribusiness through its internal operations. Accordingly, at the second level, the agribusiness and the customer present a relationship in which the agribusiness is able to shift its focus onto the customer (from internal to external) and the customer tries to look inside the agribusiness (from external to internal).

The remaining levels for agribusinesses are multi-sided improvement (J3), strategic management (J4), risk management (J5), sustainable production (J6) and economic policy (J7). The remaining customer levels include system establishment (B3), risk reduction (B4), multi-sided improvement (B5), sustainable consumption (B6) and operation management (B7). These differences provide a guideline for JASM to address the issues between agribusinesses and customers. Thus, this framework of agribusiness offers a specific direction that JASM can take to improve their practices. It also allows JASM to rearrange their resources and investments more efficiently and effectively in launching sustainable food. Furthermore, loyalty and trust can be developed by considering the perceptions of customers. Practicing sustainable food production is an important task not only to ensure healthy and safe food throughout the entire production process but also to simultaneously consider the environmental impact, economic viability and social justice.

6. Conclusions

Under belt and road initiatives, agribusiness must serve as an important bridge balancing the interests of people, plants and products. The Chinese government strives to establish regulations and requirements to prevent many types of negative consequences. In particular, guidelines for sustainable food remain in their infancy. Moreover, agribusiness lacks a specific framework for considering stakeholders' opinions in its practices. Thus, this study employs stakeholder theory to explore the decisive practices of sustainable food through VISM. Vague sets enable the uncertainty among the assessments generated from the judgements of experts and customers to be overcome. Then, ISM is used to construct the structural framework to simplify the problem into systematic analysis. By comparing the frameworks between agribusiness and the customer, the gaps in practice can be recognized to better fulfil the needs of stakeholders.

This study contains three contributions, which cover theory, industry and method. For the theoretical contribution, the results identify the government as a key stakeholder in developing sustainable food, regardless of the considerations of agribusiness or customers. The customer is the next stakeholder and is price sensitive. Hence, agribusiness is concerned with how to offer sustainable food through healthier and safer processes at a price that customers are willing to pay. For the industrial contribution, the structural frameworks offer specific guidelines to lead agribusinesses in developing sustainable food; these guidelines allow agribusiness to effectively and flexibly rearrange its limited resources. In the methods contribution, this is the first study to consider the hesitancy degree in the decision-making process to address vagueness and uncertainty.

The findings of this study present system establishment and customer behaviour as the first two levels that must be considered by agribusinesses when launching sustainable food production.

System establishment encompasses the practices of establishing relevant regulations and compliance with standards when producing sustainable food. Customer behaviour includes the practices of considering health and safety, developing sustainable label certification and using safe facilities. However, tax policy and sustainable production are also considered by customers. Offering a tax reduction for selling sustainable food is the major practice in tax policy. Subsequently, health and safety considerations, offering subsidies and loans to develop sustainable food, compliance with standards in producing sustainable food and using certified plant material are all involved in sustainable production. These practices reveal that the dynamic transformation of agribusiness is shifting from internal to external, while customers' considerations are shifting from external to internal.

Although this study attempts to overcome several gaps from previous studies, some limitations still exist that future research can consider. The proposed 22 criteria might not include extensive consideration of sustainable food, and future research must take as many criteria as possible into account. In addition, the stakeholders are not limited to customers, the government, suppliers and agribusinesses only. One suggestion for future study is to focus on the stakeholders who really affect decision-making and to try to reflect the actual situation. This study focuses only on agribusiness, while future study can use the same assessment for other industries to find the differences. Subsequently, utilizing the same method to evaluate agribusiness in diverse counties could demonstrate differences in establishing policy. Consistency among the assessment process requires quantitative analysis, which still needs future study to adopt a hybrid method to overcome the gap between existing methods.

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