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## The sustainability characteristics of Michelin Green Star Restaurants

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### ABSTRACT

The restaurant industry is increasingly aware of sustainability issues with around 34% of anthropogenic greenhouse gas emissions come from life-cycle stages in food systems and increased concerns over packaging and food waste. The Michelin Restaurant Guide has awarded the distinction of a Green Star to restaurants at the forefront of the industry in their sustainability. However, although restaurant sustainable practices are often presented in food media, the characteristics of sustainability-awarded restaurants are often unknown. This study aims to identify the extent to which sustainability is promoted by Michelin Green Star Restaurants (MGSRs) as part of their online offerings. By conducting a website content analysis of 355 MGSRs, this study examines eight sustainability initiatives during food procurement, preparation, and presentation. The results suggest that MGSRs could be sustainability ambassadors and promoters, but currently, they are modest in promoting sustainability. Most MGSRs' websites highlight their selection of local and organic food but place less emphasis on sustainable practices in food preparation, even though some of them are practising sustainability in reality. This study suggests that restaurants could be sustainability ambassadors by putting sustainable practices on their websites as well as on the "customer's plates".

### KEYWORDS

Sustainable restaurants; Michelin guide; fine-dining restaurant; food system; sustainable food service practices

## Introduction

Food consumption causes negative environmental impacts during all life-cycle stages in food systems, including land use (change), food production, food processing, distribution, food consumption, and end of life (Crippa et al., 2021). Food production, storage, preparation, and operational support

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processes produce around 34% of global greenhouse gas (GHG) emissions, and create 12% of global food waste, while also having other short and long-term environmental effects, such as land use change (e.g., Baldwin et al., 2011, Bux & Amicarelli, 2022, Notarnicola et al., 2017). These effects are arguably only heightened in the post-pandemic era, as customers' dining consumption patterns have changed in many countries with the increased demands for takeaway and delivery services having significant implications for the sustainability of the restaurant industry supply chain and subsequent waste and emissions (Arunan & Crawford, 2021, Gössling & Hall, 2022, Zhang & Wen, 2022). Therefore, it is significant for the restaurant industry to pay attention to food sustainability issues because restaurants are potential leaders in sustainability transitions and influence the entire food system (Higgins-Desbiolles et al., 2017).

Awards are important for a restaurant's reputation (Edelheim et al., 2011). Currently, there are many international and regional sustainability awards and certifications to confer restaurants' sustainability, such as Michelin Green Star (Michelin Guide, 2021), Food Made Good (2020) by the Sustainable Restaurant Association, and Dine Green (n.d.) By the Green Restaurant Association. The Michelin Guide is considered one of the most authoritative indicators in the global gastronomy industry, wielding both symbolic and material power and accepted by most high-level chefs in the field (e.g., Chiang & Guo, 2021, Lane, 2013, Meneguel et al., 2019). Since the Michelin Green Star launched in 2020, it has awarded about 400 restaurants globally that highlight sustainable practices (Michelin Guide, 2021). These Green Star restaurants have received substantial attention on advocating sustainability from customers, food critics, food media, food supply chain, and the whole restaurant industry (e.g., Ho, 2021, Huang & Hall, 2023, Noguer-Juncà & Fusté-Forné, 2022). The standards include "working directly with growers, farmers and fishermen; foraging in hedgerows and woodlands; growing plants and rear animals; and using regenerative methods such as no-dig vegetable gardens and successional cover crop growing; addressing issues related to ethics and wellbeing, as well as contributing to local, national or global charitable and educational projects" (Michelin Guide, 2021). Michelin-starred restaurants are usually regarded as fine-dining restaurants with the Michelin Guide considered as the most influential tastemaker, wielding both symbolic and material power and accepted by most high-level chefs in the field (Lane, 2013). Given their profile, the fine-dining restaurants awarded a Michelin Green Star could become significant sustainability ambassadors in both the restaurant industry and for the general public. The Michelin Green Star, therefore, offers consumers an orientation tool in terms of the sustainability of restaurants and potentially provides a role model to other restaurants and food suppliers for encouraging and promoting sustainable food practices (Mrusek et al., 2021).

The restaurant industry and foodservice sector feature prominently in many of the environmental, social, and economic elements of the United Nation (UN) Sustainable Development Goals (SDGs) because they are interconnected with almost all aspects of sustainability from the processes of food procurement, food preparation, and food presentation (Higgins-Desbiolles & Wijesinghe, 2019). However, some restaurants use the words “green” or “sustainability” as a marketing ploy literally in food media instead of conducting real sustainable practices actually, which has been described as greenwashing (Majeed & Kim, 2022). In addition, many sustainable practices are conducted back-of-house (Charlebois et al., 2015), which make them difficult to be perceived by customers if the restaurants do not promote them. Although the sustainability of restaurant, especially Michelin-starred restaurants, is often presented in food media (Huang & Hall, 2023, Martínez-Navalón et al., 2019), the empirical reality of these sustainability-awarded restaurants is unknown.

Considering the invisibility of sustainability in the restaurant industry, this study aims to identify the restaurants’ sustainable practices with respect to the three pillars sustainability (i.e., environmental, social, economic) and examine the extent to which sustainable practices are online promoted as part of their offerings by Michelin Green Star Restaurants (MGSRs). A website content analysis is conducted to identify the characteristics of MGSRs. Sustainable practices involving the process of food procurement, preparation, and food presentation are identified, coded and then analyzed based on the literature review. By identifying the sustainability of MGSRs, this study could potentially provide insights into the restaurant industry’s contributions to environmental, social, and economic sustainability.

## Literature review

According to the lifecycle “farm-to-table” framework that considers the sustainability of restaurant and food service operations in the context of the food consumption and production system or what also been described as a “sustainable culinary system” (Gössling & Hall, 2022, Gössling and Hall, 2012), this study examines the MGSRs’ sustainable practices in the processes of food procurement, preparation, and presentation. Food procurement focuses on what goes into restaurants from the wider food system, including local and organic food. Food preparation focuses more on what happens within the restaurant or foodservice operation and the strategies and practices that are utilized to be efficient yet also satisfy customers and includes issues such as energy use, food waste, and disposables. Food presentation examines what comes out from the restaurants as

well as the contributions of restaurants and foodservice operations to social and economic wellbeing, including sustainable menus, community outreach, and sustainability achievements.

### **Local food**

The definition of local food is based on distance, political boundaries, and specialty criteria, such as geographical designations and indications (Feldmann & Hamm, 2015). Geographical proximity is usually emphasized in defining local food, which refers to “the explicit spatial/geographical locality, (e.g., area, community, place or geographical boundary) distance and/or radius (e.g., food miles), within which food is produced, retailed, consumed and/or distributed” (Eriksen, 2013, p. 51). Because of its proximity, local foodstuffs are more likely to have account for lower levels of cumulative energy and carbon footprint for production, transportation and distribution to consumers than imported foodstuffs, thereby contributing to environmental sustainability. In an asparagus case study, for instance, it is estimated that transport-related GHG emissions of Peruvian asparagus (exported to Belgium) are 11.12 CO<sub>2</sub>-eq./kg, while the local Belgian chain only emits 0.03 CO<sub>2</sub>-eq./kg (Schwarz et al., 2016). However, the environmental impacts of local food will depend on food variety, regions, and time of year (Notarnicola et al., 2017); many factors also matter more than transportation, not least consumers; dietary choices (Stein & Santini, 2021). Restaurants that rely strongly on locally grown and foraged food are sometimes regarded as “terroir restaurants”, privileging the centrality of the relationship between food, culture, history and geography for customers (Tresidder, 2015). These terroir restaurants could contribute to rural development and a sense of community, a significant element of social sustainability (Ackerman-Leist, 2013). For economic sustainability, agri-food products with protected “geographical indications” are profitable as their sales value is on average double that for similar but uncertified products (Stein & Santini, 2021). In the USA, Canada, and Europe, smaller-scale localized productions have become a part of community and economic development strategies (Cvijanović et al., 2020). In general, sourcing food in the local food system (LFS) can have a number of benefits, including consuming fresher and healthier food, strengthening consumers’ willingness to pay, increasing recognition of local farmers and producers, economically benefiting farmers, increasing local community ties, benefiting the local economy, fostering environmentally-friendly production practices, and mitigating climate change (Enthoven & Broeck, 2021).

### **Organic food**

Organic food implies the use of food ingredients that are artificial spray and chemical-free, are not genetically modified, and have been produced as “naturally” as possible (Gössling & Hall, 2022). Organic food is generally considered an environmental-friendly and consumes almost 50% less nonrenewable energy than conventional food (Pérez-Neira & Grollmus-Venegas, 2018). However, when overseas land use compensates for shortfalls in domestic supply then net energy consumption may be greater (Smith et al., 2019). Organic farming is also considered as contributing to the reduction of pesticides, better soil production, the preservation of biodiversity, and animal welfare (Hanks & Mattila, 2016). All the above literature highlights the environmental sustainability of organic food and emphasized the importance of restaurants and end consumers in advocating organic agriculture and organic food consumption. Consumers’ perceptions and preferences for organic food are usually driven by the major psychological motives of “health worries” as well as other factors like availability, personal values and ethical motivations, and high prices (Asioli et al., 2017). People who prefer organic food are more likely to have a higher willingness to pay and overall satisfaction (Katt & Meixner, 2020). Given the motivations for consumption, utilizing organic food also emerges as a strong element of sustainable restaurant positioning and enhances their competitiveness as a green restaurant (Iraldo et al., 2017).

### **Energy use**

Restaurants are among the most energy-intensive types of commercial buildings. In terms of average energy consumption in a full-service restaurant (Refrigeration Design Technologies, 2020), the largest portion of energy cost is consumed by cooking and food preparation (35%), followed by heating, ventilation, and cooling (HVAC) (28%), sanitation (18%), lighting (13%), and refrigeration (6%). Fine-dining restaurants usually serve fewer customers while consuming more energy than casual dining, and often have complex cooking technologies and a large and well-maintained physical dining environment (Harrington et al., 2011). From the perspective of restaurant owners and managers, improving the efficiency of the kitchen can reduce costs while maintaining menu quality, this can be achieved by having efficient building, lighting, HVAC, kitchen appliances, refrigeration, cooking equipment, and water supply (Gössling & Hall, 2022). Having appropriate energy management systems and restaurant management systems can also result in greater efficiency, thereby contributing to environmental and economic sustainability (Hu et al., 2013).

Encouraging employees to have good operating habits, such as turning kitchen equipment off when not in use, also benefits social sustainability by promoting such practice (Friendly Power, 2021).

### **Food waste**

Food waste includes food loss or food spoilage during post-harvest, processing, and production; discarded food during retail, consumption, and production (Stirnemann & Zizka, 2021). According to the UNEP (2021), on a global scale around 242 million tonnes of food goes to waste from foodservice businesses (26%) each year. In full-service restaurants, food waste can occur during procurement and storage (suboptimal food), production (unsold meals and meal parts), and consumption (plate waste) (Filimonau et al., 2020). Due to the frequency of new menu items and fewer customers served, fine-dining restaurants have the heaviest food waste per customer per day (261.09 grams), compared with quick-service (59.28 grams), limited-service (16.53 grams), and casual restaurants (99.29 grams) (McAdams et al., 2019). Food waste is more likely to be generated from food preparation than customer plates in fine-dining restaurants due to quality assurance and aesthetic reasons (Charlebois et al., 2015). Food quality is primarily determined by the chefs, who are thus the key point in preventing, reusing, recycling, or recovering other value for food waste (Papargyropoulou et al., 2014). Food waste may also be generated along the supply chain before it reaches the restaurant, depending on the chef's use of pre-prepared versus raw food products (McAdams et al., 2019). For quality assurance, chefs are more likely to order the processed desired food ingredients from suppliers. Therefore, the accurate forecasting of guests' attendance and preferences, communication with local suppliers, purchasing frequency, and perishable food provisioning are of crucial importance in food waste management, and contributing to environmental and economic sustainability (Amicarelli et al., 2021). Additionally, the cooking and eating principles of "root-to-leaf" for plant-based foods and "nose-to-tail" for animal-based foods could be advocated to reduce food waste during food preparation (Henderson, 2012).

### **Disposables**

Apart from food waste, restaurants also produce disposable waste as a result of food storage, food packaging, and tableware, which could be recyclable inorganic (e.g., plastics, Tetra Pak packaging), organic (e.g., paper/cardboard, organic packaging), and/or refuse (e.g., paper film or aluminum foil with food residues, masks, latex gloves, cloths, nonrecyclable packaging) (Kfoury et al., 2022). Particularly since the outbreak of COVID-19, more restaurants have begun to provide off-premise dining

services, increasing the demand for dining disposables (Haas et al., 2020). As a result of COVID-19, some dine-in restaurants also provide disposable menu, disposable utensils and condiments on the table, and all restaurant staff should wear face masks and gloves which are also often disposable (Jeong et al., 2021). Such a diversity of waste complicates management, as each type of waste requires specific treatment. Maynard et al. (2020) developed a checklist of sustainability indicators in restaurants including 1) having a documented operational strategy on solid (non-food) waste management; 2) implementing selective collection; 3) limiting packaging and ordering products in bulk; 4) minimizing the use of disposables with documented goals; 5) reducing the use of plastic in the distribution of meals; 6) using returnable packaging boxes for the delivery of goods; 7) reusing and recycling glass materials; 8) encouraging customers to reduce waste; and 9) using recycled paper or FSC certified office paper. Adopting these practices to reduce disposables could therefore enhance environmental and economic sustainability.

### ***Sustainable menus***

Directing patrons toward more environmentally friendly sustainable diet can enhance the restaurant's image of sustainability and reduce the negative environmental impact on tourism and hospitality (Remar et al., 2021). A menu provides an early impression of a restaurant and direct visual communication with customers and influences their consumption decisions (Ozdemir & Caliskan, 2015). Hence, a sustainable menu is a potentially key factor in informing and influencing consumers' sustainable food choices in full-service restaurants (Babakhani et al., 2019), which is lower in cost, simpler, and more scalable than large-scale educational campaigns for sustainable diets (Attwood et al., 2020). Moreover, an informative menu with food details could also indicate traditional food practices and culinary heritage and elements of the food supply chain to customers (Hall, 2020).

Previous studies suggest that menus that include vegetarian options and sustainable labels greatly influence sustainable food consumption practices. Global GHG emissions from the production of food were found to be  $17,318 \pm 1,675 \text{ TgCO}_2\text{eq yr}^{-1}$  in 2010, and GHG emissions from animal-based food (57%) are twice those of plant-based foods (29%) (Xu et al., 2021), providing a vegetarian menu for customers is thus an important sustainable practice for fine-dining restaurants (Choi et al., 2022). Parkin and Attwood (2022) found that meat eaters were more likely to choose a vegetarian meal when provided with a menu with 75% vegetarian items but not when half were vegetarian. In terms of sustainable labeling, some restaurants design sustainable menus by marking each dish with a carbon

label, local farmer label, and rankings of general environmental impacts (Piester et al., 2020). Therefore, providing sustainable menus could not only reduce GHG emissions for environmental sustainability but also promote sustainable and healthier eating habits for social sustainability. However, the effects on customers' diet choices are varied. Piester et al. (2020) indicated that women are more likely to order sustainable food with sustainability labels than men, while Babakhani et al. (2019) found that both carbon labels and labels communicating local community benefits are insufficient to direct patrons toward ordering low emissions dishes.

### ***Community outreach***

Community outreach is defined as restaurants and the staff who work within them taking “an active role in encouraging improved sustainable behaviors in their community, including community-based gardens, cooking events, charity work, encouraging sustainable forms of eating as well as different forms of community-based activism,” thereby contributing to environmental and social sustainability (Gössling & Hall, 2022, p. 250). Many restaurants see themselves as part of a local community rooted in their regions, relying on local products, and representing and shaping the place (Hall & Gössling, 2016). Restaurants also provide tremendous opportunities to put local food into the public spotlight and reinforce the local economy (Ackerman-Leist, 2013). Maynard et al. (2021) proposed a checklist for community outreach practices in the restaurant sector including 1) designing strategies to support its community; 2) donating to food banks or charities; 3) promoting healthy eating education for the local community; 4) sourcing foodstuff from local producers; and 5) collaborating with charitable foundations or social enterprises that provide social impact.

### ***Sustainability achievements***

The sustainability achievements of a restaurant may be promoted to customers through awards. Awards are important for a restaurant's reputation and “being called an award-winning restaurant serves to set a benchmark of excellence in the competitive set the restaurant is situated in” (Edelheim et al., 2011, p. 143). Sustainability awards are used to recognize restaurants that present sustainable food and service and can range from internationally recognized awards to specific certifications or membership. There are a number of international and/or regional accreditation schemes and certifications for sustainable restaurants, including Michelin Green Star by Michelin Guide (2021), Food Made Good by Sustainable Restaurant Association (2020), Flor de Caña Sustainable

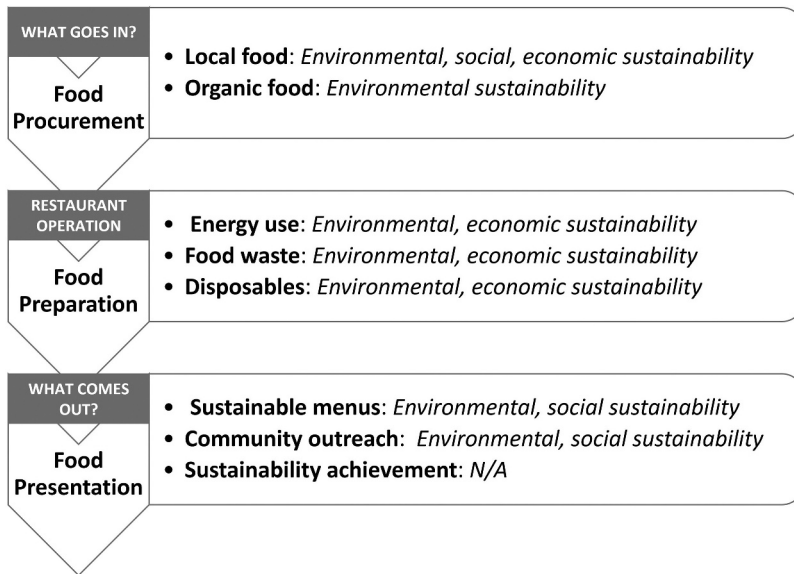
Restaurant Award by The World's 50 Best Restaurants (2023), Dine Green by the Green Restaurant Association (n.d.), Green Seal for hospitality properties (Green Seal, n.d.), and Sustainability Accreditation Greener Environment program by the Restaurant and Catering Association (SAGE, n.d.). SDGs have also been applied to identify sustainable initiatives in the restaurant industry (Di Pierro et al. 2023). Even though many restaurant owners or managers are proud of their sustainability achievements (Park et al., 2021), customers may have mixed responses. Some express preferences toward restaurants that are sustainable and use environmentally safe products (DiPietro et al., 2013), while others are concerned about greenwashing (Rahman et al., 2015, Uchida et al., 2014).

Several comprehensive criteria to examine restaurant sustainability have been proposed. For instance, Csapody et al. (2022) identified sustainable European restaurants along three dimensions (i.e., procurement of raw materials and menu items, operation and restaurant design, local communities and social responsibility); Maynard et al. (2021) developed a Green Restaurants ASSESSment (GRASS) to evaluate restaurant sustainability using indicators covering water, energy, and gas supply; menu and food waste; and waste reduction, construction materials, chemicals, employees, and social sustainability; Jang and Zheng (2020) surveyed 218 top-level restaurant managers by five environmental sustainability strategies and sixteen practices to identify differences in environmental sustainability across different restaurant segments in the US. However, these criteria are usually used by the restaurants themselves, while they are difficult to perceived by customers and the others who are not working in the restaurants. Considering the influential role of fine-dining restaurants in the food system, this study aims to investigate the online presence of the reviewed sustainable practices in MGSRs that are recognized as global leaders of sustainability in fine-dining restaurants.

## Method

### *Research strategy*

Building on the literature review, this study develops a framework to evaluate sustainability in fine-dining restaurants, involving food procurement (i.e., local food, organic food), food preparation (i.e., energy use, food waste, disposables), and food presentation (i.e., sustainable menus, community outreach, sustainability achievement) (Figure 1). Based on the identified sustainable practices, this study further examines how the MGSRs promote these practices online, and whether they conduct any innovative or exclusive initiatives to promote sustainability? Thereby, this study may provide insights into the sustainable practices implemented and demonstrated online in the fine-



**Figure 1.** Sustainable practices in fine-dining restaurants.

dining restaurant industry, which could have further implications for the wider foodservice and restaurant supply chain.

### **Data collection and analysis**

This study used the latest list of MGSRs as the sample. As an international “taste maker” in the field of gastronomy, the Michelin Green Star promotes establishments and their chefs that are committed to implementing a more sustainable gastronomy, and therefore a more sustainable society (Ho, 2021). At the time of analysis (May 2022), 368 restaurants had been awarded a Michelin Green Star.

This study conducts a website content analysis of MGSRs’ official websites to examine their sustainable practices. The primary use of content analysis is to identify and describe patterns in manifest content (Herring, 2010). Given the substantial online presence of hospitality establishments, websites and pages as media of communication in general provide abundant information and unprecedented ease to collect and analyze content information (Marzo-Navarro & Pedraja-Iglesias, 2021, Zhang et al., 2018). Restaurants usually operate their official websites as a marketing tool for providing rich information to customers (Daries-Ramon et al., 2019). Website content analysis could compile a complete list of attributes for exploring sustainability characteristics of MGSRs, which has also been employed by previous studies to examine the online presence of high-profile restaurants (e.g., Daries-Ramon et al., 2019, Daries et al., 2018, Huang & Hall, 2023, Huang et al., 2022, Huang et al., 2023).

**Table 1.** The geographical spread of MGSRs ( $n = 355$ ).

Continents	Location	n	%	Continental %
Europe	France	83	23.4%	87.9%
	Germany	60	16.9%	
	United Kingdom	27	7.6%	
	Spain	27	7.6%	
	Italy	26	7.3%	
	Switzerland	20	5.6%	
	Denmark	16	4.5%	
	Sweden	10	2.8%	
	Belgium	10	2.8%	
	Netherlands	10	2.8%	
	Norway	6	1.7%	
	Slovenia	4	1.1%	
	Ireland	3	0.8%	
	Finland	3	0.8%	
	Estonia	2	0.6%	
	Portugal	2	0.6%	
	Croatia	1	0.3%	
	Austria	1	0.3%	
	Luxembourg	1	0.3%	
Asia	Japan	24	6.8%	9.0%
	Hong Kong	2	0.6%	
	Taipei	2	0.6%	
	Thailand	1	0.3%	
	China Mainland	1	0.3%	
	Macau	1	0.3%	
	South Korea	1	0.3%	
North America	United States	11	3.1%	3.1%

Based on the latest May 2022 edition, there are 368 MGSRs in total. 355 MGSRs' official websites are analyzed, with 13 have no website. Factors are derived from previous literature (e.g., Csapody et al., 2022, Huang et al., 2022, Maynard et al., 2021). To guarantee the objectivity of the website content analysis, a dichotomous ("Yes/No") approach was used to measure all the criteria shown in Table 1: "Yes" indicates the presence of content and "No" indicates absence. Moreover, information was evaluated by percentages to determine the overall level (number of times that a criterion was present/total number of evaluated websites) (Marzo-Navarro & Pedraja-Iglesias, 2021). Analysis was also cross-checked to ensure criteria and recording accuracy. Thereby, this study could identify to what extent the sustainability is presented online as a part of offerings in MGSRs. The coding scheme is detailed in Table 2.

## Results and discussion

### Studied MGSRs

The geographical spread of MGSRs is illustrated in Table 1. From the results, this study finds that most of MGSRs are in Europe (87.9%), while the restaurants in Oceania, South America, and Africa, as well as in many Asian and North American countries are missed. Therefore, the

**Table 2.** The sustainable practices of Michelin green star restaurants ( $n = 355$ ).

Categorises	Sustainable Practices	Definition	n	%	
<b>Food Procurement</b>	Local food	Does the website state any information that the foodstuffs are sourced locally?	312	87.9%	
	-Local producers	-Mentioned sourcing local food from local producers	233	65.6%	
	-Restaurant's farm	-Mentioned sourcing local food in the restaurant's farms or gardens	173	48.7%	
	Organic food	Does the website state any information that the foodstuffs served in the restaurant are organic?	151	42.5%	
	-Mention "Organic"	-Mentioned the word "organic"	112	31.5%	
	-Animal welfare	-Mentioned considerations on animal welfare when sourcing food ingredients	62	17.5%	
	-Sustainable seafood	-Mentioned considerations on sustainable seafood when sourcing food ingredients	46	13.0%	
	Energy use	Does the website present any practice to save energy?	66	18.6%	
	-Save energy	-Mentioned energy conservation practices	61	17.2%	
	-Save water	-Mentioned water conservation practices	37	10.4%	
<b>Food Preparation</b>	-Efficient building	-Mentioned efficient/environmental-friendly building	38	10.7%	
	Food waste	Does the website present any practice to reduce food waste?	89	25.1%	
	-Nose-to-Tail eating	-Mentioned Nose-to-Tail or Root-to-leaf eating	21	5.9%	
	Disposables	Does the website present any practice to reduce, reuse, and recycle disposables?	63	17.7%	
	<b>Food Presentation</b>	Sustainable menu	Does the website provide an environmental-friendly menu labelled with sustainability-related elements or a vegetarian menu?	152	42.8%
		-Vegetarian menu	-Displayed specific menus or dishes designed for vegetarian or vegan diet	147	41.4%
-Sustainable labels		-Displayed sustainable labels on menu	32	9.0%	
Community outreach		Does the website present any practice to support the community?	71	20.0%	
Sustainability achievement		Does the website display any sustainable achievements that have been contributed?	243	68.5%	
-Sustainability statement		-Displayed a sustainability statement or introduced sustainability on a particular webpage	83	23.4%	
-Sustainability awards	-Displayed the sustainability awards	230	64.8%		

sustainability of restaurants appears to be judged by European-based criteria, which could further reflect the limitation of Michelin Green Star.

The proportion of sustainable practices mentioned on their official websites of 355 MGRSs are shown in Table 2. Initial results show considerable variation in the extent to which sustainability is a feature of restaurant positioning and the ways to present sustainability. The reviewed MGRSs are more likely to display sustainability in food procurement, followed by food presentation and food preparation.

### **Food procurement**

#### **Local food**

Most MGRSs communicate their food procurement strategies on their websites and highlight their locally sourced food (87.9%). Introducing local foodstuffs implies high food quality, as local food is usually perceived as fresh and

in season (Lin et al., 2023). Some restaurants indicate that their food is the best in the region, such as *Blue Hill at Stone Barns* (n.d.) in the US describing their food are “the best offerings from the field and market.” According to the website content of MGSRs, local food in identified MGSRs are usually sourced from *local producers* (65.6%) and the *restaurant’s garden/farm* (48.7%). For example, *Amber* (n.d.) in Hong Kong states that “buying from local producers gives us access to seasonal, fresh food with a smaller carbon price tag. It is also a valuable investment into the local economy, helps establish thriving food networks, and protects local food heritage,” reflecting environmental and economic sustainability concerns. A fine-dining restaurant’s garden/farm can also play a significant part in preserving local biodiversity and cuisine heritage. For instance, *Azurmendi* (n.d.) in Spain highlighting “a program on hydroponic crops with local varieties of vegetables in danger of extinction. Currently, they are working on a germplasm bank . . . It hosts more than 400 local seed varieties of vegetables and aims to show the importance of preserving genetic diversity,” highlighting environmental sustainability commitments.

The sourcing of local food in these fine-dining restaurants not only ensures quality food but also promote localism by protecting grown and foraged food heritage and investing in local food networks, which usually emphasizes the considerations of social and economic sustainability. Such “terroir restaurants” highlight the experience of the intersections between food, culture, history and geography for customers (Tresidder, 2015). *Noma* in Denmark with Chef, René Redzepi, is a strong promoter of a regional gastronomy, the New Nordic movement, that stress a set of principles including locality, sustainability, and respect for the natural world (Gora, 2019). However, *Noma’s* official website provides little information about sustainability but acts as an online reservation system. Similarly, the Farm-to-Table movement is also frequently mentioned with respect to local-sourced food. *Chez Panisse* and Chef, Alice Waters, are famous for creating the Farm-to-Table model, spurring the slow, local, and organic food movements, and pioneering California cuisine, which promotes social and ecological changes in the food system (Pesci & Brinkley, 2021). However, like *Noma*, the information on *Chez Panisse’s* official website is geared for online reservation with no information related to the Farm-to-Table movement.

### **Organic food**

About 42.5% of MGSRs explicitly list organic food on their websites. They would present *organic food* by mentioning the word of “*organic*” (31.5%) on websites as well as concern for *animal welfare* (17.5%) and *sustainable fishing* (13%) in food sourcing. Some of them mention that they provide organic food or source organic food ingredients directly, while some others specify how they obtain organic food to demonstrate environmental sustainability

concerns. Similar to local food, sourcing organic food could also be ascribed to organic producers and the restaurant's own farm. For example, *L'OSIER* (2020) in Japan constantly updates the website with news of food suppliers and states that "our dishes are made with ingredients such as fish caught through sustainable pole and line fishing, chickens and eggs from eco-friendly poultry farms, and organically-grown, pesticide-free vegetables." *Mountain and Sea House* (n.d.) in Taipei also introduces the "Nan'ao Natural Farm" by both text and a video, which "has an abundant natural ecology in the environment offering the freshest, and seasonal organic vegetable ... We follow the season changes in vegetable plantation and adapt an organic farming method to protect our land."

Moreover, this study finds that many MGSRs emphasize that animal-based foodstuffs are raised and obtained in natural ways in correspondence with animal welfare and sustainable fishing principles. Oaxen Krog and Slip (2021) in Stockholm state that "we strive for our producers to manifest the best practices regarding the preservation of nature, climate change and animal welfare; they should also have excellent maintenance routines for pastureland and free-range animals and follow Swedish animal protection laws; we encourage producers to use marine resources in a sustainable way and by exclusively purchasing MSC, ASC and KRAV labeled produce and/or WWF green listed recommendations." They also explain that "though these farms produce organic products, they are currently not certified organic due to the small scale of their operation." However, this study does find that fine-dining restaurants have different opinions toward the sustainability of wild fish and farmed fish. For instance, in Denmark *Amass* (n.d.) claims that "they do not use any farmed fish," while *Molskroen* (2021) uses aquaponic-farmed fish raised in "a one-hectare aquaponic greenhouse that produces fish and vegetables in a closed circuit consisting of fishponds connected to long lines of hydroponic vegetable beds."

## **Food preparation**

### **Energy use**

About 18.6% of identified MGSRs detailed their sustainable energy use on websites to demonstrate environmental sustainability, and *energy conservation* (17.2%), *water conservation* (10.4%), and *efficient building* (10.7%) are frequently mentioned as particular sustainable practices for this section. For example, *Il Gallod' Oro* (2022) in Portugal "draws up annual plans to increase energy efficiency and have introduced solar panels, low-energy bulbs, more efficient appliances and motion detectors" for saving energy, and also "have applied flow reducers in taps, an automatic watering system and more efficient pool filters" for saving water. An efficient building can enhance the sustainability of energy use in a comprehensive way, and 10.7% of MGSRs introduce

the efficiency of buildings. For instance, *Azurmendi* (n.d.) in Spain is located in a bioclimatic building, incorporating noninvasive methods of working with the environment, local and recycled materials and cutting-edge technology in terms of renewable energy.

### **Food waste**

Just over a quarter of restaurants (25.1%) state their practices of food waste management, and most of them note that food waste will be dealt with after consumption. For example, *Rest* (n.d.) in Norway introduces their philosophy of “fine dining on food waste” and “a rejection of modern consumerism” by turning food waste into a fine-dining experience. *The Macao Institute for Tourism Studies* IFTM Educational Restaurant (2022) applies “Winnow artificial intelligence (AI) food waste management system to support reducing food waste, carbon emissions while decreasing costs associated to food supply chain” and “a food decomposer convert food waste into fertilizer . . . for hydroponics system, herb, and vegetable garden.” *Moor Hall* (2022) in the UK collaborates with an organization named ReFood, which is “the UK’s only fully integrated food chain recycler, ensuring all food wasted is repurposed.” *Noma* in Denmark is among the first to adopt the Closed Loop zero-waste system to reduce kitchen waste (Callan Boys, 2014), even though its website does not mention anything about food waste.

As the food waste generated before consumption are also significant in fine-dining restaurants (McAdams et al., 2019), about 5.9% of MGSRs clarify that they use the whole raw materials, practicing *nose-to-tail and root-to-leaf eating* to reduce food waste during food preparation, and that it is more efficient than recycling or reusing food waste after consumption. Many normally non-edible parts, what others call “waste,” could also be made into food. For example, *Mountain and Sea House* (n.d.) in Taipei demonstrates three ways to eat roast chicken and suckling pig to implement nose-to-tail eating; *Domestic* (n.d.) in Denmark operates a lab to find new tastes from the biproducts, like making “non-edible tissue from meat and fish into a fermented garum sauce, leftover egg white into soja, extra sourdough from our bread production into kvass, and the residual yeast from beer production into miso amongst other things.” Furthermore, Nitzko and Spiller (2019) suggest that the efficient use of plant-based foods (root-to-leaf) is more accepted than the efficient utilization of animal-based foods (nose-to-tail); and options using the by-products in a natural form were considered more acceptable than those in which the by-products are subject to some form of processing.

### **Disposables**

The percentage of disposables (17.7%) is the lowest of all sustainable practices presented on the official websites of identified MGSRs. For instance, *Atelier Crenn* (n.d.) in the US displays Plastic Free Certification on the website and

indicates that “we have removed single use plastics from our restaurant and we are the first restaurant in the United States to do so”; *Grön* (2022) in Finland “aims to minimize food and packaging waste on all stages of food production and serving of food”, “recycles everything and separate all garbage to match the highest standard”, and “works closely with small producers to come up with new ideas to minimize food and packaging waste, like reusing the shipping boxes by producers themselves for the next delivery”. A possible explanation for the low percentage of disposables might be that fine-dining restaurants usually only provide on-premise dining to ensure the customers’ dining experience so that such restaurants they do not need many single-use packages and tableware items for food delivery or takeaway compare to casual and fast food restaurants (Fieschi & Pretato, 2018). However, due to the COVID-19 pandemic, fine-dining restaurants have provided off-premise dining choices and adopted menus for home delivery to keep open when the on-premise dining is not allowed (Kim et al., 2021). The use of disposables for off-premise dining might therefore have increased in these fine-dining restaurants. The sustainability of food delivery and takeaway should therefore be further considered in the fine-dining industry to reinforce environmental sustainability, especially in terms of disposables.

Interestingly, few MGSRs presented economic sustainability factors in food preparation on their official websites. However, the financial considerations in energy use, food waste, and disposable are inherent costs of product and non-product outputs in restaurant operation (Christ & Burritt, 2017). The omission of economic sustainability might be because these commercial organizations prefer to keep limit and perception that they are reducing costs in providing customers with high quality food experiences.

## **Food presentation**

### **Sustainable menu**

About 42.8% of restaurants provide sustainable menus on their websites with specific *vegetarian menus* or dishes (41.4%) and *sustainable labels* (9%). For vegetarian menus or dishes, apart from explicitly vegetarian or vegan restaurants (e.g., *Moment* in Denmark, *TIAN* in Austria, *Yang Ming Spring* in Taipei), some identified restaurants provide set vegetarian/vegan menus (e.g., *The Inn at Little Washington* in the US, *Cordo* in Germany, *Mahorčič* in Slovenia), while others detail the ingredients and label the vegetarian dishes in à la carte menus (e.g., *PRU* in Thailand, *FARO* in Japan, *Zinfandel’s* in Croatia). Analysis on these restaurants suggest that high-profile restaurants are more likely to promote vegetarian diets and influence customers’ food choices, which is consistent with findings in the study of Piester et al. (2020). As for sustainable labels, *Lokaal* (n.d.) in the Netherlands introduces the food providers as “our heroes” beside the menu and describes them with the

phrases like “completely pure”, “fresh from the land to the customer”, and “added value from the cow” to emphasize that the ingredients are locally sourced, organic and traceable; *Yang Ming Spring* (2022) in Taipei provides a Michelin Green Star menu labeled with Omni Food (2021) which is an “alternative comprised of a proprietary blend of plant-based protein made of peas, non-GMO soy, shiitake mushrooms and rice”; *Berchtesgadener Esszimmer* (2022) in Germany lists the Bio-Siegel labeled purveyors on the menu, which is a voluntary label for organic food regulated by the Federal Ministry of Food and Agriculture in Germany. The findings indicate that providing sustainable menus or dishes could not only benefit environmental sustainability but also potentially enhance social sustainability by influencing customers’ eating habits.

### **Community outreach**

About 20% of restaurants outline their community outreach practices. These practices are usually related to educational or charity projects to support local communities as well as protect and enrich culinary culture, which are beneficial for environmental and social sustainability. For instance, *Quince* (n.d.) in the US operates a nonprofit foundation to “support restaurants and farmers by providing direct aid and resources to Bay Area farms and hospitality workers in order to encourage entrepreneurship and sustainability in our local food supply.” *LATURE* (2022) in Japan “regularly participates in Children’s Cafeteria, thinking with children about food problems . . . and working with children to think about “wonderful Japanese food culture;” *Amber* (n.d.) in Hong Kong “participates in research on sustainable kitchens and their energy use performance with local university.” Some restaurants focus on their creativity to enrich culinary culture, highlighting social sustainability concerns. For instance, *Coque* (n.d.) in Spain and the chef, Mario Sandoval, actively collaborates with many research institutions “in proposals for healthy eating within the restaurant setting and researching new culinary techniques and technologies.”

### **Sustainability achievement**

Many identified MGSRs summarize their sustainability achievements on their websites (68.5%) by displaying *sustainability awards* (64.8%) and *sustainability statements* (23.4%). MGSRs show different responses to their sustainability achievements. Many restaurants (64.8%) demonstrate not only a Michelin Green Star but also many other sustainability awards or certifications on their official websites, while 31.5% do not showcase any sustainability achievements at all, even though they have received a Green Star. Some top restaurants, particularly those with Michelin Three Stars, barely cover sustainability practices and achievements on their websites (e.g., *Sazenka* in Japan, *Le Clos des Sens* in France, and *Schloss Schauenstein* in Switzerland). There may be

several reasons for this phenomenon: (1) many MGSRs may have announced they won a Michelin Green Star on social media, with their social media information not analyzed in this study; (2) some might not update their official websites instantly after they won the awards; and (3) some may want to maintain their elite image and they may choose not to exhibit any restaurant awards; by doing this, they might want to pronounce that they do not need to “flatter themselves” and attract customers with these awards; and (4) some might pay little attention to sustainability awards, as they showcase other restaurant awards instead. Relatively few MGSRs post their sustainability statements or commitments on the website, such as *Brace* in Denmark as a normal fine-dining restaurant, *Esporão* in Portugal as a wine estate, and *Moosleitner* in Germany as a hotel. The percentage of sustainability statements is much lower than sustainability awards, which could be evidence of the neglect of sustainability on the marketing of these sustainable fine-dining restaurants. However, with the disclosure of sustainability statements on websites, customers, business partners, and other restaurants without sustainability achievements are more likely to learn how these restaurants commit to sustainability. This study, therefore, calls for more careful thinking and emphasis on promoting sustainability practices for societal marketing and educational purposes.

In general, high-profile restaurants have the capacity to be extremely influential on broader food fashion and taste (Hall et al., 2003). By analyzing 355 MGSRs’ official websites, this study finds that the extent to which MGSRs commit themselves to sustainability is highly variable and much more limited than what has been previously suggested (e.g., Batat, 2020, Kiatkawsin & Sutherland, 2020, Nguyen et al., 2022). These high-profile fine-dining restaurants could have assumed a stronger sustainability ambassador and promoter role than they currently do, especially given the recognition that a Michelin award provides. Moreover, in many cases these high-profile fine-dining restaurants would be regarded as destination restaurants that attract both locals and culinary tourists (Huang et al., 2022, Mohamed et al., 2022). Within this perspective, the locality of such restaurants can not only benefit the environment but also provide customers with a sense of place, and the value of originality and authenticity (Chen et al., 2021). They can also be regarded as a tool for local development, involving local restaurants, farmers, farmer’s market vendors, and wholesale distributors (Roy & Ballantine, 2020).

## Conclusions

### Implications

In terms of theoretical implications, this study examines eight sustainable practices in the framework of food procurement, preparation, and

presentation, which enrich the literature on sustainability in the context of fine-dining restaurants. The results indicate that the identified MGSRs demonstrates sustainable practices for food procurement more than that for food preparation. Most of them emphasize their selection of local and organic food from distinguished suppliers or local farmers directly, suggesting not only the high-quality food but also a strong local culinary culture. However, from the results, this study argues that it is the food producers and distributors that mitigate most of the environmental issues caused by food production, rather than the restaurants. Procuring local and organic food is a sustainable restaurant practice, but the restaurants' services involve more processes, such as food preparation and food presentation that are not given as much attention.

For practical implications, this study has provided examples of some identified restaurants that have developed many novel and practical sustainable initiatives but fail to promote them online. This study therefore suggests that MGSRs need to realize their influential role in the food system and provide more online information about the sustainable practices implemented in the processes of food preparation and presentation, such as their approaches to nose-to-tail eating, reducing/reusing/recycling food waste, and saving energy. This may raise the general public's awareness of sustainable food practices and educate and encourage people to practice sustainability in the home kitchen.

Interestingly, even though sustainable practices are identified as positively influencing customer loyalty and willingness to pay it may not be promoted on restaurant websites. Given the global recognition of a Michelin award and considering the importance of sustainability in the foodservice business, it is disappointing that so many fine-dining restaurants do not act as sustainability ambassadors and promote sustainable practices on their websites as well as on their customer's plate.

### ***Limitations and future research***

This study has limitations in only analyzing the characteristics of MGSRs by official website contents. Some restaurants do not present their sustainable initiatives on websites or even do not have official websites, and some practices are thus missed. The awarded MGSRs are all fine-dining restaurants evaluated by the criteria of the Michelin Restaurant Guide, while the criteria used here are drawn from various in sustainability certifications and metrics. Therefore, the characteristics of MGSRs identified in this study might have generality issues.

Future research should examine other types of restaurants and by other sustainability restaurant awards or certifications, as compared to the Michelin Green Star, especially so as to enlarge the geographical and gastronomic scope of what constitutes a sustainable restaurant. In addition, the restaurant characteristics, such as when established, cuisine

offered, and the level of investments, could be compared with the sustainability characteristics of different restaurant types (e.g., fine-dining, casual, fast-food, and street food). Other methods, such as surveys and interviews, could also usefully be employed.

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