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A weighted fuzzy approach for green marketing risk assessment: Empirical evidence from dairy industry

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ABSTRACT

The green marketing concept encompasses the consumers' perception and response to the green initiatives and activities that companies implement such as design for environment, green production systems and processes development, and green improvements in packaging. Despite the growing interest in the green marketing domain, few studies have been carried out on the risk assessment of green marketing implementation, especially in the dairy industry. In this study, using a developed integrated fuzzy decision-making methodology, the green marketing risk factors in the dairy industry are assessed. Firstly, the fuzzy analytic hierarchy process is used for weighting the identified risk assessment criteria. Then, a weighted fuzzy inference system is proposed for green marketing risk assessment. Finally, risk mitigation strategies are proposed to deal with the highly ranked risk factors. This research study fills the gaps in the literature by (1) proposing a comprehensive list of green marketing risk factors in the dairy industry, (2) developing a novel weighted fuzzy inference system approach for assessing those risk factors, and (3) providing a final ranking of the dairy industry risk factors together with risk mitigation strategies for the highly ranked risk factors. The level of environmental awareness in society was found as the most important risk factor followed by governmental policies, rules, and regulations for supporting green products risk factors. Finally, some remarks are concluded together with presenting the future works.

1. Introduction

In the past decade, environmental protection activities have been increasingly implemented in various organizational levels and functions such as design, production, sales, and marketing (Kao and Du, 2020; Zhang and Watson IV, 2020; Papadas et al., 2017; Gelderman et al., 2021). Besides, consumers are gradually concentrating on purchasing green products and therefore implementing green marketing campaigns that increase the consumers' green awareness are of great importance but challenging ". Various markets and businesses have been aligned with various governmental and international green initiatives forming the green marketing domain (Chan and Lau, 2000; Canavari and Coderoni, 2019; Richey et al., 2014; Polonsky, 2011; Agustini et al., 2021; Li et al., 2021b). From a technical perspective, green marketing is described as marketing the products or services adapted to the environment (Peano et al., 2015). Green marketing has been defined as "the process of planning, implementing and controlling the development, pricing, promotion, and distribution of products in a manner that satisfies the following three criteria: (1) customer needs are met, (2) organizational goals are attained, and (3) the process is compatible with eco-systems" (Chen and Yang, 2019; Dangelico and Vocalelli, 2017; Tsai et al., 2020). Peattie (2015) defined green marketing as the activities curbing the negative environmental and social consequences of the current products and promotes less harmful products and/or services. American Marketing Association defined green marketing as "*Green marketing refers to the development and marketing of products that are presumed to be environmentally safe (i.e., designed to minimize negative effects on the physical environment or to improve its quality). This term may also be used to describe efforts to produce, promote, package, and reclaim products in a manner that is sensitive or responsive to ecological concerns.*" In other words, the main aspect of green marketing is about promoting sustainable consumption and production practices by various stakeholders such as governmental bodies, business organizations, and consumers (Polonsky, 2011; Chkanikova and Lehner, 2015; Canavari and

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Coderoni, 2019).

The green marketing concept encompasses the consumers' perception and response to the green initiatives and activities that companies implement such as design for environment, green production systems and processes development, and green improvements in packaging (Chen and Yang, 2019; Dangelico and Vocalelli, 2017; Tsai et al., 2020). Moreover, green marketing not only covers these internal green activities but also addresses the requirements of the consumers and society and strives to conduct marketing projects in an environmental-friendly manner (Chen and Yang, 2019; Confente et al., 2020). In addition, green marketing can provide useful information for a company manager to design an effective supply chain (Brindley and Oxborrow, 2014). There are several logical reasons for a company and marketer for implementing green marketing activities such as community pressure, government incentives and mandates, attracting customers, and competitive advantages (Chen and Yang, 2019; Martínez-López et al., 2020; Zhang et al., 2020). Also, there are several benefits for organizations that would like to turn green, given the increasing number of consumers purchasing green products/services (Guo et al., 2020; Reche et al., 2020; Zhu and Sarkis, 2016; Papadas et al., 2019).

Based on recent research by Tsai et al. (2020), it was found that companies that have already introduced green products in their portfolio are struggling to keep their business interests. This can be attributed to the fact that despite green technological improvements, companies that implement green marketing will end up paying more for green products and services that are not economically sustainable (Catarina Peneda de and Bruno Miguel, 2020). Chen and Yang (2019) highlighted that a green marketing strategy can be successful in implementing effective green marketing projects. The effective implementation of such projects depends on several factors such as changes in governmental legislation and customer price sensitivity. These factors often can have impacts on the implementation of green marketing activities (Groening et al., 2018; Chen and Yang, 2019). In other words, like any other business function, effective green marketing implementation has its risks that need to be managed (Sun et al., 2020). Within this context, firms must develop a risk assessment system to identify and assess the possible implementation risks and subsequently developing the mitigation strategies for the identified risks. Assessing the risks of green marketing activities enables organizations to control and monitor each risk and ultimately achieve their corporate strategic goals in green marketing practices (Chun-Lai, 2013). Achieving such goals would be realised by developing and performing a comprehensive risk assessment methodology that has the capability of dealing with various uncertainty and ambiguities existing in the risk analysis procedure. During past decade, several researchers have tried to identify and assess supply chain risks(Chowdhury et al., 2019; Abdel-Basset and Mohamed, 2020; Collier and Sarkis, 2021; Dohale et al., 2021). In their studies, they purely focused on supply risks such as disruption, transportation, supplier performance, and quality. However, there are some other risk associated with green marketing across supply chain that have not been consider in previous studies that only considered the risks associated with traditional supply chains. It means, most of the researchers have considered the risks associated with the supply side rather than demand side such as customer awareness regarding the green products, customers' price sensitivity, and level of income that can definitely affect the implementation of green marketing strategies. In other words, the risks in the demand side for marketing the green products have not been discussed in the previous studies that investigated traditional supply chain risks.

Globally, the agri-food sector, primary production (agriculture, fishing, and forestry) along with the food and beverage and wood processing, is responsible for a huge amount of emissions in the world. As their key environmental goal, this sector is at the frontline to battle climate change (Heller et al., 2019; Nikolaou et al., 2019; Del Borghi et al., 2019; Colley et al., 2020; Karlsson and Hovelsrud, 2021). Promoting sustainable consumption to achieve international and European environmental mitigation targets, in this sector, is possible through marketing more environmental-friendly products ultimately leading to reducing emissions (Wang et al., 2019). Dairy products are selected as representative products and are the subject of the current study. The primary reason is that they have high consumption rates. Besides, products produced from livestock emit much more greenhouse gases (GHGs) comparing to the plant-based ones highlighted as an international issue (Canavari and Coderoni, 2019). Production of dairy products has environmental impacts in their different life-cycle stages (farming, material processing, manufacturing, use, and post-use) (Famiglietti et al., 2019; Knudsen et al., 2019; Zucali et al., 2020). Annually, around 172.2 million tonnes of raw milk is produced across Europe.[1] This requires a huge amount of energy and input that can cause high environmental burdens. Besides, milk processing, dairy products manufacturing and packaging along with transportation are responsible for a huge amount of GHG emissions in the world (Thoma et al., 2013; Üçtuğ, 2019; Üçtuğ et al., 2019). Hence, dairy companies have recently adopted more environmentally friendly production processes and materials (Yang et al., 2020b; Kirilova and Vaklieva-Bancheva, 2017). Selling these products needs efficient green marketing strategies and plans. However, the marketing of these green products has its risks and challenges that need to be considered and managed (Megaladevi et al., 2018; Ogiemwonyi et al., 2019; Mishra and Sharma, 2014). Therefore, developing a comprehensive risk assessment approach is required for these companies to control and respond to the potential impacts of the risks.

Among risk management activities, risk assessment plays an important role as it provides some measures of the potential risks that can link the risk identification and response and control activities (Lin et al., 2021a, b). During past decades, multi-attribute decision-making (MADM) techniques have widely been used for risk assessment in a different context (Chemweno et al., 2018; Khan et al., 2021; Lin et al., 2020; Lyu et al., 2020a). For example, MADM techniques such as Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) (Jena and Pradhan, 2020), Analytic Hierarchy Process (AHP) (Lyu et al., 2020c), VIseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR) (Darvishi et al., 2020), Elimination and Choice Expressing the Reality (ELECTRE) Preference Ranking Organization Method for Enrichment Evaluation (PROMETHEE) (Amirshenava and Osanloo, 2018) are among the MADM techniques that have been used for assessing and ranking the risks. These techniques can handle the situation in which there are several conflicting criteria for making a decision (Aruldoss et al., 2013; Gülüm et al., 2021). Besides, some researchers used fuzzy version of the abovementioned techniques such as Fuzzy AHP (Gülüm et al., 2021; Lyu et al., 2020a, 2020b), Fuzzy TOPSIS (Ekmekcioğlu et al., 2021; Taylan et al., 2014), and Fuzzy VIKOR (Jena and Pradhan, 2020; Ramavandi et al., 2021; Rathore et al., 2020) to address inherent subjectivity and vagueness of the expert perception and evaluation in the context of risk assessment. However, the aforementioned techniques usually provide a ranking for the identified risks and they suffer from providing independent index or risk score for each individual risk. For example, AHP/FAHP provides relative importance weight of each risk based on pairwise comparison (Bakır and Atalık, 2021). TOPSIS provides a closeness index based on distance of each alternative from negative and positive ideal solutions (Adedeji et al., 2020; Penadés-Plà et al., 2016). These values are relative/comparative and don't show the exact/independent risk score/index. It means calculation of the final score for each risk depends on the behaviour of the other alternative in different criteria. Hence, several researcher tried to use fuzzy inference system (FIS) in the area of risk assessment to deal with abovementioned problem and also consider vagueness and impreciseness associated with experts' opinions (Jamshidi et al., 2013;

[1] https://ec.europa.eu/eurostat/statistics-explained/index.php/Milk_and_milk_product_statistics.

Raeihagh et al., 2020; Rezaee et al., 2020). However, the traditional FIS published in the literature (Azadnia et al., 2015; Ghadimi et al., 2019; MahmoumGonbadi et al., 2019; Nazari et al., 2018; Sabaghi et al., 2016) are not able to incorporate the weights of influencing factors related to each main attribute. These FIS models considered weighting the main attributes themselves and preference weightings of involved influencing factors are often neglected (Ahmadkhani and Moghaddam, 2021; Kerk et al., 2021; Li et al., 2021a). In current research work, this issue with the FIS models is considered in detail for which a heuristic solution approach is proposed to address this deficiency.

Based on the literature review conducted in Section 2 (see Table 1), there are limited studies in the literature that identified and assessed green marketing risks. It can be perceived that the research in the area of green marketing risk management is at its early stage. Our research study fills the above gaps in the literature (Osman et al., 2016; Polonsky, 2011; Fiore et al., 2017; Chen, 2016; Pervez et al., 2019), by (1) proposing a comprehensive list of green marketing risk factors in the dairy industry, (2) developing a novel weighted fuzzy inference system approach for assessing those risk factors to fill the gap discussed earlier regarding the inability of FIS method for considering the weight of input variables, and (3) providing a final ranking of the dairy industry risk factors together with risk mitigation strategies for the highly ranked risk factors. In this study, a comprehensive list of relevant main risk categories and their risk factors suitable for the effective risk assessment in green marketing is identified. Then, the risk factors are assessed by a set of risk assessment criteria. Besides, this study contributes an integrated fuzzy MADM approach to identify and assess green marketing risks based on a combined FAHP and a proposed FIS. Furthermore, the suitability of the developed green marketing risk assessment approach was determined by establishing a real-world case application in the dairy industry in Iran.

This reminder of this research article is arranged as follows. Section 2 includes the literature review and identified risk factors. Section 3 presents the steps of the proposed risk assessment approach followed by the empirical study and implementation reported in Section 4. Results and discussions are presented in Section 5. Finally, Section 6 provides the conclusion of the study.

2. Literature review

2.1. Marketing/green marketing and risk assessment

The current research is conducted following the few studies performed previously in the area of marketing/green marketing risk evaluation, reviewed in this section. Zhang et al. (2008) investigated the international risks of marketing and probed the existing risks from macro-environmental, industrial-environmental, and in-company perspectives. They also designed a risk assessment index and assessed the existing risks using FISs. Polonsky (2011) studied the existing barriers and opportunities to discover the reasons due to which government, company, and consumers are facing problems in pursuing environmental activities. The findings demonstrate that the failures are due to their inability to adjust and adapt themselves with thought systems in which great marketing attitudes are restricted by small decisions. Juwaheer et al. (2012) studied the effects of green marketing on purchasing patterns of consumers and researched the possibility of introducing the greener consumption patterns according to modern lifestyles. The results from the analysis of the customers' perspectives on environmental concerns and green products showed that green products are increasingly available on the market.

Chun-Lai (2013) assessed the risks of green marketing using the FAHP and developed a four-index green marketing risk assessment system composed of market risk, customer risk, production risk, and competition risk. Bu and Zhang (2013) assessed the risks of a marketing management system using a FIS and considered the existing risk from three different perspectives: marketing strategy risk, marketing mix risk, and competition risk. They found that strategy risks and marketing mix risks are the main risks in the market while competition risk is an operational one. Pervez et al. (2019) proposed a fuzzy-Likert approach for marketing risk assessment for hybrid rice growers in Bangladesh. Based on the results high fluctuation in the hybrid rice price was the most important risk. Besides these studies, a few researchers have carried out studies related to the sustainable/green supply chain management area (Baryannis et al., 2019; Abdel-Basset and Mohamed, 2020; Ali et al., 2019). In their research, although they identified some market-related risks, they mainly focused on supply risks rather than the marketing ones, which is the focus of the current research work.

Table 1 presents the results of a comprehensive literature review related to the papers that investigated the risks of marketing or green marketing. These articles are categorized based on their employed risk assessment methodology, the field of the study where the risk assessment was conducted, the application, and the studied industry.

It can be concluded that several studies have been done on green marketing (Anwar and El-Bassiouny, 2020; Dangelico and Vocalelli, 2017; Groening et al., 2018); however, lack of a comprehensive study that focuses solely on green marketing risk assessment is evident (Mangla et al., 2015; Ali et al., 2019; Baryannis et al., 2019). Moreover, most studies in the field of green marketing risk have only focused on

Table 1
Literature analysis on marketing/green marketing risk assessment.

Author	Method	Field of study for risk assessment		Green marketing risk	Real-world application	Industry/Sector
		Marketing	SCM			
Shao-ying (2004)	Fuzzy integrative evaluation method	✓	×	×	×	×
Wang (2009)	Multi-agent assessment model	✓	×	×	✓	Tinned beer in supermarkets
Rutkauskas and Ginevičus (2011)	Stochastic optimization methods	✓	×	×	×	×
Chun-Lai (2013)	FAHP	✓	×	✓	×	×
Bu and Zhang (2013)	Multi-level Fuzzy Comprehensive Evaluation	✓	×	×	×	×
Xiong et al. (2014)	Principal Component Analysis (PCA) and cluster analysis	✓	×	×	✓	Agriculture products
Boutang and De Lara (2016)	Statistical analysis	✓	×	×	✓	Insurance
Pervez et al. (2019)	Fuzzy-likert scale	✓		×	✓	Agriculture-Rice
Wu et al. (2019)	Fuzzy synthetic evaluation	×	✓	×	✓	Electric vehicle
Mangla et al. (2015)	FAHP	×	✓	×	✓	Plastic Manufacturing
Baryannis et al. (2019)	Machine learning	×	✓	×	✓	Aerospace Manufacturing
Ali et al. (2019)	Grey-based decision-making trial and evaluation laboratory	×	✓	×	✓	Food industry
Current research	Fuzzy AHP and a novel FIS	✓	✓	✓	✓	Dairy industry

Table 2
Green marketing risk categories and factors.

Green marketing risks	Definition	Reference
Customer		
1. Purchase contract	Includes problems regarding the lack of clients or customers' commitment to put the contract in action or the cancelation of the contract by the customers.	Chun-Lai (2013), Baryannis et al. (2019)
2. Customer's dissatisfaction risk	A high rate of customer dissatisfaction after using the environment-friendly product that may be dissatisfying to the customer or maybe lower than his/her expectation. This may happen because of green marketing myopia	Chun-Lai (2013), Mangla et al. (2015), Ali et al. (2019)
3. Customer loyalty	Indicates the lack of loyalty of customers to a specific brand	Chun-Lai (2013)
4. Customer acquisition rate	The rate at which the number of customers increases. This can fluctuate for green products	Chun-Lai (2013)
Competition		
5. Substitute products	There are several cheaper substitute products for green products that confine prices especially when the supply is far more than demand	Bu and Zhang (2013), Pervez et al. (2019)
6. Customers' price sensitivity and bargaining power	Represents customer sensitivity to expenses and their tendency to pay higher prices for such green products. If a few producers are serving different industries, their bargaining power increases when the replacing expenses or the substitute product price is high. If customers are price-sensitive, they will switch to a cheaper product and they are not buying green products.	Chun-Lai (2013), Narula and Desore (2016), Bu and Zhang (2013)
7. Suppliers bargaining power	When a few product/service providers serve several industries, if the price of switching to a different supplier is high, their bargaining power is increased. Especially for environment-friendly raw material. When the supplied items constitute a major part of the value-added of the final product and provide environmentally friendly products.	Bu and Zhang (2013), Mangla et al. (2015)
8. Threatening potential rivals	New rivals increase the market capacity and the need for market share; hence, the competition gets more intense.	Abdel-Basset and Mohamed (2020), Pervez et al. (2019), Bu and Zhang (2013)
9. Competitive rivalry	The higher the number of green companies, the more intensive the competition. The higher the competition, the lower the profit	Bu and Zhang (2013), Mangla et al. (2015)
Market		
10. Demand fluctuation	Unexpected changes in demand for green products due to the change in consumers' preferences or the availability of substitute products; the more the demand fluctuates, the more serious the threat	Cook Jr and Page (1987), Miller (1992), Pervez et al. (2019), Baryannis et al. (2019), Ali et al. (2019)
11. Lifetime of green product	The short lifetime of the green product	Chun-Lai (2013)
12. Market share reduction	Reduction of the total market share of the company because of focusing on new green products.	Abdel-Basset and Mohamed (2020), Chun-Lai (2013), Cook Jr and Page (1987)
13. Difficulties of entering the market	It is expensive to enter the market for green products; for example, it may require significant investment and promotional campaigns	Chun-Lai (2013), Pervez et al. (2019)
14. Rate of product sales	The products which are sold less than expected	Chun-Lai (2013), Mangla et al. (2015)
Supply		
15. Supply contract	The risk is related to the failure in supply or on-time supplying environmental-friendly raw materials.	Wu et al. (2019), Baryannis et al. (2019), Ali et al. (2019), Mangla et al. (2015), Chun-Lai (2013)
16. Rate of errors and deviations	Risks associated with the deviations from the plan due to ineffective planning and control.	Baryannis et al. (2019), Wu et al. (2019), Chun-Lai (2013)
17. Purchase expense	Risk of an unexpected increase in the price of the raw materials	Wu et al. (2019), Chun-Lai (2013), Mangla et al. (2015)
18. Quality of supply or supplier	This risk includes the low quality of the supply or supplier	Abdel-Basset and Mohamed (2020), Mangla et al. (2015), Wu et al. (2019), Pervez et al. (2019)
19. Supply disruption	A natural disaster like tsunami, heavy rain/snow, and earthquake disrupt supply of products	Abdel-Basset and Mohamed (2020)
Economic		
20. Inflation rate	The risk related to an unexpected increase in inflation and interest rate in a country and changing in product prices.	Mangla et al. (2015), Zhang et al. (2008); (Mahapatra et al., 2017)
21. Economic crises	The emergence of economic crises in a country negatively affects a company's profit	Zhang et al. (2008), Abdel-Basset and Mohamed (2020); (Hosseini and Ivanov 2020)
22. Change in currency exchange rate	Unstable currency exchange rate in a country	Abdel-Basset and Mohamed (2020), Wu et al. (2019), Miller (1992), Zhang et al. (2008)
23. Volatility in marketing and sale expenses	Fluctuation in sales and marketing activities costs such as advertisement and promotional costs.	Chun-Lai (2013)
Political		
24. Governmental policies, rules, regulation, and support	Change in monetary and financial policies of a country and its policy for supporting green products. These changes may affect any business.	Busse and Hefeker (2007), Lehkonen and Heimonen (2015), Ali et al. (2019)
25. Barriers of income return	Some governmental measures which threaten a company's income return, such as sanctions on a foreign company's representatives	Miller (1992)
26. Stability of government	The ability of the government in conducting its plans and policies as well as directing a nation by minimizing changes inside the governments.	Wu et al. (2019), Zhang et al. (2008), Busse and Hefeker (2007), Lehkonen and Heimonen (2015)
27. Civil and international unrests	The risks related to political unrest in a country and its effects on the government. For example, a terrorist attack on civilians, civil war or international pressure on the government such as international sanctions or clashes on the borders	Busse and Hefeker (2007), Lehkonen and Heimonen (2015)
Internal managerial		
28. Lack of expertise	The threat of losing experienced and specialized workforce and lack of experts in a company	Mangla et al. (2015)
29. Inappropriate organizational culture management	Misconception of personnel about the organizational culture regarding environmental issues	Salavati et al. (2016), Zhang et al. (2008)
30. Lack of flexibility	Lack of flexibility and adjustment to environmental changes due to managerial experience inadequacy	Mangla et al. (2015)
31. Changes in management board	Intense high-level management changes that can affect the organizational policy for green/sustainable marketing	Zhang et al. (2008), Ali et al. (2019)

(*continued on next page*)

Table 2 (*continued*)

Green marketing risks	Definition	Reference
Customer		
32. Inappropriate organizational culture management	Misconception of personnel about the organizational culture.	Salavati et al. (2016), Zhang et al. (2008), Ali et al. (2019)
33. Inefficient promotion plans	Promotion plans cannot reflect the relation between the product and the environment and determine the environmental responsibility of the company and improve the consumers' awareness of environmental issues	Zhang et al. (2008)
34. Misunderstanding customer requirement	Lack of a proper system for customer needs identification.	Salavati et al. (2016)
35. Investment rate on R&D for green products	Managers sometimes are not going to invest in green product development due to inherent uncertainty associated with the results of R&D.	Miller (1992)
36. Lack of adequate budget	Lack of adequate budget for green marketing plans and programs	Wu et al. (2019), Mangla et al. (2015), Zhang et al. (2008)
37. Innovative green process or product	Lack of innovative process or product design in the context of green/sustainable manufacturing	Miller (1992), Mangla et al. (2015)
38. Inappropriate management of the production line	Mal-management of the production line can affect the productivity and environment and quality of the final product, especially for environment-friendly products	Wu et al. (2019), Ali et al. (2019), Zhang et al. (2008), Abdel-Basset and Mohamed (2020)

numerical or hypothetical examples rather than providing a real case (Chun-Lai, 2013). It is also found that none of the published articles investigated the green marketing risks in the dairy industry. Since risk assessment features inherent vagueness of expert judgments, an approach that can deal with the inherent uncertainty associated with the risk categories would be beneficial (Ko et al., 2013). Hence, the theoretical underpinnings of the current study lie within proposing an integrated fuzzy decision-making approach to address the identified gaps. Firstly, the relevant green marketing risk categories and their risk factors in the dairy industry were identified (see Sub-section 2.2). Besides, a new weighted FIS approach is proposed to assess the risks of implementing green marketing in the dairy industry based on the identified risk criteria (see Table 3). The final output of this developed approach i.e. assessed and ranked risk factors, is compared with the traditional unweighted FIS approach to demonstrate the effectiveness of the proposed one. In this study, a real-world case of the dairy industry in Iran is used to show the applicability and proficiency of the proposed approach as well as investigating the challenges and risks in marketing green products in this industry.

2.2. Green marketing implementation risk categories and factors

Similar to traditional marketing, green marketing implementation is subject to specific risks. Generally, risk management encompasses four stages, i.e. (1) risk identification and classification, (2) risk analysis/assessment, (3) risk mitigation/response, (4) monitoring, and controlling the risk (Al-Bahar and Crandall, 1990; Willumsen et al., 2019; Damnjanovic and Reinschmidt, 2020). Many risk categories have been identified and extracted from the relevant literature such as customers, business competition, market, supply, economic, political, and internal/managerial risks. Furthermore, relevant risk factors related to each of these risk categories have been also extracted after completing a comprehensive review of related literature. Table 2 shows the details of these risk categories and their risk factors together with a related definition. The constructed long list of risks was utilised in the Delphi process conducted in step 2 of the developed research methodology. The final output of the Delphi process was a validated list of risk factors related to the green marketing implementation (see Section 4).

2.3. Risk assessment criteria

Risk assessment criteria selection can be considered as a vital step of the risk analysis process. One of the most frequently used indexes for measuring risk assessment is the Risk Priority Number (RPN) that can typically be calculated by multiplying severity/impact, occurrence/probability, and detectability (Ouyang et al., 2020). Previous research works suggest that these three criteria were most frequently used for risk analysis and ranking (Faghih-Roohi et al., 2020; Ouyang et al., 2020). However, all aspects of risk may not be addressed using these three criteria. With the aim of increasing the risk analysis accuracy and reliability, several researchers proposed new criteria for risk assessment such as reaction towards risk and risk urgency (Ebrahimnejad et al., 2009; Wang et al., 2018a, 2018b). Through our literature analysis presented in Table 3, the most frequently used criteria are impact/severity, occurrence/probability, detectability, and response speed towards the risk. These risk assessment criteria were considered in the current study.

3. Methodology

Fig. 1 illustrates the proposed research methodology that was followed in this current work. The proposed methodology encompasses five steps. Steps 1 helps to identify green marketing risk categories and risk factors. In Step 2, the four risk assessment criteria are defined. In step 3, the four pre-defined risk assessment criteria are weighted. Furthermore, the proposed FIS model, in step 4, is used to provide a way for experts to characterise the input variables (risk assessment criteria) and obtain the numeric score related to each of the risk factors. These risk scores were then used in step 5 to rank and identify the most important risk group. The steps of implementing this methodology, its theoretical underpinning, and the utilised tools are discussed in the following.

Step 1: Identifying the risk factors of green marketing

This step is about identifying the risk factors of green marketing implementation. To find the risk factors, the related literature is reviewed, and the available risk factors are extracted, as shown in Table 2. Afterward, the Delphi method is used to identify the most relevant risk factors. To do so, a Yes/No-based list of extracted risk factors (Appendix 1) was provided as a questionnaire to 20 experts to obtain their opinions (Karmaker et al., 2021). These experts are selected because of their expertise in both green marketing and the dairy industry in Iran (see Section 4 for the details about these experts). It is worth mentioning that the experts were asked to propose any missing risk factors from the list. The experts were allowed to provide their opinion about the extracted risk factors presented in Table 2 and add new risk factors to this list based on their experience. Then, the data from the first-round questionnaire were analysed and the most relevant risk factors were selected. If 50% or more of the experts say Yes, then the risk factor is selected. In the second round of data gathering, all selected risk factors along with the proposed ones were again sent to the same experts to get validated by them. Finally, the data from the second-round questionnaire were analysed and the most relevant risk factors are identified and used in this study. The detailed explanation of this process is described in Section 4 where the case study is presented.

Table 3
Most relevant criteria for risk assessment.

Criteria	Author(s)	Definition
Impact/Severity	Mangla et al. (2015), Fayek (2018), Lo and Liou (2018),(Singh et al. 2020; Gölcük, 2020)	What would the consequence/impact of the failure be?
Occurrence/ Probability	Fayek (2018), Lo and Liou (2018), (Singh et al. 2020; Gölcük, 2020)	What is the likelihood that failure will occur?
Response speed to the risk	Fayek (2018), (Faghih-Roohi et al., 2020)	How fast can we respond to the risk?
Detectability	Fayek (2018), Lo and Liou (2018)	How likely is such a failure to be detected?

Step 2: Identifying the risk assessment criteria

In this step, the criteria for risk assessment are identified. The most frequently used criteria in the literature of risk assessment are extracted and discussed with the experts to validate their suitability. These risk assessment criteria are discussed in Section 3.2. The risk assessment criteria are used to assess and analyse the identified risk factors. The identified risk factors in step 1 will need to be evaluated based on the four defined risk assessment criteria which is performed in step 4.

Step 3: Weighting the risk criteria using the Fuzzy Analytic Hierarchy Process

Many researchers have recently applied AHP, FUCOM, BWM, and LBWA to find the weights of criteria for different applications as these methods can calculate the consistency ratio. All of these methods need pairwise comparisons for working. However, the number of pairwise comparisons required for running these methods are different. If the number of criteria is *n*, FUCOM, BWM, LBWA, and AHP need (n-1), (2n−3), (n−1), (n(n−1)/2) number of pairwise comparisons respectively. Hence, AHP requires more pairwise comparisons compared to FUCOM, BWM, and LWBA, especially when the number of criteria is high. Furthermore, a study conducted by (Pamučar et al., 2018) revealed that the results from FUCOM and BWM may lead to a better consistency ratio over AHP when the number of criteria is high. However, there are some disadvantages with these models too. For example, a large number of comparisons in the pairs of criteria makes BWM more complex as it makes limitations for solving the mathematical model (Žižović and Pamucar, 2019). Also, FUCOM requires mathematical modeling that can make the model complicated. On the other hand, AHP can find the weights of the criteria with simple calculations and it is much easier for the researchers as it follows few numbers of steps to calculate weights of a criterion and does not involve any complex mathematical calculation (Kumar et al., 2017; Saha and Roy, 2021). Meanwhile, it has been reported by researchers that when the number of criteria is small, the final weights score and consistency ratio calculated by AHP doesn't have significant differences from those calculated by FUCOM, LBWA, BWM (Pamučar et al., 2018). Therefore, considering the abovementioned explanations, having a small number of criteria (n = 4) in this research to be weighted, easy calculation steps, and relatively understandable steps of FAHP by the experts, FAHP was used in this study to weight the criteria.

This step includes weighting the risk assessment criteria. Chang's FAHP (Chang, 1996) is used to weigh the selected criteria. To weigh risk assessment criteria using, the experts were asked to do the pairwise comparison among risk assessment criteria using the fuzzy scale shown in Table 4.

Afterward, the average of their opinions in the form of fuzzy numbers in a final pairwise comparison matrix is calculated. Then, using Chang's FAHP (Chang, 1996) steps, the weight of the risk assessment criteria are calculated.

The steps of Chang's FAHP are provided below: Consider elements of the alternatives, $X = x_1, x_2, \ldots, x_n$, are represented as an object set and the elements of the criteria are represented by $U = u_1, u_2, \ldots, u_m$ as a goal set. In his method, each object is taken and extent analysis for each goal, g_i, is conducted correspondingly. Finally, extent analysis values for each object is calculated as follows:

$$M_{g1}^{1}.M_{g2}^{2}\ldots\ldots\ldots M_{gi}^{m}\ldots. \qquad i = 1.2.3\ldots\ldots\ldots n$$

where M_{gi}^{j} is a triangular fuzzy number that can be represented by a tuple such as (a,b,c). where all the M_{gi}^{j}, j = 1, 2, 3, …, m are triangular fuzzy numbers. Now the steps of Chang's extent analysis are described as follows:

a) The value of the fuzzy synthetic extent is defined as:

$$s_i = \sum_{j=1}^{m} M_{gi}^{j} \otimes \left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{J}\right]_{-1}$$

If $M_{gi}^{j} = (a_{ij}.b_{ij}.c_{ij})$ *then* $\sum_{j=1}^{m} M_{gi}^{j}$ with the fuzzy addition operation of m extent analysis values for a particular matrix is defined as:

$$\sum_{j=1}^{m} M_{gi}^{j} = (a_{i1}.b_{i1}.c_{i1}) \otimes (a_{i2}.b_{i2}.c_{i2}) \otimes \ldots \otimes (a_{im}.b_{im}.c_{im}) = \left(\sum_{j=1}^{m} a_{ij}.\sum_{j=1}^{m} b_{ij}.\sum_{j=1}^{m} c_{ij}\right) = \left(a_i^{'}.b_i^{'}.c_i^{'}\right)$$

Also, for calculating $\left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right]^{-1}$, fuzzy addition operation is to be performed:

$$\sum\sum M_{gi}^{j} = \sum_{i=1}^{n}\left(\sum_{j=1}^{m} a_{ij}.\sum_{j=1}^{m} b_{ij}.\sum_{j=1}^{m} c_{ij}\right) = \left(\sum_{j=1}^{n} a_i^{'}.\sum_{j=1}^{n} b_i^{'}.\sum_{j=1}^{n} c_i^{'}\right)\left(\sum_{j=1}^{n} a_{ij}.\sum_{j=1}^{m} M_{gi}^{j}\right)_{-1} = \left(\frac{1}{\sum_{i=1}^{n} c_i^{'}}.\frac{1}{\sum_{i=1}^{n} b_i^{'}}.\frac{1}{\sum_{i=1}^{n} a_i^{'}}\right)$$

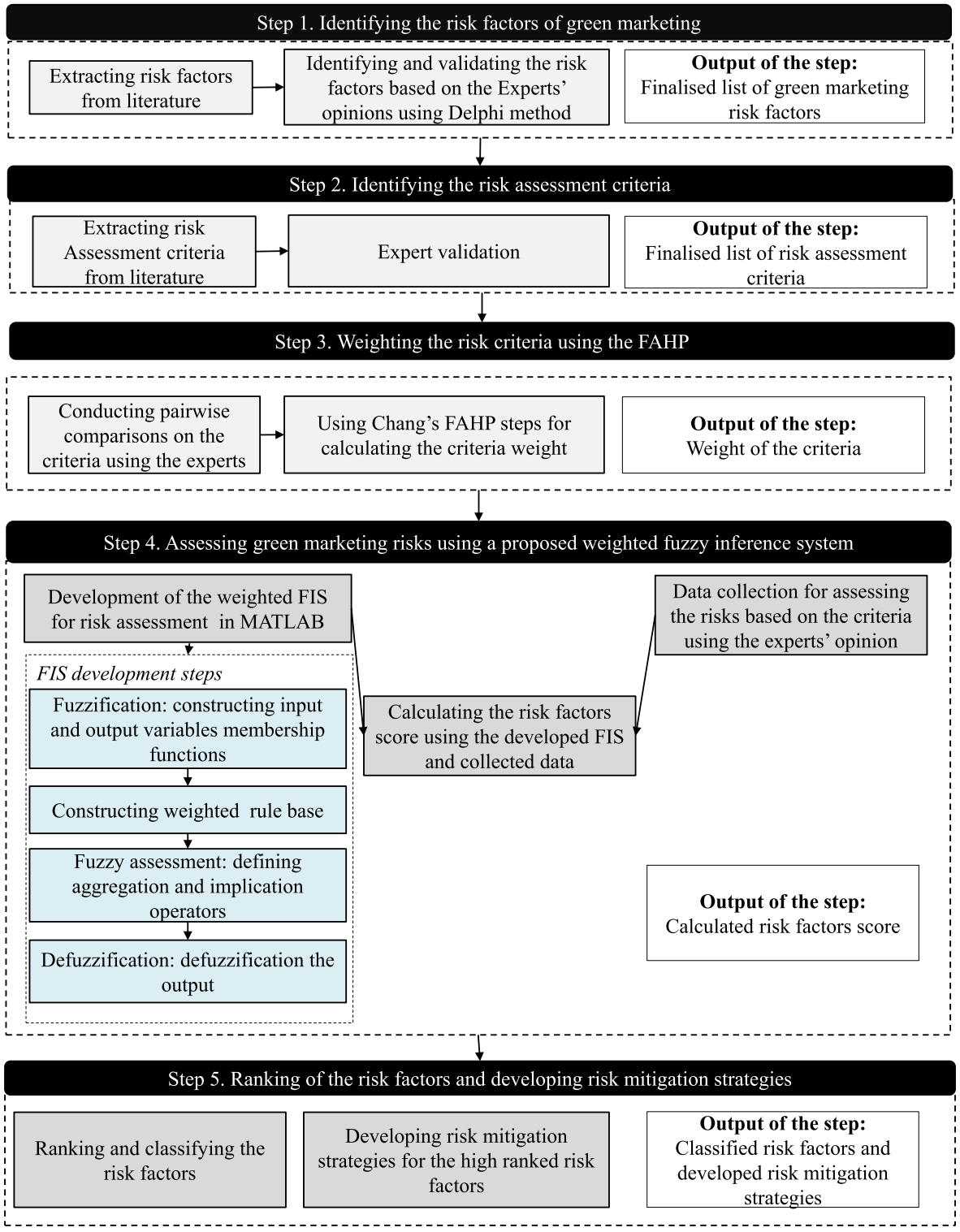


Fig. 1. Research methodology.

Table 4
Changing the linguistic variables to triangular fuzzy numbers (Chang, 1996).

Linguistic variable	Triangular fuzzy number	Reverse triangular fuzzy number
Equal importance	(1,1,1)	(1,1,1)
A little more importance	(2/3,1,2/1)	(2,1,3/2)
More importance	(2/3,1,2/1)	(2,1,3/2)
Much more important	(2/5,2,2/3)	(3/2,2/1,5/2)
Absolute importance	(3,2/5,2)	(2/1,5/2,3/1)

So,

$$s_i = \sum_{j=1}^{m} M_{gi}^{j} \otimes \left(\sum_{j=1}^{n} \sum_{j=1}^{m} M_{gi}^{j} \right)_{-1}$$

$$= \left(a_i^{'}.b_i^{'}.c_i^{'}\right) \otimes \left(\frac{1}{\sum_{i=1}^{n} c_i^{'}} . \frac{1}{\sum_{i=1}^{n} b_i^{'}} . \frac{1}{\sum_{i=1}^{n} a_i^{'}} \right) = \left(\frac{a_i^{'}}{\sum_{i=1}^{n} c_i} . \frac{b_i^{'}}{\sum_{i=1}^{n} b_i} . \frac{c_i^{'}}{\sum_{i=1}^{n} a_i} \right)$$

$$= (a_i.b_i.c_i)$$

b) Possibility degree calculation: If $S_i = (a_i.b_i.c_i)$, $S_k = (a_k.b_k.c_k)$, then possibility degree of $S_i \geq S_K$ that indicated by $V(S_i \geq S_K)$ is defined as:

$$V(S_i \geq S_K) = SUP_{y>x}(min\{\mu_{si}(x).\mu_{sk}(y)\})$$

And can be equivalently expressed as follows: $V(S_i \geq S_K) = hgt(S_i \cap S_K) = \mu_{si}(d)$

$$V(S_i \geq S_K) = \mu_{sk}(d) \begin{cases} 1 = if(a_i \geq a_K) \\ 0 = if(a_k \geq c_i) \\ \dfrac{a_k - c_i}{(b_i - c_i) - (b_k - a_k)} = otherwise \end{cases}$$

where d is the ordinate of the highest intersection point between μ_{si}, μ_{sk}.

c) The degree of possibility for a convex fuzzy number to be greater than k convex fuzzy numbers S_i; I = 1,2, …,k can be defined by:

$$V(S \geq S_1.S_2.....S_k) = V((S \geq S_1).(S \geq S_2)....(S \geq S_k)) =$$

$$\min(V(S \geq S_1).V(S \geq S_2).....V(S \geq S_k)) = \min(V(S \geq S_i) i = 1.2.....k$$

If it is assumed that for $(k = 1.2.....n\, k \neq i).d^{'}(A) = \min(V(S_i \geq S_k)$then, weight vector is given by:

$$w^{'} = (d^{'}(A).d^{'}(A_2)..... d^{'}(A_n)^T$$

d) Via normalization, the normalized weight vectors are defined as:

$$w = (d(A).d(A_2).....d(A_n)^T$$

where w is a non-fuzzy number. This provides the importance weights of each alternative.

The calculated weights are utilised in constructing the IF statements and fuzzy rule base in stage 2 of step 4.

Step 4: Assessing green marketing risks using a proposed weighted fuzzy inference system

Mamdani's inference rule was utilised to develop the proposed FIS model (Mamdani, 1974), depicted in Fig. 2. The developed model can address the inherent vagueness of expert judgments in the risk assessment. The FIS evaluation is done in four stages for each of the identified green marketing risk factors, separately.

- Fuzzification (Stage 1): in this stage, a target range is defined for the input variables which are the risk assessment criteria. These target ranges dictate the minimum and maximum limits that input variables can vary. Based on the target ranges, fuzzy membership functions (MFs) are constructed for each risk assessment criteria. Three types of triangular MFs are proposed for each risk assessment criterion as the input variable i.e., low (L), medium (M), and high (H) MFs. Also, six output MFs constructed. These six MFs are named as very low (VL), low (L), low to medium (LM), medium to high (MH), high (H), very high (VH). Fig. 3 shows the input and output variables membership functions.
- Weighted rules base (Stage 2): several IF-THEN fuzzy rules are constructed to mediate the MFs behavior related to the risk assessment criteria. Since the importance of each assessment criterion might be different, therefore, it is critical to incorporate some importance weights in the proposed model. However, the traditional FIS is unable to deal with this matter (Ghadimi et al., 2012; Azadnia et al., 2015). Hence, a novel heuristic approach is proposed in this work to tackle the described issue in the traditional FIS. The proposed heuristic works on defining various ranges for constructing fuzzy rules when taking each risk criterion weight into account. These ranges are presented in the following.

a) IF $\sum_{i=1}^{m} W_i A_i = 1$ THEN risk factor is Very Low.

b) IF $1 < \sum_{i=1}^{m} W_i A_i \leq 1.49$ THEN risk factor Low.

c) IF $1.5 < \sum_{i=1}^{m} W_i A_i \leq 1.99$ THEN risk factor Low-Medium.

d) IF $2 < \sum_{i=1}^{m} W_i A_i \leq 2.49$ THEN risk factor Medium-High.

e) IF $2.50 < \sum_{i=1}^{m} W_i A_i \leq 2.99$ THEN risk factor High

f) IF $\sum_{i=1}^{m} W_i A_i = 3$ THEN risk factor Very High.

where W_i - the importance weight of the i^{th} risk criterion A_i- the MF score related to the ith risk criterion.

The scores for the low, medium, and high MFs are 1, 2, and 3,

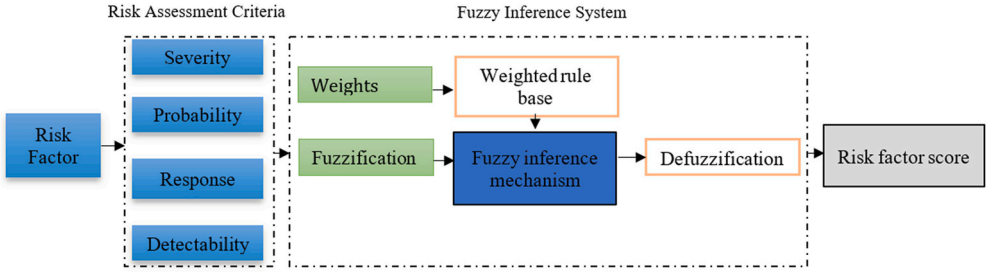
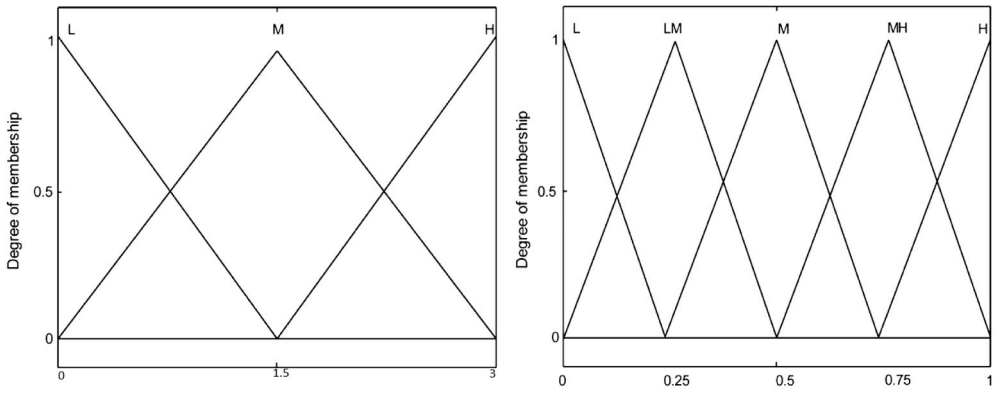


Fig. 2. Fuzzy inference system model.



a. Input variable range and MFs b) Output range and MFs

Fig. 3. Input and output variable and their MFs. a. Input variable range and MFs b) Output range and MFs.

respectively. The developed six IF statements are then used to aggregate the weighted risk criteria resulting in a THEN statement for each of the considered risk factors.

- Fuzzy assessment: This step encompasses the aggregation and implication procedures of the proposed FIS. Fuzzy operators i.e. NOT, OR, and AND are used to construct fuzzy rules as part of the implication process. This is followed by the aggregation process where a single fuzzy set is formulated as a result of aggregating the output conclusions constructed in the implication process. The obtained single fuzzy sets are used in the next step which is the defuzzification step.
- Defuzzification: The fuzzy assessment step outputs are defuzzified to a zero to one scale based on six output MFs constricted in the defuzzification process. The numeric score of each risk factor assessed against the risk criteria is the final output of this step and the entire developed FIS model.

  Step 5: Ranking of the risk factors and developing risk mitigation strategies

The calculated risk factor scores in step 4 are used to derive a final ranking of the risk factors. Then, the ranked risk factors are classified into three priority groups. Finally, mitigation strategies will need to be developed for each of the risk factors classified in the "high-risk" group. These strategies can be defined by consulting the same group of experts that were involved in the previous steps. The implementation procedures of the proposed risk assessment methodology have been demonstrated in the next section using an empirical study in the dairy industry.

4. Empirical study and implementation results

Nowadays, one of the most important industries in Iran is the dairy industry. The industry plays an important role in the country's entrepreneurship environment creating many job occupancies. Currently, more than hundreds of dairy companies are active in Iran. Given the numerous numbers of competitors, marketing is considered as of the most important functions within an organization's value chain operating in the Dairy industry. It worth mentioning that the operations inside the dairy sector such as milk processing, dairy products manufacturing, and packaging along with transportation are responsible for a large amount of environmental impact. Hence, dairy companies have recently tried to produce more environmentally friendly products and processes. A few of these green transformations include sustainable supplier selection for procuring environmental friendly raw materials, developing environmentally friendly packaging, applying new technologies for heat generation and distribution in dairy factories, using energy-efficient machines, waste-stream treatments improvement for water savings, and developing facilities for recycling/remanufacturing of the wastes. Consequently, selling the products that are manufactured and distributed in an environmental-friendly manner needs a proper green marketing implementation. This will help them to recover the extra expenses that are spent for the aforementioned green transformation. However, green marketing implementation suffers from several risks that need to be addressed. This issue was highlighted upon several interviews conducted with the managers of dairy companies that produce environmental-friendly products. It was mentioned that the risks associated with green marketing of such products could incur negative effects on their businesses. Hence, this case study was conducted to deal with the abovementioned problem. In this research study, the steps of the proposed approach have been implemented to investigate, identify, and assess the risks of green marketing in the dairy industry in Iran. The results of the study are provided in the following.

4.1. Green marketing risk identification in the dairy industry

In this step, the risks of green marketing were identified. Firstly, a list of green marketing risks was extracted from the related literature, tabulated in Table 2. Afterward, the identified risks were validated by industry-specific experts using the Delphi method. For this purpose, initially, a Yes/No questionnaire including the extracted risks was provided and sent to 20 marketing experts, in the dairy industry. They were asked to select the relevant green marketing implementation risks. These experts were selected because of their expertise in both green marketing and the dairy industry. The majority of these experts were marketing managers or marketing consultants of dairy companies. In terms of experience, 12 participants had experience of more than 15 years, and 8 participants had between 10 and 15 years of experience. Out of twenty experts, 15 of them were from dairy manufacturing companies and 5 were marketing consultants. It is worth mentioning that the experts were also asked to add any missing but relevant risks to the end of the questionnaire. The experts added several risks to the list such as the role of environmental factors in customer buying, the level of environmental awareness in the society, the effects of the reference groups, ethnic variety, the level of family's income in the country, governmental policies and rules on green marketing and advertisement, the company's willingness to pursuing environmental initiatives, and product distribution. The data from the first-round questionnaire was gathered and analysed. A score of 1 was used for each YES answer and 0 was used for each NO answer. Afterward, the mean score for each risk was calculated. A threshold of 50% was set to select the most related risk factors. Subsequently, the second round of the survey was conducted to finalise the green marketing implementation risk factors. For the second round, again a Yes/No questionnaire was designed and distributed between the experts that included the selected risk factors and the newly

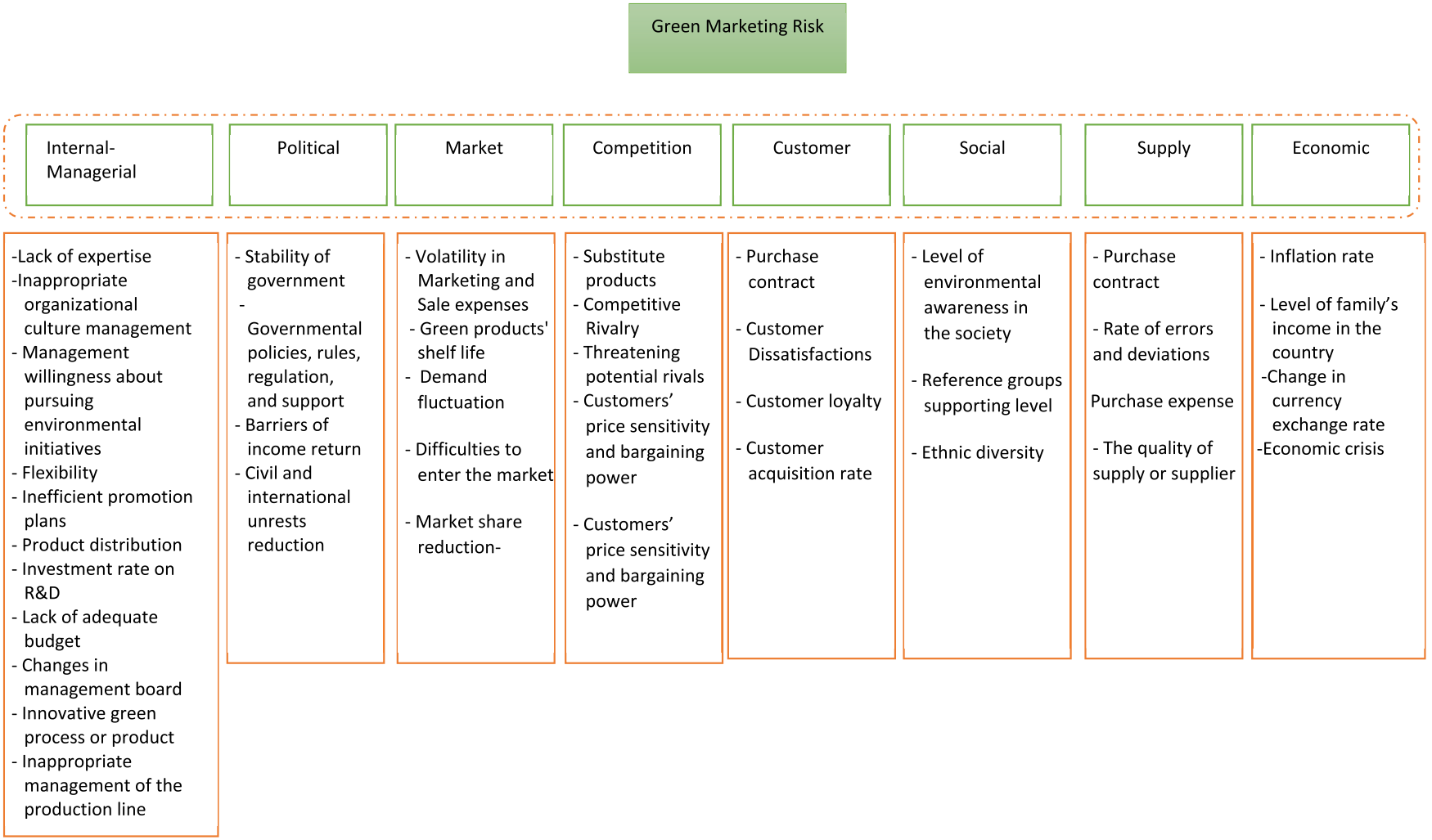


Fig. 4. Finalised green marketing risk factors.

Table 5
Average of pairwise comparison matrix.

	Probability	Severity	Detectability	Response speed
Probability	(1,1,1)	(0.85, 1.15, 1.45)	(1.35, 1.85, 2.35)	(0.85, 1.25, 1.65)
Severity	(0.69, 0.87, 1.17)	(1,1,1)	(1.25, 1.75, 2.25)	(1.1, 1.45, 1.8)
Detectability	(0.42, 0.54, 0.74)	(0.44, 0.57, 0.8)	(1,1,1)	(0.8, 1.15, 1.5)
Response speed	(0.6, 0.8, 1.17)	(0.55, 0.69, 0.91)	(0.66, 0.87, 1.25)	(1,1,1)

added ones by the experts. Again, the data from the second round of the survey were analysed and the risk factors that met the threshold were selected as the final ones. Based on the results of this step, 40 risks were approved and classified into 8 categories. The finalised risk categories and their risk factors are presented in Fig. 4.

4.2. Risk assessment criteria weighting

In this step, Chang's FAHP (Chang, 1996) was used to weigh the identified risk assessment criteria in Sub-section 2.3. Hence, the experts were approached to perform the pairwise comparison process based on the scale shown in Table 4. Afterward, as shown in Table 5, average of the fuzzy numbers in the pairwise comparison matrices achieved through experts' opinion is calculated. Following the FAHP steps, the final weights of the four risk assessment criteria were obtained. Due to space limitation purposes, the calculation procedures of the FAHP process are not presented in this paper. The final importance weightings are shown in Table 6.

4.3. Assessment of the risk factors using the proposed weighted FIS model

In this step, the proposed weighted FIS in Section 3 was utilised to assess the risks of green marketing in the dairy industry. After constructing the FIS models for each risk factor, the data gathering process was implemented. To gather the relevant data, a questionnaire was designed (Appendix 2) and distributed among the 20 experts in the field of green marketing, especially from the dairy industry, for obtaining the linguistic values of the identified risk factors with regards to the four risk assessment criteria. The experts provided their assessment of all risk factors against the four assessment criteria (i.e. impact/severity, probability/occurrence, detectability, response speed to the risk). After gathering the input data, the average assessment values of each risk criterion were calculated and fed into the coded FIS models as the input sets. These input sets were then fuzzified based on a comprehensive knowledge consisting of various weighted fuzzy rules.

The traditional FIS cannot incorporate the risk assessment criteria weights in the evaluation process. Therefore, the final risk factor scores will not reflect the DMs' preferences and provide imprecise and misleading decision-making assistance. To resolve this issue, a heuristic approach was developed and applied in this research work (see Section 3). This heuristic approach solves the problem of assigning direct weights to the input variables (risk assessment criteria) which is not desirable. Such a task will wrongfully alter the input value provided by the experts and jeopardise the risk assessment process validity. Instead, the proposed heuristic incorporates the weights in the fuzzy rule construction process that will properly translate the DMs' knowledge.

The following example is given to show the importance of the developed approach in constructing the fuzzy inference system. Assume the scores of response speed to risk, detectability, severity, and probability of failure are medium, low, low, and high, respectively. The corresponding numbers in the assessment process would be 2, 1, 1, 3. Using the risk assessment criteria weights shown in Table 6, the final output value can be obtained as shown in Table 7.

Table 6
Importance weights of risk assessment criteria.

Criterion	Weight
Probability	0.338
Severity	0.324
Detectability	0.159
Response speed	0.179

The obtained aggregated value of 1.8538 means that the output MF should be Low to Medium as the value of 1.8538 is located between the 1.5 to 1.99 range. Therefore, the following rule can be concluded:

"IF response speed is Medium AND detectability is Low AND severity is Low AND probability is High, THEN the output is Low to Medium."

MATLAB fuzzy logic package was deployed to code and implement the FIS models. Figs. 5–8 are provided in order to show a schematic view of the implemented approach in MATLAB software. Fig. 5 shows the risk assessment model that includes response, detectability, severity, and probability as the input variables (criteria) and risk score as the output variable. Figs. 6 and 7 show the designed membership functions for input and output variables. Due to space limitation and for illustration purposes, the membership functions for the Response criterion as the input variable is shown in Fig. 6. Fig. 8 shows the developed interface for inserting the input variable values for each risk factors and calculating their final risk score. For example, for level of environmental awareness in society, Response = 2.90, Detectability = 2.93, Severity = 2.86, and Probability = 2.84. As shown in Fig. 8, once the values are inserted in the MATLAB interface, the final risk score is calculated as 0.819. Same procedure is conducted for each risk factor to find the final score of each risk.

Table 8 provides the obtained final scores of the risk factors. These risk factor scores are used to obtain the final ranking of the risk factors presented in Sub-section 5.1.

5. Discussions

To achieve sustainability, the dairy manufacturing company needs to cover all three interconnected environmental, social, and economic aspects of sustainability in their business activities and processes (Karmaker et al., 2021; Raut et al., 2017). It means dairy manufacturing companies are looking for increasing their economic benefits while reducing the negative impact on the environment and society. However, many of these companies in today's competitive environment are struggling to implement sustainability initiatives as they do not have the expertise and knowledge required for the successful implementation and adaptation of sustainability practices. This can happen as the area of sustainability research is still not well defined, developed, or applied, especially in dairy manufacturing industries, and therefore there are still some black boxes in this area (Karmaker et al., 2021; Luthra et al., 2017). Green marketing is one of the main business functions in dairy industry that can help them to move towards sustainability.

The green marketing concept includes promoting sustainable consumption and production practices among society. This concept also includes the consumers' perception and reaction to the green initiatives and activities that companies implement such as design for environment, green/sustainable production and processes, green transportation, and green packaging (Chen and Yang, 2019; Dangelico and Vocalelli, 2017; Tsai et al., 2020). Several reasons such as rule and regulations, community pressure, customers' needs, and corporate social responsibility push manufacturing companies to implement green marketing activities and projects (Chen and Yang, 2019; Martínez-López et al., 2020; Zhang et al., 2020). Furthermore, marketing and promoting

Table 7
An example of applying the new method of Fuzzy Inference Systems.

	Response Speed	Detectability	Severity	Occurrence/Probability	Output value
MF score, A_i	2	1	1	3	
Importance weight, W_i	0.17926	0.15920	0.32426	0.33728	
W_iA_i	0.3585	0.15920	0.32426	1.0118	$\sum_{i=1}^{m} W_iA_i = \mathbf{1.8538}$

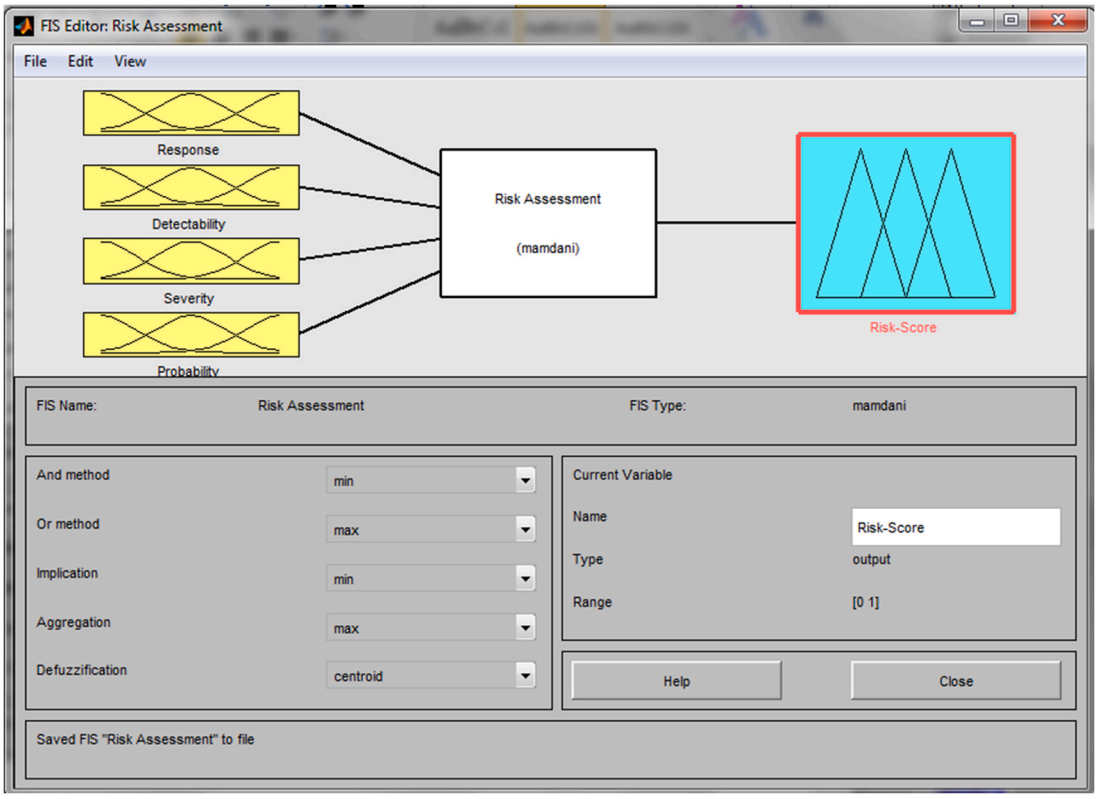


Fig. 5. FIS model implemented in MATLAB for risk assessment.

green products can provide competitive advantages for organizations considering the increasing number of consumers purchasing green products/services (Guo et al., 2020; Papadas et al., 2019; Reche et al., 2020; Zhu and Sarkis, 2016). Therefore, it can be perceived that green marketing can support companies implementing greener and cleaner production systems and, consequently, produce green products. In order to have successful implementations of green marketing projects and initiatives, their correspondence risks should be identified and assessed (Sun et al., 2020). During past decades, many researchers have carried out studies in the field of green marketing. However, none has developed a framework for identifying and assessing risks of green marketing.

As it was mentioned earlier, the dairy industry is responsible for a large amount of negative environmental impact. Therefore, supporting and promoting green dairy products and production is essential that can happen through green marketing. In order to have a successful implementation of green marketing projects and initiatives, a comprehensive risk assessment framework is needed and has been developed and validated in this study. Further discussion of the finding of the study is provided in the subsequent section.

5.1. Risk classification and ranking

To perform an appropriate discussion of the findings, the risk factors were classified into three groups, A, B, and C, after calculating their scores in step 4 of the methodology. In the final step (step 5), The risk factors with the scores between 0.66 and 1 were classified as Group A. These factors have the potential of incurring "high risk" of marketing green dairy products. Moreover, the risk factors with the scores between 0.33 and 0.66 were classified as Group B. These factors have the potential of incurring "medium risk" of marketing green dairy products. Furthermore, the risk factors with the scores between 0.1 and 0.33 were classified as group C. These risk factors have the potential of incurring "low risk" of marketing green dairy products. Table 9 tabulates the ranking order of green marketing risk factors in the dairy industry.

After calculating the final score of the risk factors, several meetings were held to validate the results and discussing the possible risk mitigation strategies. During the meetings, the experts provided their opinions and suggestions for dealing with the most important risk factors. In this paper, the risk mitigation strategies for group A are provided.

5.2. Risk mitigation strategies

- *Level of environmental awareness in society*

The level of environmental awareness in society was found as the most important risk factor within Group A. The awareness of consumers depends on their knowledge about environmental threats. This knowledge can lead the consumer to select the companies producing green dairy products. In Iran, there is a need for the government to support and

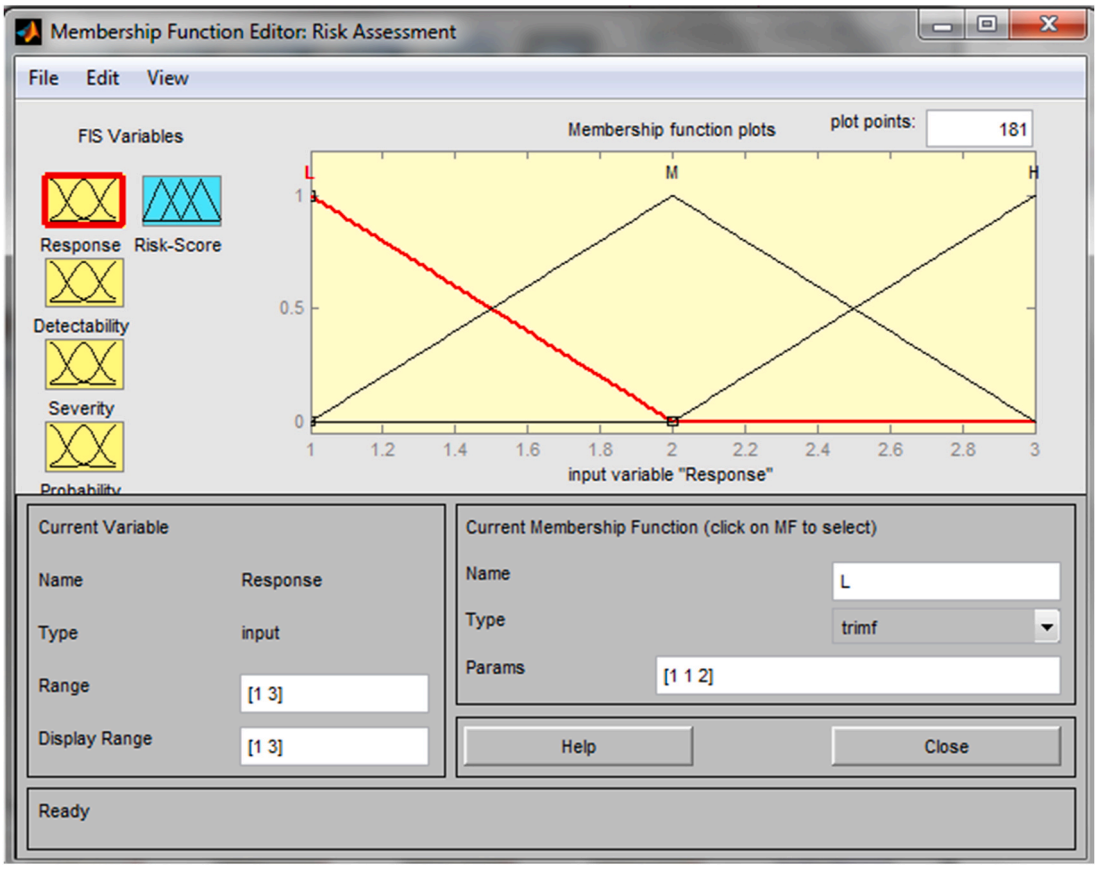


Fig. 6. Example of input variable membership function in MATLAB.

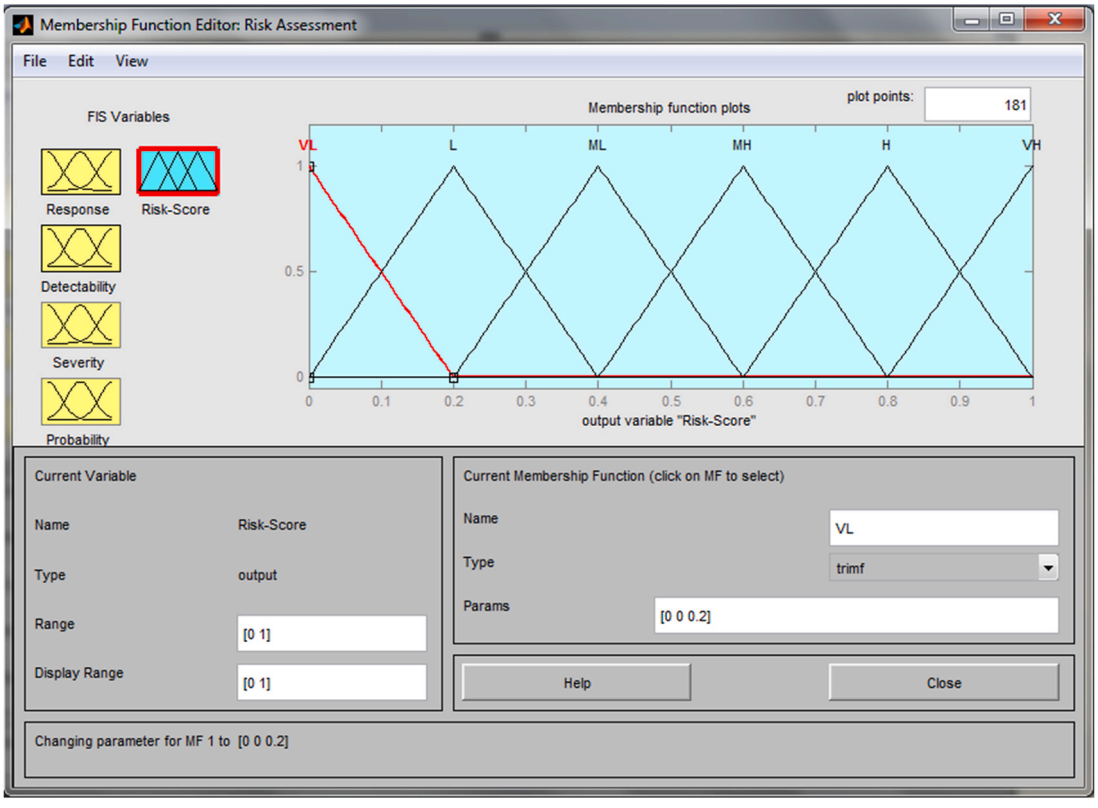


Fig. 7. Output membership functions implemented in MATLAB for risk assessment.

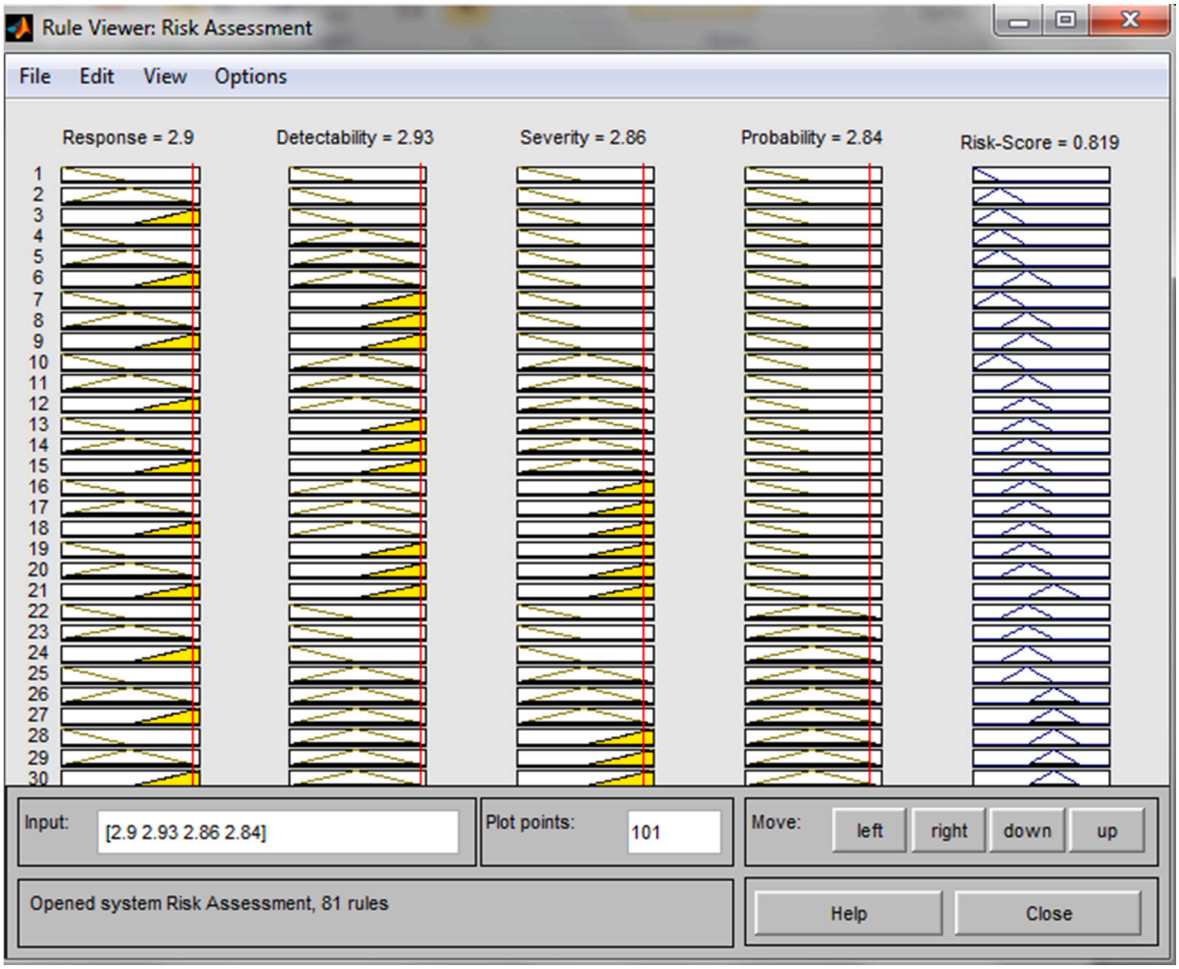


Fig. 8. Rule viewer for calculation of the risk score implemented in MATLAB.

Table 8
Final scores of green marketing risks.

Risk category	Risk factor	scores		risks	scores
Customers	Purchase contract	0.486	economic	Inflation rate	0.44
	Customer Dissatisfactions	0.696		Level of family's income in the country	0.734
	Customer loyalty	0.482		Change in currency exchange rate	0.441
	Customer acquisition rate	0.445		Economic crises	0.246
	Customers' price sensitivity and bargaining power	0.707			
Competition	Substitute products	0.741			
	Competitive Rivalry	0.571	Political	Stability of government	0.642
	Supplier's bargaining power	0.597		Governmental policies, rules, regulation, and support	0.754
	Threatening potential rivals	0.525		Barriers of income return	0.345
Market	Volatility in Marketing and Sale expenses	0.558		Civil and international unrests	0.19
	Green products' shelf life	0.411	Internal managerial	Lack of expertise	0.302
	Demand fluctuation	0.569		Inappropriate organizational culture management	0.634
	Difficulties to enter the market	0.457		Management willingness to pursuing environmental initiatives	0.655
	Market share reduction	0.514		Flexibility	0.615
Supply	Supply contract	0.273		Inefficient promotion plans	0.654
	Rate of errors and deviations	0.443		Product distribution	0.581
	Purchase expense	0.394		Investment rate on R&D for green products	0.609
	The quality of supply or supplier	0.255		Lack of adequate budget	0.57
Social	Level of environmental awareness in society	0.819		Changes in management board	0.572
	Reference groups supporting level	0.643		Innovative green process or product	0.628
	Ethnic diversity	0.551		Inappropriate management of the production line	0.309

collaborate with green companies to increase consumer's knowledge of green products by several advertisements and educational programs. Since one of the principles of green marketing is public cooperation and educating consumers (Zhu and Sarkis, 2016; Chaudhary and Bisai, 2018), companies can provide educational courses to provide consumers in various age ranges with information on company's activities, and goals on achieving green marketing. Volunteer customers can also be part of the awareness-raising activities trying to increase consumers' responsibility about their environment. Upon sharing and discussing the results with the involved dairy companies, it was highlighted that

Table 9
Final ranked risk factors of green marketing in dairy industries.

Group	Risk factor	Score
A	Level of environmental awareness in society	0.819
	Governmental policies, rules, regulation	0.754
	Substitute products	0.741
	Level of family income in society	0.734
	Customers' price sensitivity and bargaining power	0.707
	Customer Dissatisfactions	0.696
B	Management willingness to pursuing environmental initiatives	0.655
	Inefficient promotion plans	0.654
	Reference groups supporting level	0.643
	Stability of government	0.642
	Inappropriate organizational culture management	0.634
	Innovative green process or product	0.628
	Flexibility	0.615
	Investment rate on R&D for green products	0.609
	Supplier's bargaining power	0.597
	Product distribution	0.581
	Changes in management board	0.572
	Competitive Rivalry	0.571
	Lack of adequate budget	0.57
	Demand fluctuation	0.569
	Volatility in Marketing and Sale expenses	0.558
	Ethnic diversity	0.551
	Threatening potential rivals	0.525
	Market share reduction	0.514
	Purchase contract	0.486
	Customer loyalty	0.482
	Difficulties to enter the market	0.457
	Customer acquisition rate	0.445
	Rate of errors and deviations	0.443
	Change in currency exchange rate	0.441
	Inflation rate	0.44
	Green products' shelf life	0.411
	Purchase expense	0.394
	Barriers of income return	0.354
C	Inappropriate management of the production line	0.309
	Lack of expertise	0.302
	Supply contract	0.273
	The quality of supply or supplier	0.255
	Economic crises	0.246
	Civil and international unrests	0.19

promotional programs such as festivals, special discounts on green products, and green product lotteries can be utilised to encourage society and raise their awareness toward environmental issues. Moreover, governments can develop long-term goals to improve awareness in communities. For instance, the concepts regarding the significance of the environment and preserving it for prospect generation should be included in school textbooks to fundamentally facilitate social changes. Moreover, educational programs may be developed for citizens to improve their awareness of environmental issues and encourage them to buy green products.

- *Governmental policies, rules, and regulation*

Governmental policies, rules, and regulation for supporting green products risk factor was ranked as the second most important risk in green marketing. Upon discussions with the experts, lack of supportive policies, rules, and regulations from the government for supporting green/sustainable production was pointed out. Several market mechanisms can help to mitigate this risk factor such as "cap and trade" (Stuhlmacher et al., 2019; Yang et al., 2020a) and "carbon taxes" (Xu et al., 2020) can be applied in the country to support eco-friendly companies. Besides, the "command and control" approach (Li et al., 2019) should be implemented by the government to make some environmental standards compulsory for the companies in the dairy industry. Furthermore, providing low/no interest rate loans for the green companies was discussed that can reduce costs and consequently the final price of products. Cohen et al. (2019) pointed out that both government research and development support and sales subsidies prompt the firms to produce greener. Ghosh et al. (2018) highlighted many support packages that governments can provide such as green technology adoption incentives, initiatives to promote R&D, and support collaborations between various stakeholders to design and develop greener products.

- *Substitute products and customers' price sensitivity & bargaining power*

Substitute products, customers' price sensitivity & bargaining power risk factors are part of the competition category risks which are ranked as the third and fifth important factors in Group A, respectively. There are several cheaper substitute products for green products that confine prices especially when the supply is far more than demand. Developing systems for curbing project expenses and producing high-quality products based on the principles of green-lean manufacturing can lead to cheaper products and increase the value for the consumers (Siegel et al., 2019). Moreover, effective advertisement and informing customers about the benefits of green products may affect the demand for such products and reduce the bargaining power of customers (Shin and Ki, 2019; Kao and Du, 2020). An example of an effective advertisement can focus on environmentally friendly packaging that ensures these products meet the expectations of the consumers. Besides, companies should find innovative and productive processes for the production of green products to reduce the price of the final products.

- *Level of family income in society*

The level of family income in each country is ranked as another important green marketing risk factor. Considering different income levels, green products can be produced in different price ranges. It means companies can consider family income as a threshold for customer segmentation and define different strategies for each segment. Subsequently, pricing could be done based on the consumer's income level. Besides, the government could assign subsidies for buying green products. Al Mamun et al. (2018) pointed out that a proper decision support system should be developed by companies, with financial incentives from governments, to assess green product development feasibility while targeting various customer segments including low-income households. Such practices will increase the suppliers' and manufacturers' collective knowledge in producing green products to these low-income consumers that ultimately promotes green consumption among this segment of society as well.

- *Customer dissatisfactions*

Another source of risk is the high level of consumer dissatisfaction which is ranked as the sixth most important risk factor among a total of 40 risk factors. This can happen when companies are suffering from green marketing myopia. Green marketing myopia occurs when brands focus more on a product's green features than fundamental customers' needs (Hanna et al., 2018; Stafford and Graul, 2020). Consumers, even environmentally conscious ones, want product features that promise some type of direct benefit to them. To promote environmentally-friendly products, it is an urgent need to identify customer's environmental necessities and develop the products accordingly (Sharma, 2018). For example, companies can develop a database of their customers and study their requirements and needs to develop the values which improve their customers' satisfaction including green product consumption requirements. Quality functional deployment (QFD) and Kano techniques may also be applied to identify the customers' needs and wants when companies developing products (Avendaño and Garcia, 2020; Jugend et al., 2020; Ozalp et al., 2020).

5.3. Comparisons

The results of the proposed weighted FIS risk scoring mechanism

Table 10
Comparison between scoring and ranking using the innovative approach and the traditional approach to Fuzzy Inference Systems.

Risk factor	Score (Proposed approach)	Score (Traditional FIS)	Ranking (Proposed)	Ranking (Traditional)
Level of environmental awareness in society	0.819	0.834	1	1
Governmental policies, rules, regulation	0.754	0.654	2	9
Substitute products	0.741	0.628	3	13
Level of family income in society	0.734	0.597	4	5
Customers' price sensitivity and bargaining power	0.707	0.707	5	12
Customer Dissatisfactions	0.696	0.629	6	14
Management willingness to pursuing environmental initiatives	0.655	0.634	7	3
Inefficient promotion plans	0.654	0.621	8	10
Reference groups supporting level	0.643	0.741	9	11
Stability of government	0.642	0.643	10	7
Inappropriate organizational culture management	0.634	0.642	11	6
Innovative green process or product	0.628	0.696	12	4
Flexibility	0.615	0.734	13	8
Investment rate on R&D for green products	0.609	0.695	14	33
Supplier's bargaining power	0.597	0.465	15	2
Product distribution	0.581	0.597	16	16
Changes in management board	0.572	0.581	17	23
Competitive Rivalry	0.571	0.572	18	17
Lack of adequate budget	0.57	0.571	19	18
Demand fluctuation	0.569	0.569	20	19
Volatility in Marketing and Sale expenses	0.558	0.57	21	21
Ethnic diversity	0.551	0.51	22	20
Threatening potential rivals	0.525	0.588	23	24
Market share reduction	0.514	0.558	24	34
Purchase contract	0.486	0.514	25	25
Customer loyalty	0.482	0.494	26	22
Difficulties to enter the market	0.457	0.509	27	27
Customer acquisition rate	0.445	0.478	28	26
Rate of errors and deviations	0.443	0.445	29	30
Change in currency exchange rate	0.441	0.485	30	28
Inflation rate	0.44	0.441	31	15
Green products' shelf life	0.411	0.309	32	29
Purchase expense	0.394	0.609	33	31
Barriers of income return	0.354	0.523	34	37
Inappropriate management of the production line	0.309	0.335	35	36
Lack of expertise	0.302	0.337	36	35
Supply contract	0.273	0.44	37	32
The quality of supply or supplier	0.255	0.302	38	38
Economic crises	0.246	0.287	39	39
Civil and international unrests	0.19	0.273	40	40

were compared with the traditional FIS to provide more insights into the final ranked risk factors. This comparison was performed to reveal the outcome of assigning importance weightings on the risk criteria using the developed heuristic approach embedded in the proposed weighted FIS model. The results of this comparison, tabulated in Table 10, show how not applying the weighted FIS model can change the scores of risk factors. The results confirm that there is a significant change in the position of the risk factors using the two approaches. When not applying the DMs' weights regarding the four risk criteria, the level of environmental awareness in society was still ranked as the most important risk factor comparing to the weighted traditional FIS approach results. Besides, the level of family income risk factor is still included in the Group A risk factors. But all the other group A risk factors are included in Group B as a result of not considering risk criteria weights. From this investigation, it is found that the weighted FIS risk scoring mechanism is a suitable tool for considering the risk criteria weightings.

The current study provides three main contributions that make the results of this study different from the existing studies in the literature. Firstly, this study provided a comprehensive list of green marketing risk using the literature and relevant experts' opinions in the dairy industry. Previous study in the literature mainly focused on pure supply chain risks such as disruption, transportation, supplier performance, volatility of costs and prices, and quality (Song et al., 2017; Chowdhury et al., 2019; Dohale et al., 2021; Moktadir et al., 2021). For example, (Abdel-Basset and Mohamed, 2020) identified and ranked sustainable supply chain risks in a telecommunication equipment industry. The results of their study show volatility of costs and prices as the main important risk factor. Based on a study cried out by (Chowdhury et al., 2019), disruption in the supply chain identified as the most driving risk factor in the readymade garment industry. However, there are some risks associated with green marketing in the demand side of a supply chain such as the level of environmental awareness, customer dissatisfaction, and substitute product that have rarely discussed in the literature. For the first time, this study provided comprehensive list of 40 risk factors in 8 categories. Based on the results of this study, the level of environmental awareness in society was found as the most important risk factor followed by governmental policies, rules, and regulations for supporting green products risk factors.

Secondly, this study proposed a structured novel weighted FIS approach that can incorporate the input variables (risk assessment criteria) weights into the assessment. As, it was discussed earlier in this paper, weight of input variables cannot be considered by the existing traditional FIS models. Thirdly, based on the results of the proposed approach, a final ranking of the green marketing risk factors in the dairy industry along with risk mitigation strategies for the most important risk factors were provided that have not been done in the previous studies.

5.4. Validation

To show the proficiency of the proposed approach and validate the results, a survey has been conducted. In this survey, the results of the proposed approach along with the results of the traditional FIS were

Table 11
Risk factors ranking comparison and validation.

Rank	Traditional (T)	Proposed approach (P)
1	Level of environmental awareness in society	Level of environmental awareness in society
2	Supplier's bargaining power	Governmental policies, rules, regulation
3	Management willingness to pursuing environmental initiatives	Substitute products
4	Innovative green process or product	Level of family income in society
5	Level of family income in society	Customers' price sensitivity and bargaining power
6	Inappropriate organizational culture management	Customer Dissatisfactions

presented to the experts. The first 6 risk factors with the highest score of each method were provided to the experts (see Table 11). Structured interviews have been conducted to gather the experts' opinions. The results of the interviews revealed that all the experts preferred the results of the proposed method over the traditional method.

In addition, to validate the results of the proposed approach and the ranking of the list first 6 risk factors with the highest score along with their ranking were given to the experts. Then, each expert was asked to provide ranks of the risk factors using a survey. The results of the ranking based on the experts' opinions are shown in Table 12. The values in the table show the rank provided for each risk factor based on each expert opinion.

Then the results were checked and analysed to see how the experts ranked the risk factors. To do this, the number of experts (1–20) who provided rank 1–6 for each risk factor were counted and shown in Table 13. For example, as shown in Table 13, for the level of environmental awareness in society risk factor, out of 20 experts, 14 experts ranked 1, 5 experts ranked 2, and 1 expert rank 3 and none of them ranked the risk factors 4–6. Then, we compared these results with the results achieved through our proposed approach. Based on the results, if more than 50% of the experts (10 + 1) ranked the risk similar to the rank achieved through the proposed approach, then the rank is accepted and validated. For example, for the level of environmental awareness in society risk factor, out of 20 experts, 14 experts ranked 1 (70% of the experts) that can validated the result of our proposed approach as it provided rank 1 for this risk factor too. The results of the validation process show that all the risk factors validated as each of them got at least 11 votes for the ranks they achieved through our proposed approach.

5.5. Sensitivity analysis

A sensitivity analysis was conducted to highlight the effect of variation in the four assessment criteria weights on the assessment process and ranking of the green marketing risks. Furthermore, the sensitivity analysis was performed to show the quality of the results achieved through the developed FIS. It shows how the proposed approach is sensitive to the criteria weights when imposing high weights to one risk assessment criterion while putting all the other weights to constant. Following the same procedure, four sensitivity analysis experiments were conducted performed in this research activity. Table 14 shows the average input value of the 6 high ranked risk factors in the different risk assessment criteria that achieved through the experts' opinions for risk assessment. Table 15 shows the experiments based on different weights of risk assessment criteria and their corresponding risk score. To run the experiments, data in Table 14 were used as the input values for the risk factors. In the Experiment 1, weight of Probability (Wp) is equal to 0.5 and weights of Economic Response (Wr), Detectability (Wd), and Severity (Ws) are equal to 0.1667. Then, the FIS is coded and implemented in MATLAB based on this setting. The scores of the six risks are then calculated by using the data provided in Table 14 and developed FIS based on the experiment 1 setting. Similarly, experiments 2, 3 and 4 were configured, coded and implemented.

Table 14
Risk factors with their relevant input value in the assessment criteria.

Risk factor	Response (r)	Detectability (d)	Severity (s)	Probability (p)
Level of environmental awareness in society (R1)	2.90	2.93	2.86	2.84
Governmental policies, rules, regulation (R2)	2.06	2.11	2.70	2.79
Substitute products (R3)	2.93	1.86	2.88	2.90
Level of family income in society (R4)	2.06	2.11	2.70	2.79
Customers' price sensitivity and bargaining power (R5)	1.93	1.95	2.70	2.68
Customer Dissatisfactions (R6)	2.34	2.25	2.45	2.40

Table 12
Experts' opinion for ranking the risk factors.

Risk Factors	Experts																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Level of environmental awareness in society	1	1	2	1	1	2	1	3	1	1	1	2	2	1	1	2	1	1	1	1
Governmental policies, rules, regulation	3	2	1	2	2	1	2	2	2	2	3	1	3	2	2	1	2	2	3	3
Substitute products	2	3	4	3	3	3	3	1	3	3	2	3	1	4	3	3	3	4	2	2
Level of family income in society	4	4	3	4	4	5	4	4	5	4	6	4	4	5	4	4	4	3	4	5
Customers' price sensitivity	6	5	5	5	5	6	5	5	4	5	4	5	6	3	5	5	6	5	6	4
Customer Dissatisfactions	5	6	6	6	6	4	6	6	6	6	5	6	5	6	6	6	5	6	5	6

Table 13
Results of validation process.

Risk factors	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank proposed approach	Validated?
Level of environmental awareness in society	**14**	5	1	0	0	0	1	✓
Governmental policies, rules, regulation	4	**11**	5	0	0	0	2	✓
Substitute products	2	4	**11**	3	0	0	3	✓
Level of family income in society	0	0	2	**13**	4	1	4	✓
Customers' price sensitivity and bargaining power	0	0	1	3	**11**	5	5	✓
Customer Dissatisfactions	0	0	0	1	5	**14**	6	✓

Table 15
Sensitivity analysis results.

Experiment	Weight	Risk score					
		R1	R2	R3	R4	R5	R6
1	Wp = 0.5, Ws = 0.167, Wd = 0.167, Wr = 0.167	0.819	0.749	0.741	0.749	0.707	0.696
2	Wp = 0.167, Ws = 0.167 Wd = 0.167 Wr = 0.5	0.739	0.489	0.745	0.489	0.455	0.517
3	Wp = 0.167 W = 0.5, Wd = 0.167, Wr = 0.167	0.819	0.734	0.721	0.734	0.709	0.701
4	Wp = 0.167, Ws = 0.167, Wd = 0.5, Wr = 0.167	0.837	0.632	0.705	0.623	0.560	0.689

For example, level of environmental awareness in society (R1) got a score of 2.90 in Response, 2.93 in Detectability, 2.86 in Severity, and 2.84 in Probability. Therefore, it was expected that R1 gets the highest score in the experiment with the highest weight in Detectability. As it is shown in Table 15, R1 got the highest score in Experiment 4 (0.837) in which Detectability has the highest weight (0.5) compared to the other experiments. The same analysis were conducted for R2, R3, R4, R5, and R6 as shown in Table 15. For R2, R3, R4, R5, and R6, the risk factors got the higher scores in Experiments 1, 2, 1, 3, and 3, respectively, as it was expected. Based on the results of the sensitivity analysis, it can be perceived that the model is sensitive to the criteria weights and works properly. Hence, the results are reliable.

6. Conclusion and future works

The last two decades have seen a growing trend towards green marketing (Gustavo et al., 2021). However, it has been proved by many academia and practitioners during recent years that the implementation of green marketing has its own risks that can affect the performance of businesses (Papadas et al., 2019; Confente et al., 2020). Among different industry sectors, in the dairy sector (both in farming and manufacturing) incurs a huge amount of environmental emissions to the environment. Hence, dairy companies are trying to reduce the negative environmental impacts by the implementation of environmental activities such as green marketing. Green marketing practices in the dairy industry are still in their early stages where a comprehensive risk assessment approach is needed to guide practitioners in the dairy industry to mitigate their negative environmental impacts. Although many studies have recently been conducted in the area of green marketing, less attention has been devoted to identifying and assessing green marketing risks using a comprehensive framework. In this study, an integrated fuzzy decision-making approach was developed for green marketing risk assessment in the dairy industry. In the first phase, the green marketing risks were extracted from the literature and then approved by the experts. Then, using FAHP, the risk criteria were weighted by the experts. Using a weighted FIS, the final risks were analysed and ranked based on their importance. Besides, risk mitigation strategies are proposed to deal with the highly ranked risk factors. level of environmental awareness; governmental policies, rules, and regulation; Substitute products; customers' price sensitivity and bargaining power; the level of family income; and Customer dissatisfactions are the highly ranked risk factors. These risk factors are categorized as very important risks that need to be considered by policymakers and practitioners when they develop and implement their marketing strategies. In this research, for each of the risks, mitigation strategies were provided and discussed in the discussion section.

The current study provides three main contributions. First, a full set of green marketing risks in the dairy industry was identified by examining the literature and gathering experts' opinions using a Delphi method. For the first time, these risks were identified and categorized. Second, a structured approach using FAHP and novel weighted FIS that can incorporate the input variables (risk assessment criteria) weights into the assessment was proposed. Traditional FIS models suffer from incorporating the weight of the input variables in the assessment. Finally, a final ranking of the dairy industry risk factors together with risk mitigation strategies for the highly ranked risk factors.

In terms of theoretical contribution, the current study contributes toward knowledge in the area of green marketing by providing a comprehensive list of the green marketing risks in the dairy industry. In addition, the proposed weighted FIS contributes toward the literature of green marketing risk assessment theoretically as there was a lack of a systematic approach for risk assessment in the domain of green marketing. In terms of practical contribution, considering the few studies conducted on the risks of green marketing, the results of this study can provide managers a roadmap for improving their competitive advantages in the market. The results of the study provide a comprehensive insight to manufacturers, policymakers, and industry practitioners regarding the existing green marketing risks, their ranking, and their mitigation strategies. The results of this study help them to implement green marketing strategies, projects, and initiatives successfully.

The proposed approach has some advantages. As it discussed in the manuscript, the traditional FIS published in the literature (Azadnia et al., 2015; Sabaghi et al., 2016; Ghadimi et al., 2019; Mahmoum-Gonbadi et al., 2019; Nazari et al., 2018) cannot incorporate the weights of input variables(criteria). However, the proposed approach of this study can incorporate the weights of the input variables (criteria) by proposing a heuristic solution approach. In addition, most of the MADM techniques such as TOPSIS, VIKOR, AHP, and ELECTRE usually provide only a ranking for the identified risks and they suffer from providing independent index or risk score for each individual risk. These values are relative/comparative and don't show the exact/independent risk score/index. It means the calculation of the final score for each risk depends on the behaviour of the other alternative in different criteria. The proposed FIS has the advantage over the abovementioned technique by providing each risk factor score independently.

However, there are also some limitations with the proposed approach like every single approach. For example, if the number of assessment criteria (input variables) increases the number of rules will be increased exponentially and developing and implementing the rules in the software will be cumbersome. To solve this issue in the case of a high number of input variables, future works can focus on applying artificial neural networks or some heuristics.

The limitations of this study include the scarcity of experts and companies producing green products and conservative participants avoiding answering a few questions. However, the authors could wear them down by several meetings and conducting interviews on different occasions. Like any model, the current model has its limitations, one of the limitations for the FIS model is if the number of input variables (assessment criteria) increases, the number of rules will increase exponentially that makes the process of developing the model time-consuming. This can be solved by developing some heuristics and techniques in the future.

It is suggested that future research on green marketing identify other risks of green marketing or approach the issue from a different perspective such as investigating the effects of green marketing risks on company performance, providing fuzzy programming models for

assessing risks and optimizing the allocation of resources for responding to risks of green marketing. In addition, there could be a good opportunity to use some other techniques such as Level Based Weight Assessment (LBWA), Best Worst Method-BWM, and Full Consistency Method (FUCOM). Furthermore, there would be good opportunities for researchers to study green marketing risks in the other sectors as well and compare the results with the current research. Finally, this study provided risk mitigation strategies for the high-rank risk factors (group A); future studies can investigate the possible risk mitigation strategies for the risk factors in groups B and C. The described implications of their research are quite relevant and topical for the development of a greener economy and would help to support more companies to become sustainable especially in developing economies. Therefore, this calls for further research to extend the implications of this study to other economic regions such as underdeveloped and developed ones.

CRediT authorship contribution statement

Amir Hossein Azadnia: Supervision, Conceptualization, Methodology. **Mohsen Geransayeh:** Investigation, Software, Data curation. **George Onofrei:** Writing – review & editing. **Pezhman Ghadimi:** Writing – original draft, Visualization, Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jclepro.2021.129434.

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