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Evaluation of Green Marketing Strategies by Considering Sustainability Criteria

Danial Esmaelnezhad [1], Mohammad Dana Lagzi [1], Jurgita Antucheviciene [2,*], Shide Sadat Hashemi [3] and Sina Khorshidi [4]

[1] Industrial Management Department, Faculty of Management, University of Tehran, Tehran 1417935840, Iran; d.esmaelnezhad@ut.ac.ir (D.E.); mohammad.lagzi@ut.ac.ir (M.D.L.)
[2] Department of Construction Management and Real Estate, Vilnius Gediminas Technical University, LT-10223 Vilnius, Lithuania
[3] Modares Science and Technology Park, Tarbiat Modares University, Avina Co., Tehran 1411713116, Iran; hashemi@bornagostaran.com
[4] Financial Engineering Department, Faculty of Management, University of Tehran, Tehran 1417935840, Iran; sinakhorshidi@ut.ac.ir
* Correspondence: jurgita.antucheviciene@vilniustech.lt

Abstract: The purpose of this study is to identify and prioritize green marketing strategies in the food industry by taking sustainability goals into consideration since it is very difficult to prioritize and select green marketing strategies when considering sustainability criteria in their implementation. Therefore, it is necessary to use an appropriate solution to prioritize these strategies. For this purpose, sustainability criteria and green marketing strategies are recognized. Then, sustainability criteria are screened using the fuzzy Delphi method. Subsequently, using the fuzzy stepwise weight assessment ratio analysis method, the criteria are weighted according to expert recommendations. Next, green marketing strategies in the Iranian food industry are ranked using several fuzzy multiple criteria decision-making methods: fuzzy additive ratio assessment, fuzzy complex proportional assessment, fuzzy technique for order preference by similarity to the ideal solution, and fuzzy Viekriterijumsko Kompromisno Rangiranje methods. Finally, the results are integrated with the help of the Copeland method to choose the best strategies. The results indicated that the criteria of 'minimizing waste', 'minimizing environmental impacts', and 'consumer participation' had the highest weight. In addition, the strategies for the 'development of waste reduction technology, 'development of market research to detect green needs', and 'use of recycled or reusable materials in products' received a higher rank.

Keywords: green marketing strategies (GMSs); sustainability; food industry; fuzzy MCDM

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1. Introduction

In Iran, the food industry accounts for about 18.5% of the country's total food waste [1]. Food waste causes financial losses and adverse effects on the environment. The contribution of the food industry to this waste is significant [2]. The high amount of food waste not only depletes resources but also diminishes the value of materials, resulting in socio-ecological consequences [3,4]. This fundamental challenge poses a significant threat to sustainability. From a social perspective, food waste can lead to food insecurity and poverty and reduce the availability and affordability of food [5,6].

The food industry uses such a large portion of water that this process finally leads to bacterial contamination; this is one of the main reasons for the loss of ecosystem balance as an effective and remarkable hazard to sustainability [7]. According to current studies, 1/3 of the world's food production is spoiled every year [8]. These food losses produce 3.3 billion tons of carbon dioxide [9], which accounts for 30% of the world's greenhouse gas emissions [10]. Food waste can have a very negative effect on community health and the

environment and endanger global sustainability. Food waste can also have socio-economic consequences, such as poverty, high food prices, and declining incomes [11]. It should be noted that these wastes vary at various stages of the food cycle in developed and developing countries, as reported by the Food and Agriculture Organization (FAO) of the United Nations and shown in Figure 1.

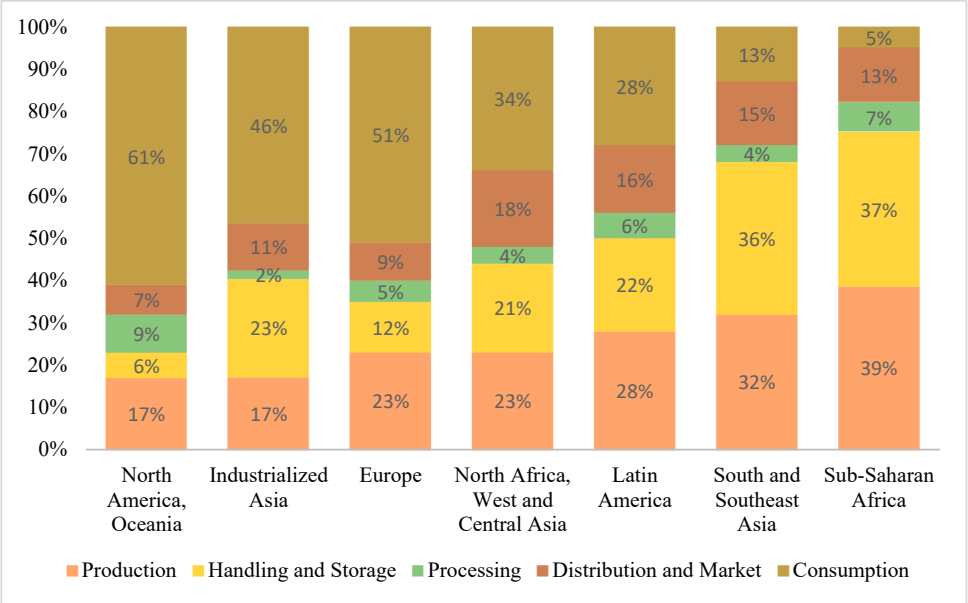

Figure 1. Food waste by region and different stages of the value chain (percent of kcal wasted).

Figure 1 shows food waste in various parts of the world, which is different in developing and developed countries in disparate sections. As can be seen, Iran is located in the southwestern part of Asia, which has more food waste in both production (23%), and consumption (34%), than the other sections. Therefore, decisions to reduce food waste that directly and indirectly have a serious impact on the environment should focus on these two areas [11]. Other risks to the food industry for the community and the environment are food packaging, including plastic packaging, which is popular because of its ease of use and low production costs [12]. Food packaging waste makes up more than a third of solid waste, which has many environmental effects [13].

Figure 2 demonstrates the amount of waste at different stages of food production in Southwest Asia. Since the food industry does not dominate 34% of consumption, it focuses on its value chain (25%), which directly reduces waste and environmental effects. Today, sustainability has become a necessity for business organizations, which, along with environmental and social issues, is part of their strategic goals of companies. A large number of companies are adopting green measures to address consumers' concerns about their environmental effects [14]. Thus, green marketing strategies (GMS) are needed by organizations to maintain a competitive advantage and achieve sustainability [15]. Furthermore, green marketing strategies (GMSs) of food companies can indirectly affect the culture of consumption [11,12] and move in the direction of sustainability. Managers and marketers of the food industry, by considering the role of food production and consumption on environmental degradation and examining marketing strategies, can help reduce the effects of this industry on the environment, community health [16], and costs [17]. One of the ways to deal with environmental crises and issues is to use green products. Green products have positive characteristics such as not harming the environment and protecting it; they are useful for the health of society; and they are better in terms of quality and environmental performance [18]. GMSs in the food industry play an important role in reducing environmental degradation [13,15,16]. Furthermore, the green actions of companies affect the choice of compatible products by customers [11,19]. In addition to developing envi-

ronmentally friendly products that have the minimum effect on the environment, GMSs must also meet customer expectations [20]. Many industries today use GMSs to ensure sustainable growth; however, many studies have suggested that aligning green actions with business strategies is no longer a competitive advantage but a necessity [13,16,18,21].

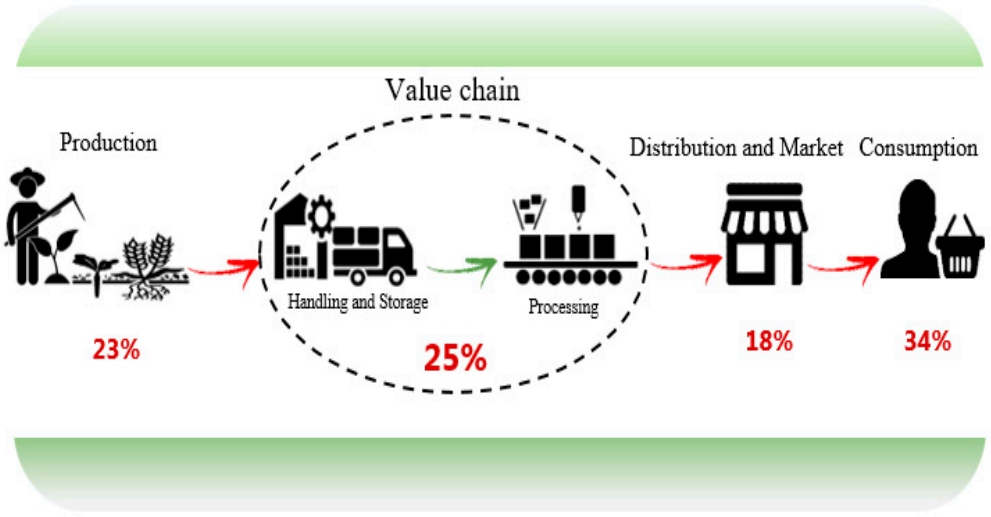

Figure 2. The amount of waste produced at different stages of food production in West and Central Asia.

Due to the importance of environmental problems, companies in various industries consider it necessary to choose the right combination of GMSs to achieve a sustainable competitive advantage [22]. Since different industries have different GMSs to achieve a competitive advantage [23], it cannot be said that there is a single strategy for all industries. It is important to note that the right strategy must be in line with market conditions [24]. One of the most important challenges in choosing GMSs is having enough knowledge to accurately evaluate their impact on various dimensions of sustainability. To address this challenge, fuzzy multiple criteria decision-making (MCDM) methods can be used as an approach to aid managers in eliminating the complexity of decisions and also taking into account the mental ambiguities of experts [25,26]. Similarly, due to the requirement to pay attention to standards and different aspects of sustainability, food industry managers have been forced to use GMS with a sustainability lens. To our knowledge, several articles have focused on green marketing [16,27–29], also in the food industry [30], mainly promoting green consumption by customers. Meanwhile, there is minimal research on the evaluation of GMSs, and none of these articles has considered all dimensions of sustainability in evaluating strategies [31,32]. Surprisingly, the green marketing literature has paid limited attention to the evaluation of green strategies in the food industry. Loosely speaking, there are still no studies evaluating GMSs considering sustainability criteria for the food industry. This matter caused key sustainable GMS to go unrecognized in the food industry. Consequently, it is not possible to formulate strategic policies and respond to existing problems and challenges (such as food waste) in this industry. The lack of studies on the evaluation of GMSs prompted us to identify and prioritize these strategies based on the most important sustainability criteria. Accordingly, this article makes a major contribution to research on GMSs by demonstrating the significance of choosing strategies in the food industry.

Based on the previous study in green marketing, the ranking of GMSs based on sustainability dimensions in a fuzzy environment has been conducted for the first time in this study. The proposed research framework based on fuzzy hybrid-MCDM helps the food industry choose its GMSs according to the challenges of this industry. Considering the importance of green marketing in the development of sustainability in the food industry in Iran, this study ranks GMSs from the perspective of sustainability dimensions using a

hybrid-MCDM approach in a fuzzy environment. In this research, we identified GMSs and sustainability criteria for evaluating strategies from past literature and used the fuzzy Delphi method to screen strategies. Sustainability criteria and sub-criteria are measured using the step-wise weight assessment ratio analysis (fuzzy SWARA) method. In the next step, using four fuzzy-MCDM methods, the strategies are ranked based on the weight of each sub-criterion. Finally, the Copeland method will be used as a method to integrate rankings. The proposed research framework based on fuzzy hybrid-MCDM helps the food industry choose its GMSs according to the challenges of this industry.

The rest of this paper is arranged as follows: Section 2 reviews the relevant literature on GMSs in the food industry, their dimensions, and sustainability criteria to evaluate strategies and the application of MCDM techniques in this area. Section 3 discusses the hybrid fuzzy MCDM approach. In Section 4, the results of the proposed model will be comprehensively analyzed and discussed, and finally, managerial implications, research constraints, and overall research conclusions will be presented.

2. Literature Review

This research focuses on the evaluation of GMSs to improve the sustainability dimensions of the food industry in Iran. The literature review is divided into three sections, in the following order: studies related to GMSs, studies related to sustainability criteria for evaluating GMSs, and studies related to the application of fuzzy MCDMs for GMSs.

2.1. Green Marketing Strategies

Green marketing involves all marketing activities that provide for human needs in an appropriate manner that does not harm the environment. Thus, manufacturing, packaging, marketing, distribution, and even product idea generation include these activities. Hence, the definition of marketing does not simply restrict itself to selling or advertising. In other words, green marketing signifies all activities to reduce products' harmful effects on the environment [33]. Additionally, green marketing can be equal to environmental marketing or sustainable marketing. Green marketing primarily concerns the environment; environmental, social, and economic sustainability are integral to sustainable marketing [14]. Due to the interaction between firms and the environment, green marketing has become an important issue and has been significantly growing in the recent two decades [14,34].

Nowadays, environmental concerns and climate change have become vital issues for customers and manufacturers [22], and consumers who are more inclined to choose green products are increasing, and a percentage of these consumers pay higher prices for environmentally friendly products [35]. The company's success in this area is based on innovative measures to integrate environmental concerns and marketing strategies, as a result of which opportunities are identified [36]. Therefore, company goals and environmental protection must be aligned through accurate GMS. According to Mukonza and Swarts [22], companies can help promote greener consumer consumption through GMSs, thus creating new markets and business opportunities.

Given the increasing importance of environmental protection from a consumer perspective, an appropriate GMS can easily influence customer purchasing decisions because customers pay attention to the sustainable activities of companies in the community, and these actions have a positive effect on loyalty and brand image [27]. Park et al. [37] reviewed the application of GMSs in the online environment. This study was based on two objectives: 1. Investigating the impact of green information transmitted from online environments. 2. Examining the moderating role of environmental awareness on customers' perceptions, attitudes, and green conceptions, according to Mukonza and Swarts [22], GMS has a positive effect on the company's business performance and brand image.

Rahman and Nguyen-Viet [38] examined the effect of green advertising receptivity, non-deception, green brand image, and transparency on green brand trust and subsequently its effect on consumer purchase intention. They concluded that green advertising receptivity and green brand image influence green brand trust. Furthermore, green brand

trust influences consumer purchase intention, and the influence of non-deception and transparency on green brand trust is insignificant.

Belz and Schmidt-Riediger [39] investigated the characteristics and drivers of sustainability marketing strategies in the German food industry. They identified four types of sustainability marketing strategies with distinctive characteristics: performers, followers, indecisive, and passive. They concluded that there is a fit between strategic positioning and the incorporation of sustainability issues into marketing. Companies that are positioned in the quality segment tend to adopt sustainable marketing. Risitano et al. [40], in their research on the impact of sustainability on marketing strategy and business performance in the Italian fisheries sector, identified factors that contribute to the sustainable development of fisheries companies. For this purpose, they analyzed the relationships between sustainable social behavior, sustainable environmental behavior, sustainable marketing, and return on investment. They concluded that adopting a sustainable marketing strategy has a positive impact on the environmental, social, and economic development of society. Rudawska [31] surveyed 770 small- and medium-sized enterprises (SMEs) with the aim of identifying sustainable marketing strategies used in the European food industry. Taherpouran et al. [32] identified 13 factors for the development of green marketing in the food industry in Iran. We identified GMSs for achieving sustainability through a literature review. This article helps to extend the literature on evaluating GMSs, especially in the food industry. Table 1 shows the assembled GMSs from the literature.

Table 1. Green Marketing Strategies.

Green Marketing Strategies	References
Development of waste reduction technology	[20,29,41]
Observance of environmental considerations in product design	[29,41,42]
Development of market research to detect green needs	[41]
Sponsorship or patronage of environmental groups or events	[42]
Increasing public awareness of ecological	[25,29]
Using ecological and clean materials in packaging	[29,30,41,43]
Green alliances or collaboration contracts with governmental organizations	[29,44,45]
Selection of cleaner transportation systems	[29,43,45]
Using ecolabels or environmental certification	[25,41]
Commercialization of environmentally friendly products and services	[35]
Avoiding 'greenwashing' and removing barriers to consumer trust	[43,44]
Observance of environmental considerations in distribution and reverse logistics systems	[20,29,30,43]
Educating all employees on environmental awareness	[25,43]
Demonstrating the company's environmental actions through advertisement	[29,43,45]
Integrating all departments to facilitate flexibility in response to environmental needs	[42,43]
Reducing information asymmetries and encouraging consumers	[29,42]
Considering a suitable mix of media	[25,42]
Concentrating on LOHAS consumers (Lifestyle of Health And Sustainability)	[42]
Identifying the beliefs and values of consumers and stakeholders and creating a marketing plan based on these values	[41,42]
Considering environmental aspects in pricing policy	[41,43,45]
Using recycled or reusable materials in products	[25,41]
Using label information and terms that consumers understand and can make decisions	[41]

According to the Table 1, 22 strategies were identified from the literature review. These strategies include a range of actions that food companies face.

2.2. Sustainability Criteria for Evaluating Green Marketing Strategies

Sustainability refers to the ability of a system, process, or scheme to persist over the long term while considering current and future social, economic, and environmental needs and utilizing optimal resources while maintaining ecological resilience and balance. Criteria for sustainability refer to a set of quantitative and qualitative indicators that are used to measure the sustainability of systems, processes, and organizations [14].

Companies' commitment to green activities requires attention to and adherence to the dimensions of sustainability. In fact, the necessary condition for achieving the advantage of sustainability is to consider environmental thinking in all processes of any organization. Implementing and carefully selecting GMS can help fulfill this commitment [21]. Strategies can be well adapted when balancing sustainability and marketing principles because sustainability principles emphasize minimum consumption and maximum resource conservation. In contrast, the principles of marketing strive for maximum consumption or production and minimum conservation of resources [45].

Previous research has shown that sustainability has become a major issue for policymakers due to its specific dimensions, especially its environmental dimension, and in this regard, organizations must pay attention to GMSs to become a more sustainable brand [27,46]. Ho et al. [26] claimed that the orientation of green marketing has the biggest effect on sustainability. Based on this, to become a top brand, companies must direct their environmental activities towards sustainability criteria to become a more sustainable and green brand in this competitive environment [47]. Numerous studies have claimed that promoting the consumption of green products is a significant role in green marketing, and the role of companies in promoting these products is directly related to achieving sustainability [41,48].

In order to achieve appropriate feedback from the implementation of GMSs, companies must establish appropriate criteria for measuring and evaluating GMSs or actions. It is important to note that, due to the lack of effective criteria in previous studies to evaluate GMSs in a particular industry [25], considering evaluation criteria based on sustainability dimensions can help develop a model for evaluating marketing strategies. Furthermore, in most previous studies on green issues, the scope of sustainability in the environmental dimension was defined [45]. Since the term sustainability is a combination of all economic, social, and environmental responsibilities, the study of these areas provides a valuable understanding of the development of organizational strategies [47]. Dimensions and sustainability criteria for evaluating GMSs in the food industry are shown in Table 2.

Table 2. Sustainability criteria for evaluating GMSs.

Dimensions	Criteria	References
Environmental (D_1)	Developing green products (C_1)	[27,49–51]
	Reducing greenhouse gas emissions (C_2)	[49,51,52]
	Minimizing environmental impacts (C_3)	[25,29,49,50]
	Minimizing waste (C_4)	[25,29,49–51]
Social (D_2)	Compliance with market expectations (C_5)	[49,52]

Table 2. *Cont.*

Dimensions	Criteria	References
	Compliance with company policy (C_6)	[52]
	Compliance with government policies (C_7)	[20,25,44]
	Customer satisfaction (C_8)	[43,44,50,51]
	Consumer participation(C_9)	[29,43,44,50,51]
	Maximizing organizational commitment (C_{10})	[44,49]
	Brand reputation (C_{11})	[20,35,49,51]
	Consumer loyalty (C_{12})	[20,49,53]
	Competitors' performance (green) (C_{13})	[54]
	Sustainable industrial image (C_{14})	[35,50]
Economic (D_3)	Price parity (C_{15})	[35,50]
	Green market size (C_{16})	[35]
	Firm's profitability (C_{17})	[49]
	Market share (C_{18})	[25,42–44,49]
	Economic feasibility (C_{19})	[42,44]
	Final production costs (C_{20})	[29,49]
Manufacturing (D_4)	Firm's innovation capacity (C_{21})	[44,49]
	Launch of new products (C_{22})	[29,49,51]
	Product quality (C_{23})	[49,51]

According to Table 2, the dimensions of sustainability in this article, which is intended to evaluate GMSs, include four dimensions: environmental, social, economic, and manufacturing. Environmental (D_1) is one of the most important dimensions in the food industry because it emphasizes the use of energy, reducing pollution and waste, and generally preserving and reducing environmental impacts [55]. Social (D_2) is about connecting with consumers and improving their quality of life through corporate social responsibility, which helps to promote the company's image [56]. Economic (D_3) refers to maximizing profits and minimizing the costs incurred to earn money; it also emphasizes the optimal use of resources to create a significant lasting impact by reducing the adverse consequences of exploitation [27,48,50]. For the first time, this study proposes a manufacturing dimension for the food industry. In fact, manufacturing sustainability is very closely related to the other three dimensions. This dimension refers to the creation and improvement of the quality of manufactured products, which helps to preserve the environment and safety by using appropriate economic processes [57].

2.3. Application of Fuzzy MCDMs for Green Marketing Strategies

It is very difficult for companies to add green marketing to their strategic plans, which is considered a side policy. On the other hand, many companies have not been able to benefit from their green marketing activities, so choosing the right GMS for companies is essential [24]. However, choosing an optimal GMS has always been a major decision problem for organizations and managers, and MCDM methods can be very helpful to solve this problem [26,58].

In recent years, several studies have been conducted on the application of MCDM to GMS and sustainability. Chen and Yang [25] ranked the green marketing audit criteria using the analytical hierarchy process (AHP) and decision-making trial and evaluation laboratory (DEMATEL) methods. The results of their research showed that the development of GMS depends on linking green marketing activities with company performance. Banihashemi et al. [59] investigated, classified, and weighted barriers in the execution of

green supply chain management in the construction industry. In their paper, the fuzzy BWM method was applied to weigh the challenges. Ho et al. [26] used a fuzzy-MCDM hybrid model to investigate the interrelationships and effects of green marketing orientations on sustainability during the COVID-19 pandemic. They used fuzzy DEMATEL-based analytical network processes (ANP) or fuzzy DANP in this MCDM hybrid model. In Korucuk et al.'s [60] study, a practical approach was used to examine and provide appropriate solutions to the problem of choosing digital marketing strategies and green approaches. Liu et al. [23] presented a gray decision model using DEMATEL to evaluate the drivers of green marketing implementation in the Chinese automotive industry. Tabavar et al. [28] proposed the AHP and technique for order of preference by similarity to the ideal solution (TOPSIS) fuzzy hybrid method for ranking GMSs affecting entrepreneurship. Nilashi et al. [61] examined neuromarketing techniques in the green marketing of sustainable products using the AHP method.

In this study, in order to consider the uncertainty of food industry experts, a fuzzy environment prevails in all steps. Fuzzy decision-making methods help experts consider uncertainty in their decisions [62]. So far, the choice of GMSs with respect to sustainability criteria in a fuzzy environment has not been observed. Additionally, not all industries have the same strategies, so this study is essential. The theoretical basis for this study is built upon the existing literature related to green marketing and sustainability. Specifically, we draw upon the works of scholars such as Ho et al. [26] and Chen and Yang [25], among others, to develop the present research framework. This study contributes to the green marketing literature by evaluating different GMSs based on sustainability criteria. Obviously, this study fills a gap in the literature by providing empirical evidence on the effectiveness of these strategies, which can help firms develop more sustainable marketing practices.

3. Methodology

The presented contribution focuses on a practical approach for ranking GMSs by considering different dimensions of sustainability in a fuzzy environment. The proposed approach has three main steps: selecting criteria and strategies, weighting sustainability criteria, and ranking GMSs. In the first step, alternatives and criteria are identified through a literature review. The literature review is conducted by searching keywords such as 'green marketing', 'sustainability', and 'MCDM' in the 'Google Scholar' and 'Scopus' databases. Then the fuzzy Delphi method is used to screen alternatives. A questionnaire is used as the primary data source to achieve this goal, which makes this research a survey-method study. Interviews were conducted in five sessions with the food industry and academic experts between March and April 2022. Thus, this research is cross-sectional from the perspective of time horizon. These experts included ten senior managers from Iran's food industry who were over 30 years old, held a Ph.D. in Food Science and Technology or at least a master's degree in management and had a minimum of five years of experience as a CEO or R&D manager. In the next step, the fuzzy SWARA method is used for calculating the weights of criteria and sub-criteria. There are four methods of MCDM, including fuzzy additive ratio assessment (ARAS), fuzzy complex proportional assessment (COPRAS), fuzzy TOPSIS, and fuzzy viekriterijumsko kompromisno rangiranje (VIKOR) for GMS ranking. In the end, the Copeland method is applied to integrate the results to obtain the final results. Therefore, this research is multi-method and quantitative from the perspective of the research method. This research and its results are based on measurement and observation; therefore, its philosophy is positivism. The general research framework is shown in Figure 3.

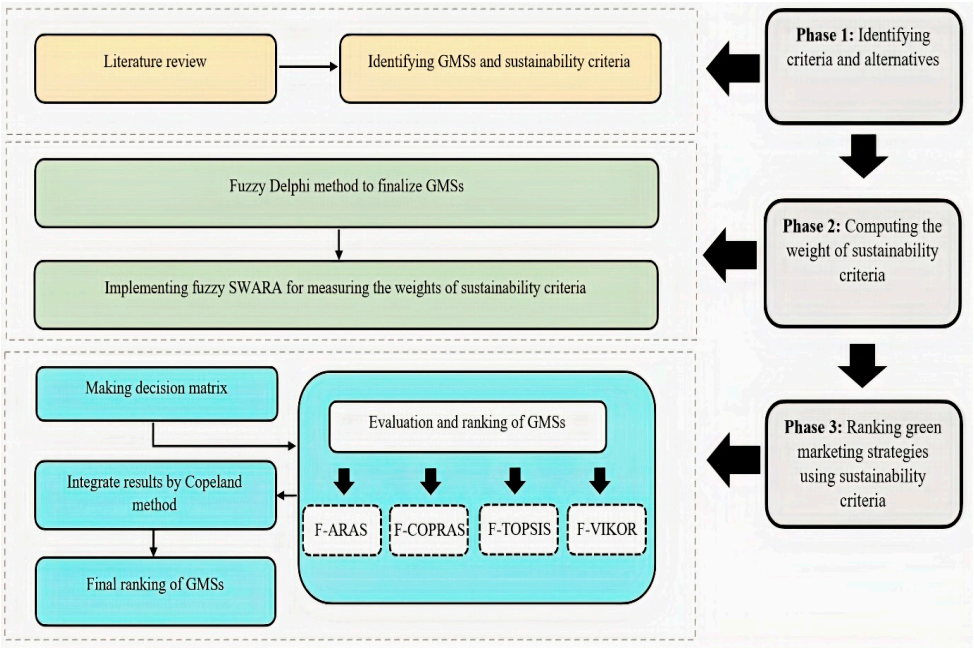

Figure 3. The general research framework.

3.1. Fuzzy Delphi Method

In this research, the fuzzy Delphi method has been used to identify the most important strategies and eliminate the less important ones. MCDM is used to compare some options and rank them based on some criteria. MCDM may be used when the evaluation process includes several variables in which verbal expressions from experts' opinions are used in the questionnaire, in which case they cannot be easily converted into quantitative units. In the meantime, the fuzzy technique is a suitable method for quantifying verbal expressions that is comprehensive and popular [63,64].

The steps of the fuzzy Delphi method are described below, adapted from Guttorp et al. [62]:

Step 1: According to the strategies identified in Table 1, a questionnaire was designed using a linguistic scale to indicate the importance of each strategy.

Step 2: Collecting the opinions of the experts using the questionnaire. The questionnaires were completed by industrial and academic experts.

Step 3: The experts' opinions were converted into triangular, fuzzy numbers. Calculating the fuzzy weight ($\widetilde{w}_j$) of each strategy using (1):

$$\widetilde{w}_j = (\alpha_j, \gamma_j, \beta_j) \ \forall j \ \epsilon \ m \tag{1}$$

where:

$$\alpha_j = \min_{i \in n} \{a_{ij}\} \ \forall j \ \epsilon \ m \tag{2}$$

$$\gamma_j = \left(\prod_{i=1}^{n} b_{ij} \right)^{1/n} \ \forall j \ \epsilon \ m \tag{3}$$

$$\beta_j = \max_{i \in n} \{c_{ij}\} \ \forall j \ \epsilon \ m \tag{4}$$

Step 4: The obtained weights are then defuzzified using the center of gravity method as follows:

$$S_j = \frac{\alpha_j + \gamma_j + \beta_j}{3} \ \forall j \ \epsilon \ m \tag{5}$$

Step 5: Strategies with values greater than 0.7 are selected, and those with values less than 0.7 are eliminated.

3.2. Fuzzy SWARA Method

The process of determining the weight of the criteria using the fuzzy SWARA method is as follows [65]:

Step 1: Calculating the value of the coefficient of comparative importance ($\widetilde{k}_j$) using Equation (6):

$$\widetilde{k}_j = \begin{cases} \widetilde{1}_j = 1 \\ \widetilde{s}_j + 1_j > 1 \end{cases} \tag{6}$$

Step 2: Calculating the value of the fuzzy weights of the criteria ($\widetilde{q}_j$) using (7):

$$\widetilde{q}_j = \begin{cases} 1_j = 1 \\ \frac{\widetilde{k}_{j-1}}{\widetilde{k}_j} j > 1 \end{cases} \tag{7}$$

Step 3: Calculating the weight of the criterion ($\widetilde{W}_j$) using (8):

$$\widetilde{W}_j = \frac{\widetilde{q}_j}{\sum_{k=1}^{n} \widetilde{q}_k} \tag{8}$$

3.3. Hybrid MCDM Methods

Each MCDM technique has a specific perspective and considers an aspect in the evaluation and ranking of options that the other technique does not consider. In this research, different MCDM methods have been used to evaluate strategies from different perspectives. Since each combined method may consider a different rank for strategies, Copeland's method is used to achieve a unified result.

3.3.1. Fuzzy ARAS Method

The steps for solving the fuzzy ARAS method are as follows [66]:

Step 1: Formation of the decision-making matrix (DMM) with fuzzy numbers ($\widetilde{a}_{ij}$).

Step 2: Normalization of the DMM matrix. For benefit criteria using (9):

$$\widetilde{\widetilde{a}}_{ij} = \frac{\widetilde{a}_{ij}}{\sum_{i=0}^{m} \widetilde{a}_{ij}} \tag{9}$$

And for the cost criterion, using (10):

$$\widetilde{a}_{ij} = \frac{1}{\widetilde{a}^*_{ij}}, \ \widetilde{\widetilde{a}}_{ij} = \frac{\widetilde{a}_{ij}}{\sum_{i=0}^{m} \widetilde{a}_{ij}} \tag{10}$$

Step 3: Calculating the normalized weight values of the criteria using Equation (11):

$$\widetilde{\widehat{a}}_{ij} = \widetilde{a}_{ij} \times w_j, \ \ i = 0, 1, 2, \ldots, m \tag{11}$$

Step 4: Determining the values of the optimality function using (12).

$$\widetilde{S}_i = \sum_{j=1}^{n} \widetilde{\widehat{a}}_{ij}, \ \ with \ i = 1, 2, \ldots, n \tag{12}$$

Step 5: The $\widetilde{S}_i$ must be defuzzified using (13):

$$S_i = \frac{1}{3}\left(S_{i\alpha} + S_{i\beta} + S_{i\gamma}\right) \tag{13}$$

Step 6: Calculating the degree of alternative utility using (14):

$$K_i = \frac{S_i}{S_0} \tag{14}$$

3.3.2. Fuzzy COPRAS Method

The steps of fuzzy COPRAS are described below, adapted from Zavadskas and Kaklauskas [67]:

Step 1: Forming the fuzzy decision-making matrix.

Step 2: Converting fuzzy matrix numbers to crisp numbers using (15):

$$x_{ij} = \frac{\left[\left(x_{ij}^{u} - x_{ij}^{l}\right) + \left(x_{ij}^{m} - x_{ij}^{l}\right)\right]}{3} + x_{ij}^{l} \tag{15}$$

Step 3: Calculating the normalized decision matrix using (16):

$$\overline{x}_{ij} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}}, \;\; i = 1, 2, \ldots, m, \;\; j = 1, 2, \ldots, n \tag{16}$$

Step 4: Calculating the weighted normalized matrix using (17):

$$\hat{x}_{ij} = w_j \times \overline{x}_{ij} \tag{17}$$

Step 5: Calculating the sum of the criteria values.

For benefit criteria, we are using (18):

$$s_{+i} = \sum_{j=1}^{k} \hat{x}_{-ij}, \;\; i = 1, 2, \ldots, m, \;\; j = 1, 2, \ldots, n \tag{18}$$

And for cost criteria, we use (19):

$$s_{-i} = \sum_{j=k+1}^{n} \hat{x}_{+ij}, \;\; i = 1, 2, \ldots, m, \;\; j = k+1, k+2, \ldots, n \tag{19}$$

Step 6: Calculating relative importance values of alternatives using (20):

$$Q_i = S_{+i} + \frac{\sum_{i=1}^{m} s_{-i}}{S_{-i} \times \sum_{i=1}^{m} \frac{1}{s_{-i}}}, \;\; i = 1, 2, \ldots, m \tag{20}$$

Step 7: Calculating performance scores as follows:

$$Q_{max} = max\{Q_i\}, \;\; i = 1, 2, \ldots, m \tag{21}$$

$$P_i = \frac{Q_i}{Q_{max}} 100\% \tag{22}$$

Finally, the alternatives should be ranked from highest to lowest based on the COPRAS performance score (P_i).

3.3.3. Fuzzy TOPSIS Method

The steps of the fuzzy TOPSIS method are as follows [68]:

Step 1: Compute the normalized fuzzy decision matrix for benefit and cost criteria as follows:

$$\widetilde{r}_{ij} = \left(\frac{a_{ij}}{c_j^*}, \frac{b_{ij}}{c_j^*}, \frac{c_{ij}}{c_j^*}\right) \quad and \quad c_j^* = \max_i \{c_{ij}\} \quad (for\ benefit\ criteria) \tag{23}$$

$$\widetilde{r}_{ij} = \left(\frac{a_j^-}{c_{ij}}, \frac{a_j^-}{b_{ij}}, \frac{a_j^-}{a_{ij}}\right) \quad and \quad c_j^- = \min_i\{a_{ij}\} \quad (for\ cost\ criteria) \tag{24}$$

Step 2: Constructing the weighted normalized fuzzy decision matrix ($\widetilde{v}_{ij}$) using (25):

$$\widetilde{v}_{ij} = \widetilde{r}_{ij} \times w_j \tag{25}$$

Step 3: Computing the fuzzy positive ideal solution (FPIS) and fuzzy negative ideal solution (FNIS) as follows:

$$A^* = (\widetilde{v}_1^*, \widetilde{v}_2^*, \ldots, \widetilde{v}_n^*), \ \ where\ \widetilde{v}_j^* = \max_i\{v_{ij3}\} \tag{26}$$

$$A^- = (\widetilde{v}_1^-, \widetilde{v}_2^-, \ldots, \widetilde{v}_n^-), \ \ where\ \widetilde{v}_j^- = \min_i\{v_{ij1}\} \tag{27}$$

Step 4: Computing the (d_i), which is the distance from each alternative to the FPIS and the FNIS, using (28):

$$d_i^* = \sum_{j=1}^n d\left(\widetilde{v}_{ij}, \widetilde{v}_j^*\right), \ \ d_i^- = \sum_{j=1}^n d\left(\widetilde{v}_{ij}, \widetilde{v}_j^-\right) \tag{28}$$

Step 5: Calculating the closeness coefficient (CC_i) of each alternative using (29):

$$CC_i = \frac{d_i^-}{d_i^- + d_i^+} \tag{29}$$

Step 6: The alternative with the highest (CC_i) is the best alternative, and we can rank the alternatives.

3.3.4. Fuzzy VIKOR Method

According to Opricovic [69], the steps of the fuzzy VIKOR method are as follows:

Step 1: Forming the decision-making matrix.

Step 2: Normalizing the initial sub-criteria values due to the various dimensions and units of the criteria to eliminate the sub-criteria type and dimension effects on the evaluation. Standardizing the sub-criteria value as follows:

The normalization value for the sub-criteria of profit is obtained with objective data as follows:

$$b_{ij} = \frac{a_{ij}}{\sum_{i=1}^m a_{ij}} \quad (i = 1, 2, \ldots, m, \quad j = 1, 2, \ldots, p) \tag{30}$$

The normalization value for the sub-criteria of profit with triangular fuzzy numbers is obtained through the following:

$$\widetilde{b}_{ij} = \left(\frac{\widetilde{a}_{ij}}{\max_i\left\{\widetilde{a}_{ij}\right\}}\right) = \left[\frac{a_{ij}^L}{\max_i\left\{a_{ij}^L, a_{ij}^M, a_{ij}^R\right\}}, \frac{a_{ij}^M}{\max_i\left\{a_{ij}^L, a_{ij}^M, a_{ij}^R\right\}}, \frac{a_{ij}^R}{\max_i\left\{a_{ij}^L, a_{ij}^M, a_{ij}^R\right\}}\right] \tag{31}$$
$$i = 1, 2, \ldots m, \quad j = p+1, \ p+2, \ \ldots n$$

Normalization values for cost sub-criteria with objective data can be obtained by:

$$the\ b_{ij} = \frac{1/a_{ij}}{\sum_{i=1}^m 1/a_{ij}} \quad (i = 1, 2, \ldots, m, \quad j = 1, 2, \ldots, p) \tag{32}$$

Normalizing the value for cost sub-criteria with triangular fuzzy numbers using (33):

$$\widetilde{b}_{ij} = \left(\frac{\min_i\left\{\widetilde{a}_{ij}\right\}}{\widetilde{a}_{ij}}\right) = \left[\frac{\min_i\left\{a_{ij}^L, a_{ij}^M, a_{ij}^R\right\}}{a_{ij}^R}, \frac{\min_i\left\{a_{ij}^L, a_{ij}^M, a_{ij}^R\right\}}{a_{ij}^M}, \frac{\min_i\left\{a_{ij}^L, a_{ij}^M, a_{ij}^R\right\}}{a_{ij}^L}\right] \quad i = 1, 2, \ldots m, \quad j = p+1,\ p+2,\ \ldots n \tag{33}$$

Step 3: If B^+ and B^- imply the fuzzy positive and negative ideal solutions, respectively, FPIS and FNIS can be calculated using (34):

$$\begin{cases} B^+ = \left(b_j^+\right) = \left\{\left(\max_i b_{ij} \middle| \ j \in J_1\right), \left(\min_i b_{ij} \middle| \ j \in J_2\right)\right\} \\ B^- = \left(b_j^-\right) = \left\{\left(\min_i b_{ij} \middle| \ j \in J_1\right), \left(\max_i b_{ij} \middle| \ j \in J_2\right)\right\} \end{cases} \tag{34}$$

Step 4: After determining the fuzzy positive and negative ideal solutions, calculate S_i and R_i using (35) and (36):

$$S_i = \sum_{j=1}^{n} \frac{w_j\left(b_j^+ - b_{ij}\right)}{\left(b_j^+ - b_j^-\right)} \tag{35}$$

$$R_i = \max_j \left(\frac{w_j\left(b_j^+ - b_{ij}\right)}{\left(b_j^+ - b_j^-\right)}\right) \tag{36}$$

Step 5: Computing the Q_i for all alternatives to rank the alternatives restrained and accurately using (37):

$$\begin{array}{l} Q_i = \frac{v\left(S_i - S^+\right)}{S^- - S^+} + \frac{(1-v)\left(R_i - R^+\right)}{R^- - R^+} \\ S^- = \max_i\{S_i\}, \quad S^+ = \min_i\{S_i\} \\ R^- = \max_i\{R_i\}, \quad R^+ = \min_i\{R_i\} \end{array} \tag{37}$$

Step 6: Ranking all the alternatives by comparing S_i, R_i, and Q_i in decreasing order. When the following two conditions are met, the alternatives are ranked based on Q_i, and the optimal alternative is for Q_i to be the smallest.

Acceptable advantage: $Q(A^{(2)}) - Q(A^{(1)}) \geq 1/(m-1)$, where $Q(A^{(1)})$ is the first alternative that is ranked according to the value of Q_i, and $Q(A^{(2)})$ is the second alternative that is ranked according to the value of Q_i.

Acceptable stability in evaluation: after ranking by the value of Q_i, the alternative $A^{(1)}$ must also be the best reordered by the value of S_i or R_i. If one of the conditions is not met, then compromise solutions are provided as follows:

If the first condition is not met, both alternatives will be the best alternatives. If the second condition is not met, alternatives $A^{(1)}$ and $A^{(2)}$ are both selected as the top alternatives.

3.3.5. Copeland Method

In this method, to evaluate the final ranking, the number of wins and losses for each alternative is calculated. The ranking is done by calculating the difference between the number of wins ΣC and the number of losses ΣR [70].

Grade of each factor = $\Sigma C - \Sigma R$.

4. Result and Discussion

The result is divided into three sections, in the following order: first, screening analysis of GMSs using fuzzy Delphi; second, using fuzzy SWARA to estimate the weight of sustainability criteria, and finally, analyzing the ranking of strategies.

4.1. Use of Fuzzy Delphi to Screen the Most Important Green Marketing Strategies

Considering evaluating and selecting GMS in the Iranian food industry, in this study, an attempt has been made to expertly examine the importance of the dimensions of sustainability in order to select appropriate GMS for this industry. First, using a literature review, 22 GMSs were extracted, and the results are shown in Section 2.1. Then, fuzzy Delphi questionnaires on a 5-point Likert scale were completed by 20 senior food industry executives, academic experts, and environmental consultants. In the first round, using the fuzzy Delphi technique, strategies with a threshold of less than 0.7 were eliminated, and their number was reduced to 16. In the second round, questionnaires were sent to experts again, and finally, the final number of GMSs was reduced to 12 alternatives. The results of which can be seen in Table 3.

Table 3. Evaluation strategies after fuzzy Delphi method screening.

Code	Strategies	1st Round	2nd Round	De-Fuzzy
A1	Using ecological and clean materials in packaging	✓	✓	0.719
A2	Development of market research to detect green needs	✓	✓	0.823
A3	Concentrating on LOHAS consumers (Lifestyle of Health And Sustainability)	✓	✓	0.854
A4	Using recycled or reusable materials in products	✓	✓	0.802
A5	Using ecolabels or environmental certification	✓	✓	0.719
A6	Sponsorship or patronage of environmental groups or events	✓	✓	0.740
A7	Observance of environmental considerations in product design	✓	✓	0.813
A8	Selection of cleaner transportation systems	✓	✓	0.771
A9	Development of waste reduction technology	✓	✓	0.896
A10	Considering a suitable mix of media	✓	✓	0.813
A11	Demonstrating the company's environmental actions through advertisement	✓	✓	0.833
A12	Identifying the beliefs and values of consumers and stakeholders and creating a marketing plan based on these values	✓	✓	0.740
A13	Using label information and terms that consumers understand and can make decisions	✓	×	0.698
A14	Observance of environmental considerations in distribution and reverse logistics systems	✓	×	0.688
A15	Increasing public awareness of ecological	✓	×	0.688
A16	Commercialization of environmentally friendly products and services	✓	×	0.615
A17	Green alliances or collaboration contracts with governmental organizations	×	×	-
A18	Avoiding 'greenwashing' and removing barriers to consumer trust	×	×	-
A19	Educating all employees on environmental awareness	×	×	-
A20	Reducing information asymmetries and encouraging consumers	×	×	-
A21	Considering environmental aspects in pricing policy	×	×	-
A22	Integrating all departments to facilitate flexibility in response to environmental needs	×	×	-

4.2. Fuzzy SWARA Application to Estimate the Weight of Sustainability Criteria

In the next step, the weights of the main criteria and sub-criteria are calculated using the fuzzy SWARA method, for which experts are given questionnaires and asked to assess the importance of each criterion compared to the previous criterion. Then, the weight of the criteria and sub-criteria is calculated using Equation (8). The weight of the main criterion is multiplied by the sub-criterion. Table 4 shows the weight of the sustainability criteria and the relevant sub-criteria.

Table 4. Final weight criteria using Fuzzy SWARA method.

Dimension	Criteria	De-Fuzzy Value		Final Weight
		Dimension Weight	Criteria Weight	
d_1		0.534		0.534
	C_4		0.497	0.2663
	C_3		0.264	0.1421
	C_2		0.16	0.0866
	C_1		0.083	0.0449
d_2		0.268		0.268
	C_9		0.483	0.1314
	C_{10}		0.241	0.0661
	C_6		0.129	0.0361
	C_7		0.069	0.0196
	C_8		0.037	0.0107
	C_5		0.024	0.0069
	C_{14}		0.014	0.0042
	C_{13}		0.008	0.0023
	C_{12}		0.004	0.0013
	C_{11}		0.002	0.0007
d_3		0.135		0.135
	C_{19}		0.487	0.0666
	C_{17}		0.243	0.0336
	C_{16}		0.141	0.0199
	C_{15}		0.073	0.0104
	C_{18}		0.04	0.0057
	C_{20}		0.024	0.0035
d4		0.076		0.076
	C_{23}		0.556	0.0428
	C_{21}		0.3	0.0238
	C_{22}		0.151	0.0124

As can be seen in Table 4, among the 23 sustainability criteria, C4 obtained the most weight and C11 obtained the lowest weight by the fuzzy SWARA method. In addition, C3 and C9 are ranked second and third, respectively, after minimizing waste.

4.3. Ranking the Strategies

In this section, according to the weights obtained from the previous section and using the opinions of the same previous experts, the ranking of strategies is calculated using MCDM methods. According to the results of Table 5, in the four main methods of this research, 'development of waste reduction technology' was identified as the most important GMS of Iran's food industry. Additionally, in these methods, 'demonstrating the company's environmental actions through advertisement' was ranked as the last one. Moreover, the sixth and seventh ranks as well as the tenth to twelfth ranks of these four methods were similar; however, in other rankings, the results were different. For example, in the fuzzy COPRAS results, fuzzy TOPSIS results, and fuzzy VIKOR results, 'develop market research

to detect green needs' has been identified as the second GMS; however, in the fuzzy ARAS method, 'using recycled or reusable materials in products' is in the second place and 'develop market research to detect green needs' is in the third place.

Table 5. Scores obtained by Fuzzy MCDM methods to prioritize GMSs.

Strategies	Fuzzy ARAS	Fuzzy COPRAS	Fuzzy TOPSIS	Fuzzy VIKOR	Copeland (Final Rank)
Development of waste reduction technology	1	1	1	1	1
Development of market research to detect green needs	3	2	2	2	2
Using recycled or reusable materials in products	2	3	3	3	3
Using ecological and clean materials in packaging	4	5	4	5	4
Observance of environmental considerations in product design	5	4	5	4	5
Selection of cleaner transportation systems	6	6	6	6	6
Concentrating on LOHAS consumers (Lifestyle of Health And Sustainability)	7	7	7	7	7
Sponsorship or patronage of environmental groups or events	8	8	8	9	8
Identifying the beliefs and values of consumers and stakeholders and creating a marketing plan based on these values	9	9	9	10	9
Considering a suitable mix of media	10	10	10	8	10
Using ecolabels or environmental certification	11	11	11	11	11
Demonstrating the company's environmental actions through advertisement	12	12	12	12	12

Based on the above considerations, the use of several MCDM methods has led to a different ranking of green marketing strategies. Based on this, an appropriate aggregation method is needed to provide the final result of green marketing strategies and to help food companies' managers rank the strategies accurately. In this regard, the Copeland method is used to integrate the results of the four implemented MCDM methods. This method calculates the number of wins and losses in pairwise comparison; thus, in this study, the Copeland method is preferred to the Borda method. The final results of ranking green marketing strategies are shown in Table 5.

5. Discussion and Implications

According to the results of Fuzzy SWARA, 'waste minimization' has the highest weight among others, which indicates that the value and importance of each GMS are primarily measured based on this criterion from the environmental dimension of sustainability. In the food industry, waste reduction is the most important goal of companies in terms of environmental sustainability [71], because food waste and product packaging are the main reasons for the impact of these industries on the environment, and food producers must have a good strategy to address this challenge [27]. Therefore, the results of fuzzy SWARA

in this study confirm that the Iranian food industry should implement GMSs to reduce food waste.

According to the results of the ranking methods used in this article, 'development of waste reduction technology' is the most important GMS in Iran's food industry (Table 5). Companies use waste reduction technologies to help meet environmental protection requirements and improve environmental management performance. In addition, the development of these technologies can be considered an optimal solution to resolve the conflict between economic development and environmental protection [22]. A wide range of technologies have been developed in various fields to reduce the negative impact on the environment by reducing food waste and to eliminate the damage caused by this phenomenon (such as innovation in food packaging, the use of nanotechnology, and intelligent transportation) [72]. Improving health conditions is a way to prevent food waste. For instance, electron beams are used to disinfect foods without compromising their basic properties, including taste and nutritional value, and to increase the shelf life of food [73]. Using smarter packaging to deal with the food waste crisis is another technological innovation to reduce food waste. This approach can be carried out in different ways; one of the most important methods is to improve the packaging properties for food preservation. These smart packages can control the rate of deterioration. The application of nanocoatings in food packaging is one of the most important uses of nanotechnology in the field of food waste. In fact, nanoparticles that can act as a barrier to oxygen in plastic packaging reduce the rate of food spoilage. The use of nanosensors can also be used to detect bacteria and reduce the risk of contamination [72]. As a result, the development of waste reduction technologies is an essential strategy for companies' sustainability.

Moreover, 'development of market research to detect green needs' and 'using recycled or reusable materials in products' were ranked as second and third strategies (Table 5). Xie et al. [74] noted that customer awareness of environmental threats and instilling a passion for sustainable behavior in them leads to the formation of green needs that will be very difficult for companies to identify. On the other hand, the more sensitive customers are to environmental issues, the greater the demand for green products [28], so raising awareness should be combined with identifying customers' green needs. One of the wastes of the food industry, such as fast foods, ready meals, beverages, and snacks, is related to the materials used in their packaging, which are often made of plastic. With the increase in population, the demand for food production and packaging increases. This increase in demand causes an increase in the production of waste, the majority of which is related to solid packaging waste [75]. By performing reuse, which is related to the waste management strategy, packaging waste can be reused, which plays a significant role in helping the health of the environment [76]. In addition, due to the high use of plastic packaging in the food industry, the use of recycled or reusable materials in products and their packaging is strongly required [77].

The last rank is 'demonstrating the company's environmental actions through advertisement', which shows that it is less important compared to other strategies. In addition, this strategy has been awarded the last rank in all techniques. As green advertisements influence green brand trust directly and influence consumers purchasing intentions indirectly [38], sometimes the environmental claims of companies in line with green marketing may be false or misleading and mislead consumers. These claims and advertisements should be controlled and evaluated by governments to empower consumers to make more informed decisions.

5.1. Theoretical Contributions

Theoretically, this paper focuses on the sustainability of the food industry to increase our theoretical understanding of GMSs, which play an essential role in this direction. We assert that important actions such as the development of waste reduction technology, the development of market research to detect green needs [41], and the use of recycled or reusable materials in products [25,51], will lead to the food industry moving towards

sustainability. Given that the food industry is sensitive to sustainability requirements, particularly those related to the environment, our research examines the role of 'development of waste reduction technology' and 'development of market research to detect green needs' in improving the industry's processes and reducing waste while minimizing environmental damage. In this way, this study separates the importance and impact of a set of GMSs for the development and sustainable improvement of the food industry in developing countries such as Iran.

5.2. Practical Contributions

In practical terms, the findings of this research clarify the important strategies that have been paid less attention to in similar research to improve the performance of the food industry in the direction of sustainability. Correspondingly, investing in the development and implementation of waste reduction technologies can be a long-term solution for food industry managers to improve their environmental management performance and meet environmental protection requirements. As mentioned earlier, the use of electron beams is one of the most important proposed technologies to reduce food waste and improve food health conditions [73]. To promote a sustainable future for the food industry in Iran, we propose that the government incentivize companies to invest in waste-reduction technologies or enforce regulations that mandate reductions in food waste. By doing so, the Iranian government can catalyze a shift towards eco-friendly practices in the industry and set an example for other developing countries to follow.

Based on our current level of knowledge, it is difficult to provide a range of comprehensive and up-to-date strategies for food industry companies in Iran to adopt waste reduction technologies. However, it is possible to discuss some obstacles and potential opportunities that food industry companies in Iran may face in adopting these technologies. One of the main challenges in the food industry is the lack of awareness and knowledge about waste reduction technologies and their benefits [78]. Financial constraints may also be an obstacle for companies, especially if they are small or medium-sized, to invest in equipping themselves with these technologies [74]. Regarding the level of motivation of the food industry, there is evidence that this industry is increasingly interested in adopting sustainable practices, including waste reduction technologies, but they face challenges in implementation [41,79]. Therefore, food industry managers should continuously seek to overcome challenges and obstacles in the implementation of GMSs.

6. Conclusions

In the production stages of the food industry, various wastes are produced, which most often affect the environment. In addition, due to the diversity of food industries, these negative effects will have different quantities and qualities that can cause environmental pollution if not prevented. The food industry can help reduce the community's environmental impact by implementing GMS and achieving sustainability by promoting green products.

The main purpose of this study is to rank GMSs for the Iranian food industry, which are implemented in line with various dimensions of sustainability. To address this key issue in the food industry, 22 GMSs and 23 sustainability criteria for evaluating these strategies are identified through a literature review, which is very comprehensive and complete so far and has not been studied in detail heretofore. It dropped to 12 strategies to achieve the industry's most critical strategies using fuzzy Delphi. Sustainability criteria were weighted using the fuzzy SWARA method, and GMSs were ranked using four methods: fuzzy ARAS, fuzzy COPRAS, fuzzy TOPSIS, and fuzzy VIKOR. Finally, the Copeland method was used to integrate the results of the MCDM methods in this study. The results of weighing sustainability criteria to measure GMSs show that 'minimizing waste', 'minimizing environmental impacts', and 'consumer participation' are most important in Table 4.

According to the results of this study, one of the most important measures of Iran's food industry's sustainability, especially environmental sustainability, is investing in waste

reduction technologies. The underdevelopment of food industry machinery is one of the most significant reasons for high waste in Iran. Food companies are required to acquire and implement waste reduction knowledge and technologies in their food production lines. These technologies should be used in the design and construction of food processing machines to reduce waste. The second strategy of high importance in this research is to identify the green needs of customers, which should be done with the development of market research. Sustainable food consumption behaviors vary widely and are sometimes contradictory, so food companies must have very strong R&D teams to identify needs and promote environmental awareness and green consumption. In general, the findings of this study can be very important in selecting the most effective GMSs for the food industry.

The results of this study confirm that the development of technologies to reduce food industry waste is one of the fundamental measures that strongly affect the food production system and should be considered the most important GMS by managers. Second, in terms of implications for managers, this study provides practical guidelines for evaluating green strategies for food company executives who want to measure their firm's green actions based on a comprehensive list of sustainability criteria. In this article, the SWARA method is used for weighting the criteria, which has limitations. One of them is that there are mutual relationships between the criteria; however, in this method, these relationships are ignored and assumed to be independent. Therefore, the DEMATEL and WINGS methods can be used for future research. Another problem is the inconsistency of data in the SWARA method, which can be used with other weighting methods such as BWM. It is also possible to use other methods of uncertainty, such as hesitant fuzzy (HF) and intuitionistic fuzzy (IF), to consider the opinions of experts.

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References

1. Shabanali, H.; Aramyan, L.H.; Sijtsema, S.J.; Alambaigi, A. Determinants of household food waste behavior in Tehran city: A structural model. *Resour. Conserv. Recycl.* **2019**, *143*, 154–166. [CrossRef]
2. Wharton, C.; Vizcaino, M.; Berardy, A.; Opejin, A. Waste watchers: A food waste reduction intervention among households in Arizona. *Resour. Conserv. Recycl.* **2021**, *164*, 105109. [CrossRef]
3. Messner, R.; Johnson, H.; Richards, C. From Surplus-to-Waste: A Study of Systemic Overproduction, Surplus and Food Waste in Horticultural Supply Chains. *J. Clean. Prod.* **2021**, *278*, 123952. [CrossRef]
4. Somlai, R. Insights into business strategies for reducing food waste in the Australian food industry. *Bus. Strategy Environ.* **2022**, 1–14. [CrossRef]
5. Heidari, A.; Mirzaii, F.; Rahnama, M.; Alidoost, F. Environmental Toxicology and Biogeochemistry of Ecosystems A theoretical framework for explaining the determinants of food waste reduction in residential households: A case study of Mashhad. *Environ. Sci. Pollut. Res.* **2019**, *27*, 6774–6784. [CrossRef]
6. Sadegh, M.; Marzban, S.; El, H.; Ben, T. Heliyon Effects of COVID-19 pandemic on household food waste behaviour in Iran. *Heliyon* **2022**, *8*, e11337. [CrossRef]
7. Ravindran, R.; Jaiswal, A.K. Exploitation of Food Industry Waste for High-Value Products. *Trends Biotechnol.* **2016**, *34*, 58–69. [CrossRef]

8. Galanakis, C.M.; Cvejic, J.; Verardo, V.; Segura-Carretero, A. Food Use for Social Innovation by Optimizing Food Waste Recovery Strategies. In *Innovation Strategies in the Food Industry: Tools for Implementation*; Academic Press: Cambridge, MA, USA, 2016; pp. 211–236, ISBN 9780128037935.
9. Ritchie, H.; Roser, M. Environmental Impacts of Food Production. Our World Data 2020. Available online: https://ourworldindata.org/environmental-impacts-of-food (accessed on 12 February 2022).
10. HSPH Apples, The Nutrition Source, Harvard T.H. Chan School of Public Health. Available online: https://www.hsph.harvard.edu/nutritionsource/sustainability/ (accessed on 12 December 2021).
11. Chen, S.; Brahma, S.; Mackay, J.; Cao, C.; Aliakbarian, B. The role of smart packaging system in food supply chain. *J. Food Sci.* **2020**, *85*, 517–525. [CrossRef] [PubMed]
12. Diggle, A.; Walker, T.R. Implementation of harmonized Extended Producer Responsibility strategies to incentivize recovery of single-use plastic packaging waste in Canada. *Waste Manag.* **2020**, *110*, 20–23. [CrossRef] [PubMed]
13. Xanthos, D.; Walker, T.R. International policies to reduce plastic marine pollution from single-use plastics (plastic bags and microbeads): A review. *Mar. Pollut. Bull.* **2017**, *118*, 17–26. [CrossRef] [PubMed]
14. Bhardwaj, S.; Nair, K.; Tariq, M.U.; Ahmad, A.; Chitnis, A. The State of Research in Green Marketing: A Bibliometric Review from 2005 to 2022. *Sustainability* **2023**, *15*, 2988. [CrossRef]
15. Suki, N.M. Green product purchase intention: Impact of green brands, attitude, and knowledge. *Br. Food J.* **2016**, *118*, 2893–2910. [CrossRef]
16. Nguyen, T.T.H.; Yang, Z.; Nguyen, N.; Johnson, L.W.; Cao, T.K. Greenwash and green purchase intention: The mediating role of green skepticism. *Sustainability* **2019**, *11*, 2653. [CrossRef]
17. Barclay, K.; Miller, A. The sustainable seafood movement is a Governance concert, with the audience playing a key role. *Sustainability* **2018**, *10*, 180. [CrossRef]
18. Kaur, B.; Gangwar, V.P.; Dash, G. Green marketing strategies, environmental attitude, and green buying intention: A multi-group analysis in an emerging economy context. *Sustainability* **2022**, *14*, 6107. [CrossRef]
19. Amoako, G.K.; Dzogbenuku, R.K.; Doe, J.; Adjaison, G.K. Green marketing and the SDGs: Emerging market perspective. *Mark. Intell. Plan.* **2022**, *40*, 310–327. [CrossRef]
20. Dangelico, R.M.; Vocalelli, D. "Green Marketing": An analysis of definitions, strategy steps, and tools through a systematic review of the literature. *J. Clean. Prod.* **2017**, *165*, 1263–1279. [CrossRef]
21. Cui, L.; Guo, S.; Zhang, H. Coordinating a green agri-food supply chain with revenue-sharing contracts considering retailers' green marketing efforts. *Sustainability* **2020**, *12*, 1289. [CrossRef]
22. Mukonza, C.; Swarts, I. The influence of green marketing strategies on business performance and corporate image in the retail sector. *Bus. Strategy Environ.* **2020**, *29*, 838–845. [CrossRef]
23. Liu, X.; Xu, Z.; Bai, C. Drivers' evaluation to implement green marketing practices in automobile industry of China. *Int. J. Netw. Virtual Organ.* **2016**, *16*, 362–376. [CrossRef]
24. Ginsberg, J.M.; Bloom, P.N. Choosing the right green marketing strategy. *MIT Sloan Manag. Rev.* **2004**, *46*, 79–84.
25. Chen, H.C.; Yang, C.H. Applying a multiple criteria decision-making approach to establishing green marketing audit criteria. *J. Clean. Prod.* **2019**, *210*, 256–265. [CrossRef]
26. Ho, C.Y.; Tsai, B.H.; Chen, C.S.; Lu, M.T. Exploring green marketing orientations toward sustainability the hospitality industry in the covid-19 pandemic. *Sustainability* **2021**, *13*, 4348. [CrossRef]
27. Gustavo, J.U.; Trento, L.R.; de Souza, M.; Pereira, G.M.; Lopes de Sousa Jabbour, A.B.; Ndubisi, N.O.; Chiappetta Jabbour, C.J.; Borchardt, M.; Zvirtes, L. Green marketing in supermarkets: Conventional and digitized marketing alternatives to reduce waste. *J. Clean. Prod.* **2021**, *296*, 126531. [CrossRef]
28. Tabavar, A.A.; Aramesh, H.; Vakili, N.; Vakili, N. Effects of green marketing strategies on entrepreneurship in medicinal herbs in Sistan and Baluchestan Province. *Asia Pac. J. Tour. Res.* **2021**, *26*, 119–131. [CrossRef]
29. Sugandini, D.; Muafi, M.; Susilowati, C.; Siswanti, Y.; Syafri, W. Green supply chain management and green marketing strategy on green purchase intention: SMEs cases. *J. Ind. Eng. Manag.* **2020**, *13*, 79–92. [CrossRef]
30. Nguyen, H.V.; Nguyen, N.; Nguyen, B.K.; Lobo, A.; Vu, P.A. Organic food purchases in an emerging market: The influence of consumers' personal factors and green marketing practices of food stores. *Int. J. Environ. Res. Public Health* **2019**, *16*, 1037. [CrossRef]
31. Rudawska, E. Sustainable marketing strategy in food and drink industry: A comparative analysis of B2B and B2C SMEs operating in Europe. *J. Bus. Ind. Mark.* **2019**, *34*, 875–890. [CrossRef]
32. Taherpouran, F.; Abadi, H.; Karimi, B.H. 'The investigation in effective factors on development of green marketing' (Case Study: Food Industries). *Int. J. Nonlinear Anal. Appl.* **2020**, *11*, 413–431. [CrossRef]
33. Polonsky, M.J. An Introduction to Green Marketing. *Electron. Green J.* **1994**, *1*, 1–10. [CrossRef]
34. Riva, F.; Magrizos, S.; Rubel, M.R.B. Investigating the link between managers' green knowledge and leadership style, and their firms' environmental performance: The mediation role of green creativity. *Bus. Strategy Environ.* **2021**, *30*, 3228–3240. [CrossRef]
35. Chen, Y.S. The driver of green innovation and green image—Green core competence. *J. Bus. Ethics* **2008**, *81*, 531–543. [CrossRef]
36. Peattie, K. Trappings versus substance in the greening of marketing planning. *J. Strateg. Mark.* **1999**, *7*, 131–148. [CrossRef]
37. Park, E.; Kwon, J.; Kim, S.B. Green marketing strategies on online platforms: A mixed approach of experiment design and topic modeling. *Sustainability* **2021**, *13*, 4494. [CrossRef]

38. Rahman, S.U.; Nguyen-Viet, B. Towards sustainable development: Coupling green marketing strategies and consumer perceptions in addressing greenwashing. *Bus. Strategy Environ.* **2022**, 1–14. [CrossRef]
39. Belz, F.M.; Schmidt-Riediger, B. Marketing strategies in the age of sustainable development: Evidence from the food industry. *Bus. Strategy Environ.* **2010**, *19*, 401–416. [CrossRef]
40. Risitano, M.; Romano, R.; Rusciano, V.; Civero, G.; Scarpato, D. The impact of sustainability on marketing strategy and business performance: The case of Italian fisheries. *Bus. Strategy Environ.* **2022**, *31*, 1538–1551. [CrossRef]
41. Lago, N.C.; Marcon, A.; Ribeiro, J.L.D.; de Medeiros, J.F.; Brião, V.B.; Antoni, V.L. Determinant attributes and the compensatory judgement rules applied by young consumers to purchase environmentally sustainable food products. *Sustain. Prod. Consum.* **2020**, *23*, 256–273. [CrossRef]
42. Smith, K.T.; Brower, T.R. Longitudinal study of green marketing strategies that influence Millennials. *J. Strateg. Mark.* **2012**, *20*, 535–551. [CrossRef]
43. Kinoti, M.W. Green marketing intervention strategy and sustainable development. *Int. J. Bus. Soc. Sci.* **2011**, *2*, 263–273.
44. Cronin, J.J.; Smith, J.S.; Gleim, M.R.; Ramirez, E.; Martinez, J.D. Green marketing strategies: An examination of stakeholders and the opportunities they present. *J. Acad. Mark. Sci.* **2011**, *39*, 158–174. [CrossRef]
45. Kumar, V.; Rahman, Z.; Kazmi, A.A. Sustainability Marketing Strategy: An Analysis of Recent Literature. *Glob. Bus. Rev.* **2013**, *14*, 601–625. [CrossRef]
46. Ottman, J.A. Green is now mainstream. In *The New Rules of Green Marketing Strategies, Tools, and Inspiration for Sustainable Branding*; Routledge: London, UK, 2014; pp. 1–21. [CrossRef]
47. Sharma, M.; Joshi, S. Brand sustainability among young consumers: An AHP-TOPSIS approach. *Young Consum.* **2019**, *20*, 314–337. [CrossRef]
48. Leonidou, L.C.; Leonidou, C.N.; Palihawadana, D.; Hultman, M. Evaluating the green advertising practices of international firms: A trend analysis. *Stud. Econ. Financ.* **2011**, *28*, 6–33. [CrossRef]
49. Fraj, E.; Martínez, E.; Matute, J. Green marketing strategy and the firm's performance: The moderating role of environmental culture. *J. Strateg. Mark.* **2011**, *19*, 339–355. [CrossRef]
50. Snowden, K. Competitiveness Review: An International Business Journal changes publisher. *Compet. Rev.* **2007**, *17*. [CrossRef]
51. Borin, N.; Lindsey-Mullikin, J.; Krishnan, R. An analysis of consumer reactions to green strategies. *J. Prod. Brand Manag.* **2013**, *22*, 118–128. [CrossRef]
52. Rivera-Camino, J. Re-evaluating green marketing strategy: A stakeholder perspective. *Eur. J. Mark.* **2007**, *41*, 1328–1358. [CrossRef]
53. Baktash, L.; Talib, M.A. Green marketing strategies: Exploring intrinsic and extrinsic factors towards green customers' loyalty. *Qual. Access Success* **2019**, *20*, 127–134.
54. Pipatprapa, A.; Huang, H.H.; Huang, C.H. The Role of Quality Management & Innovativeness on Green Performance. *Corp. Soc. Responsib. Environ. Manag.* **2017**, *24*, 249–260. [CrossRef]
55. Gimenez, C.; Tachizawa, E.M. Extending sustainability to suppliers: A systematic literature review. *Supply Chain Manag.* **2012**, *17*, 531–543. [CrossRef]
56. Naderi, I.; Van Steenburg, E. Me first, then the environment: Young Millennials as green consumers. *Young Consum.* **2018**, *19*, 280–295. [CrossRef]
57. Mohammad Ebrahimi, S.; Koh, L. Manufacturing sustainability: Institutional theory and life cycle thinking. *J. Clean. Prod.* **2021**, *298*, 126787. [CrossRef]
58. Rostamzadeh, R.; Govindan, K.; Esmaeili, A.; Sabaghi, M. Application of fuzzy VIKOR for evaluation of green supply chain management practices. *Ecol. Indic.* **2015**, *49*, 188–203. [CrossRef]
59. Banihashemi, S.A.; Khalilzadeh, M.; Antucheviciene, J.; Edalatpanah, S.A. Identifying and Prioritizing the Challenges and Obstacles of the Green Supply Chain Management in the Construction Industry Using the Fuzzy BWM Method. *Buildings* **2023**, *13*, 38. [CrossRef]
60. Korucuk, S.; Aytekin, A.; Ecer, F.; Karamaşa, Ç.; Zavadskas, E.K. Assessing Green Approaches and Digital Marketing Strategies for Twin Transition via Fermatean Fuzzy SWARA-COPRAS. *Axioms* **2022**, *11*, 709. [CrossRef]
61. Nilashi, M.; Yadegaridehkordi, E.; Samad, S.; Mardani, A.; Ahani, A.; Aljojo, N.; Razali, N.S.; Tajuddin, T. Decision to adopt neuromarketing techniques for sustainable product marketing: A fuzzy decision-making approach. *Symmetry* **2020**, *12*, 305. [CrossRef]
62. Guttorp, P.; Kaufman, A.; Gupta, M. Fuzzy Mathematical Models in Engineering and Management Science. *Technometrics* **1990**, *32*, 238. [CrossRef]
63. Priyadharshini, D.; Gopinath, R.; Poornappriya, T.S. A fuzzy MCDM approach for measuring the business impact of employee selection. *Int. J. Manag. (IJM)* **2020**, *11*, 1769–1775.
64. Esmaelnezhad, D.; Taghizadeh-Yazdi, M.; Amoozad Mahdiraji, H.; Vrontis, D. International strategic alliances for collaborative product Innovation: An agent-based scenario analysis in biopharmaceutical industry. *J. Bus. Res.* **2023**, *158*, 113663. [CrossRef]
65. Keršuliene, V.; Zavadskas, E.K.; Turskis, Z. Racionalaus ginčų sprendimo būdo nustatymas taikant naują kriterijų svorių nustatymo metodą, pagrįstą nuosekliu laipsnišku poriniu kriterijų santykinės svarbos lyginimu. *J. Bus. Econ. Manag.* **2010**, *11*, 243–258. [CrossRef]

66. Turskis, Z.; Zavadskas, E.K. A new fuzzy additive ratio assessment method (ARAS-F). Case study: The analysis of fuzzy multiple criteria in order to select the logistic centers location. *Transport* **2010**, *25*, 423–432. [CrossRef]
67. Zavadskas, E.K.; Kaklauskas, A. *Pastatų Sistemotechninis įvertinimas*; Technika: Vilnius, Lithuania, 1996; 275p.
68. Chen, S.-J.; Hwang, C.-L. Fuzzy multiple attribute decision making methods. In *Fuzzy Multiple Attribute Decision Making*; Springer: Berlin/Heidelberg, Germany, 1992; pp. 289–486.
69. Opricovic, S. Multicriteria optimization of civil engineering systems. *Fac. Civ. Eng. Belgrade* **1998**, *2*, 5–21.
70. Copeland, A.H. *A Reasonable Social Welfare Function*; University of Michigan: Ann Arbor, MI, USA, 1951.
71. Chen, C.C.; Sujanto, R.Y.; Tseng, M.L.; Fujii, M.; Lim, M.K. Sustainable consumption transition model: Social concerns and waste minimization under willingness-to-pay in Indonesian food industry. *Resour. Conserv. Recycl.* **2021**, *170*, 105590. [CrossRef]
72. Sahani, S.; Sharma, Y.C. Advancements in applications of nanotechnology in global food industry. *Food Chem.* **2021**, *342*, 128318. [CrossRef]
73. Pillai, S.D.; Shayanfar, S. Electron Beam Technology and Other Irradiation Technology Applications in the Food Industry. *Top. Curr. Chem.* **2017**, *375*, 249–268. [CrossRef]
74. Xie, X.; Hoang, T.T.; Zhu, Q. Green process innovation and financial performance: The role of green social capital and customers' tacit green needs. *J. Innov. Knowl.* **2022**, *7*, 100165. [CrossRef]
75. Jacob, J.; Lawal, U.; Thomas, S.; Valapa, R.B. *Biobased Polymer Composite from Poly(Lactic Acid): Processing, Fabrication, and Characterization for Food Packaging*; Elsevier Inc.: Amsterdam, The Netherlands, 2020; ISBN 9780128187951.
76. Malik, N.; Kumar, P.; Shrivastava, S.; Ghosh, S.B. An overview on PET waste recycling for application in packaging. *Int. J. Plast. Technol.* **2017**, *21*, 1–24. [CrossRef]
77. Ncube, L.K.; Ude, A.U.; Ogunmuyiwa, E.N.; Zulkifli, R.; Beas, I.N. An overview of plasticwaste generation and management in food packaging industries. *Recycling* **2021**, *6*, 12. [CrossRef]
78. Sridhar, A.; Ponnuchamy, M.; Kumar, P.S.; Kapoor, A. Food preservation techniques and nanotechnology for increased shelf life of fruits, vegetables, beverages and spices: A review. *Environ. Chem. Lett.* **2021**, *19*, 1715–1735. [CrossRef]
79. Guillier, L.; Duret, S.; Hoang, H.M.; Flick, D.; Nguyen-Thé, C.; Laguerre, O. Linking food waste prevention, energy consumption and microbial food safety: The next challenge of food policy? *Curr. Opin. Food Sci.* **2016**, *12*, 30–35. [CrossRef]