

Multivariable analysis and Visualisation of the Governance Sustainability measures in the Greek Hotel Industry

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Abstract. Environmental, Social and Governance (ESG) sustainability measures of the hotel industry are widely used for the assessment of the impact of tourism in the local and regional social and natural environment. The Research Institute for Tourism (RIT) official survey on ESG measures in the Greek hotel industry was designed and evaluated in summer 2024. The survey results served as one of the main pillars of the joint venture among the Hellenic Chamber of Hotels (HCH), the Technical Chamber of Greece (TCG) and the Greek Ministry of Tourism (MINTOUR) for the development of a new hotel ranking system based on ESG sustainability measures and indices. In this research, primary data on governance sustainability aspects such as policies, vision, targeting, training, corporate social responsibility, risk factors, certification, accessibility and architecture are analysed using multivariate and visualization tools leading to inference and conclusions within and between the main segments of this critical for the Greek economy industry.

Key words: ESG, sustainability, governance, data visualization, survey data, Greek hotel industry

1 Introduction

The hospitality industry, particularly the hotel sector, faces increasing pressure to integrate ESG considerations into their business strategies (Singal, 2015). This pressure stems from various stakeholders, including customers, employees, local communities, and regulatory bodies, all of whom have increasing expectations for sustainable and socially responsible practices (Baum et al., 2016, Chua and Han, 2022, Legrand et al., 2013).

The World Travel & Tourism Council (WTTC) Guidelines for ESG indicators for the hotel industry report (WTTC, 2021), proposes a hierarchical model consisting of 8 topics with several common performance metrics (CPM) for each of them. The 8 topics are, climate change, energy, water community, waste generation and diversion, supply chain work force, governance, risk and compliance (PRC). Most of the CPM are related to consumptions of resources, emissions and waste along with ethical and managerial issues. The main Stakeholder Groups in the hotel industry related to sustainability topics are identified by WTTC and summarized in Table 1.

Table 1. Stakeholders groups in the Hotel Industry

GROUP1	Owners and Franchisees, Investors, Stakeholders
GROUP2	Employees, Associates, Colleagues, Team Members
GROUP3	Customers, Corporate Clients, Guests, Consumers
GROUP4	Suppliers, Supply Chain
GROUP5	Organisations Relating to Sustainability issues, Regulatory Bodies
GROUP6	Communities, Community Organisations

The stakeholder theory is a relational approach, integrating economic, social and ethical considerations providing a strategic framework for hotel managers to use (Barakat, & Wada, 2021). The theory best supports the ESG-related model as all stakeholders are invested in the company's ESG report to achieve their own goals and priorities and furthermore they are relying on ESG in order to build positive perceptions and attitudes, consumption behaviors, perceived corporate image, and brand loyalty. (Back, 2024).

The Greek Hotel Industry (GHI) constitutes a key sector in the Greek economy, contributing up to 4.8% to the gross domestic product and 6.6% to employment in 2023, with the respective multipliers evaluated above the economy's average (Soklis et al., 2025). Furthermore, there is a strong intersectoral relationship of the GHI with other main economic sectors such as wholesale and retail trade, food products, agriculture, real estate and energy in terms of output. Soklis et al. (2025) argue that from the total increase in output caused by the operation of the GHI, 65% corresponds to an increase in the output of the hotel sector, while the remaining 35% corresponds to an increase in the output of the other sectors of the Greek economy. Furthermore, from the increase in employment caused by the operation of the GHI, 26% corresponds to an increase in employment in other sectors.

The Greek hotel sector has undergone a significant transformation over the past 15 years toward higher-end accommodation, with a notable increase in 4- and 5-star hotels, which underscores Greece's efforts to attract high-value tourism and meet the demands of an evolving global market. (Soklis et al., 2025). Over that period, the number of 5-star hotels more than doubled, while the number of 4-star hotels increased by nearly 70%. This transformation was accelerated during the recent and long-lasting Greek economic crisis making the GHI a robust and developing sector, with annual investments totalling 1 billion Euros and a major contribution to constructions and other industries and communities (Petrakos et al., 2020). Furthermore, GHI development has a positive impact on income inequality and the risk of poverty in Greece during that long and particularly harmful period for the most disadvantaged citizens (Petrakos et al., 2023).

2 Methodology and Metadata

In August 2024 the Research Institute for Tourism (RIT) in Athens, Greece launched a large-scale survey on ESG sustainability in the GHI on behalf of the HCH. Targeting on the population of the Greek hotels legally operating during 2024 and based on the official registry of the HCH, a stratified random sample was drawn according to the

main industry classifications, namely NUTS II (Regions), Category, and Size. Data collection was implemented using Computer Assisted Web Interviewing (CAWI) in Compliance with the GDPR and Quality Policies of the Institute. A sample of nearly 900 hotels (n=896) with small percentage of unit and item non response. Following the data validation process a triple weighting scheme along the stratification dimensions was implemented during the statistical analysis phase. The survey results served as one of the main pillars of the joint venture among the Hellenic Chamber of Hotels, the Technical Chamber of Greece and the Greek Ministry of Tourism for the development of a new hotel ranking system based on ESG sustainability measures and indices.

According to the official Register of the Greek Hotels legally operating in 2024 (RGH), updated and maintained by the Hellenic Chamber of Hotels (HCH), the Greek hotel sector comprises 10,110 hotels with a total capacity of 447,352 rooms. The majority (78%) of the Greek hotels are small in size, with capacity up to 50 rooms, usually operating as family and local enterprises. Medium and large size hotels have different business characteristics, since they are usually classified in the upper star categories and often belong to national or international hotel chains. Interesting enough, the 18% of hotel-owning enterprises account for the 46% of the Greek hotel sector room capacity. Seasonal hotels, which operate during the extended summer season from mid-spring to mid-fall, represent 62.6% of the total hotel units and 73.9% of the total room capacity. Additionally, more than half of all hotels are situated on Greece's popular islands. Although luxury hotels of 4 & 5 star category account for nearly 27% of the total units, they account for more than 53% of the total room capacity (Fig. 1).



Fig. 1. Distribution of the 2024 Greek Hotels population in units (a) and rooms (b) according to category (star) classification

The survey was broader in scope, encompassing all ESG dimensions within the hotel industry, so the questionnaire was comprehensive and detailed. This research presents an analysis of data related to the Governance dimension, particularly focusing on everyday management issues and initiatives, using both univariate and multivariate mode in particular Multiple Factor Analysis (MFA).

MFA is an extension of Principal Component Analysis (PCA) designed to handle multiple sets of variables structured into groups. It allows for the integration of multiple data tables while balancing their influence on the overall analysis. MFA provides a clearer visualization of multidimensional data in two-dimensional graphs, especially

when dealing with a large number of features. Prior to MFA, Latent Class Analysis (LCA) was used to group individuals (hoteliers) into discrete segments based on their stances toward sustainability practices. MFA was then applied directly to an aggregated data table, where the rows represent the LCA segments and the columns represent the features or variables. The objective of MFA is to provide a visual representation of the profiles of the LCA segments. In MFA, the length of a vector (from the origin to a point in the factor space) represents the importance or contribution of a variable or an individual to the factor structure. A longer vector indicates that the variable contributes more to the factor and has a stronger association with the dimension. The methodologies described above were implemented in R, using the 'poLCA' package for LCA and the 'FactoMineR' and 'factoextra' packages for MFA.

The questionnaire design followed the hierarchical structure depicted in Fig. 2 and detailed in the appendix, which was based on four research questions, namely a) Training, Development, and Awareness Programs on sustainability for employees, b) Commitment to **environmental protection** and implementation of relative actions, c) Hotel design, renovations, and expansions aligned with sustainability principles and d) Certifications and Risk Assessment.

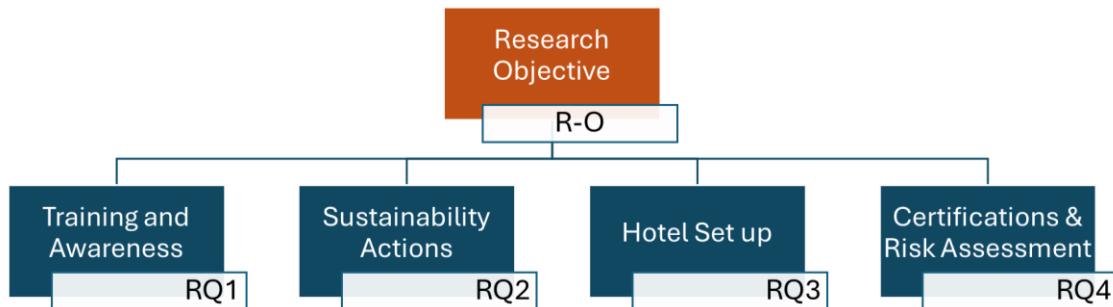


Fig. 2. The hierarchical structure of the questionnaire

3 Data Analysis Results

Univariate Analysis Results

Training, Development, and Awareness Programs on sustainability for employees in the GHI, can benefit the trainees, their professional team and their organization in several aspects, such as the reinforcement of company culture, the up scaling of staff retention and the encouragement of sustainability communication (Legrand, et al. 2016). It has been noticed that trained employees, up-skilled in sustainability, are more satisfied with their work that creates positive impact for the society and environment, and they become effective - and some of them enthusiastic- in communicating with customers, providers and other stakeholders engaging them in discussions on sustainability.

Nearly half of the Greek hoteliers (46%) have implemented training and awareness programs for their employees subjecting **recycling**. Within the star category classification, there is an upward trend in this ratio from 30% in average among 1*star hotels up to 70% in 5* ones (UpTr1*-5*). Most regions, especially the touristic ones led by the South Aegean Islands, score homogeneously above 40%.

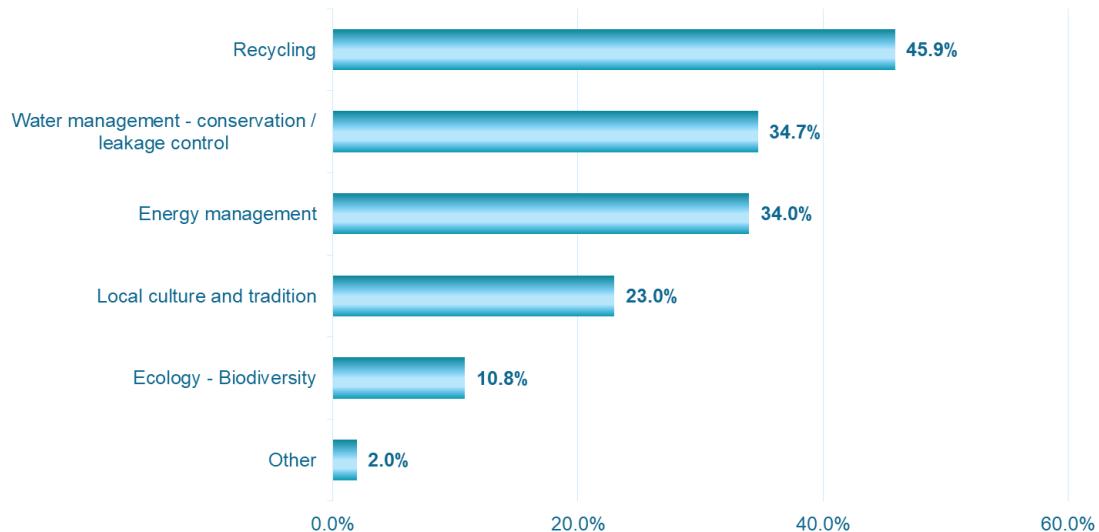


Fig. 3. Total Percentages of hotels offering Training, Development, and Awareness Programs on sustainability for employees

Training and awareness programs subjecting **water management/leakage control/conservation** and **energy management** are implemented by more than one third of the Greek hotels following the same upward pattern UpTr1*-5*. Again, most regions score above 30 % for both subjects with the Ionian Islands leading the water management percentages and the South Aegean Islands the energy management ones.

Programs for Employee Education, Training and Awareness on Sustainability Issues focusing on **local culture and tradition** are implemented by 23% of hotels in total, evenly distributed among regions and stars with noticeable higher value in the 5* star category. Similar programs concerning **ecology and biodiversity** are less popular, adopted by the 11% of the Greek hotels, nationwide, primary within the luxury categories. (Fig. 3).

As reported in relevant surveys worldwide, (e.g., Robinot et al., 2010, Mathur et al. 2017), there is an emerging need for the hotel industry to raise customer awareness about sustainability issues and take the lead in encouraging customer participation and appreciation of sustainable experiences. On average, about 30% of Greek hotels implement **guest awareness** initiatives on sustainability, in order to inform guests about the opportunities provided by the hotel to minimize the carbon footprint of their vacation, benefit the local community and the natural environment, and raise their awareness on

ecological and sustainability issues. Further analysis reveals considerable variations across categories described by an UpTr1*-5* from 24% to 53% (Fig. 4(a)).

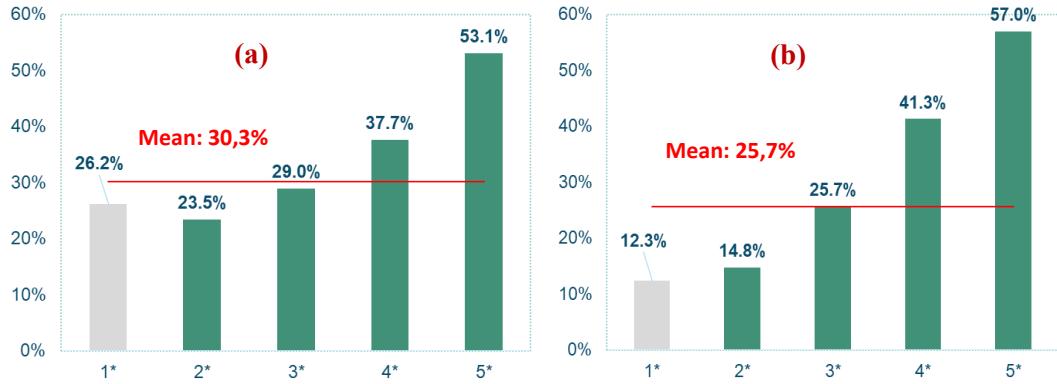


Fig. 4. (a) Percentages of hotels implement guest awareness initiatives on sustainability by category

(b) Percentages of hotels **corporate social responsibility** initiatives related to the environment and the local community by category

Approximately one fourth of the Greek hotels have undertaken and implemented **corporate social responsibility (CSR)** initiatives related to the environment and the local community over the past three years with a clear UpTr1*-5* ranging from 12% to 57% as hotel classification rises. (Fig.3 (b)). Seasonal hotels (27,5%) demonstrate a higher engagement in CSR activities compared to year-round hotels (22,4%).

During an in-depth qualitative survey with a leading Greek hospitality enterprise, the sustainability manager stated that clients do not merely expect the hotel's commitment to sustainability, but they take it for granted. Rodriguez and Cruz (2007) concluded that **environmental commitment** has significant positive impact on profitability although other studies failed to detect such a relationship (Aznar et al., 2016). According to the RIT survey results, 40% of Greek hoteliers are committed to environmental protection and have implemented related actions. This commitment follows an

upward trend across star classifications (UpTr1*-5*), ranging from an average of 30% in 1-star and 2-star hotels to 70% in 5-star establishments

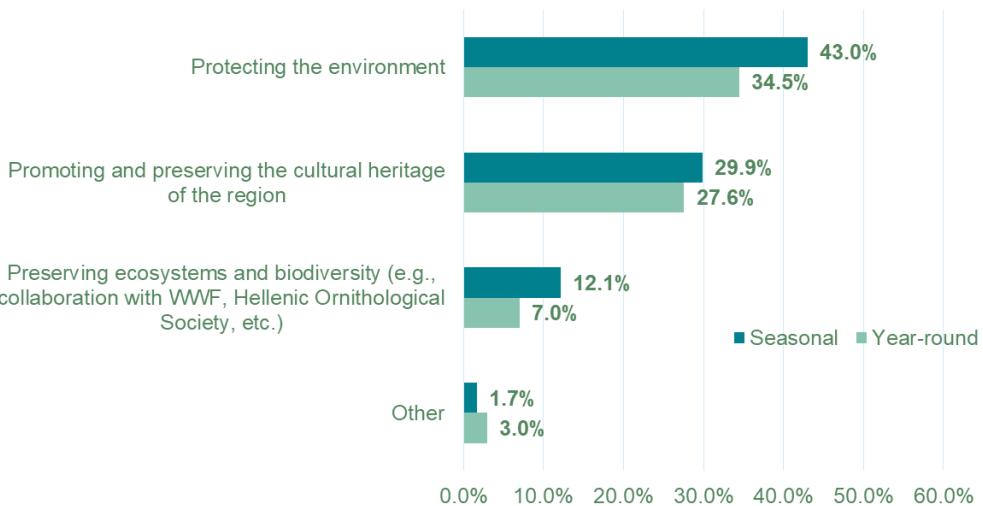


Fig. 5. Percentages of hotels committed to and implements actions on sustainability issues of local and regional interest, by operation

Twenty nine percent (29%) of the Greek hoteliers is committed to promoting and preserving the **cultural heritage** of their region and have implemented **related actions**. Hotels in the upper three-star categories and those located in Epirus-Thessaly region, South Aegean Islands and Crete score above 30%. Finally, about 10% of the GHI enterprises, coming from the luxury categories and the South Aegean Islands, Crete and Peloponnese, are **collaborating with eco societies** such as WWF, the Hellenic Ornithological Society, etc. in preserving ecosystems and biodiversity in their region. In all three variables seasonal hotels keeping a leg up, more or less (Fig. 5).

Environmental, energy, and sustainability **certifications** are exclusively held by luxury hotels, with half of 5-star hotels and a quarter of 4-star hotels obtaining such credentials. These certified hotels are primarily located in Crete, the South Aegean Islands, and Attica. Overall, 13.5% of Greek hotels hold at least one certification in these areas, with the most popular being GREEN KEY, ISO 14001, and TRAVELIFE, as shown in Fig. 6.

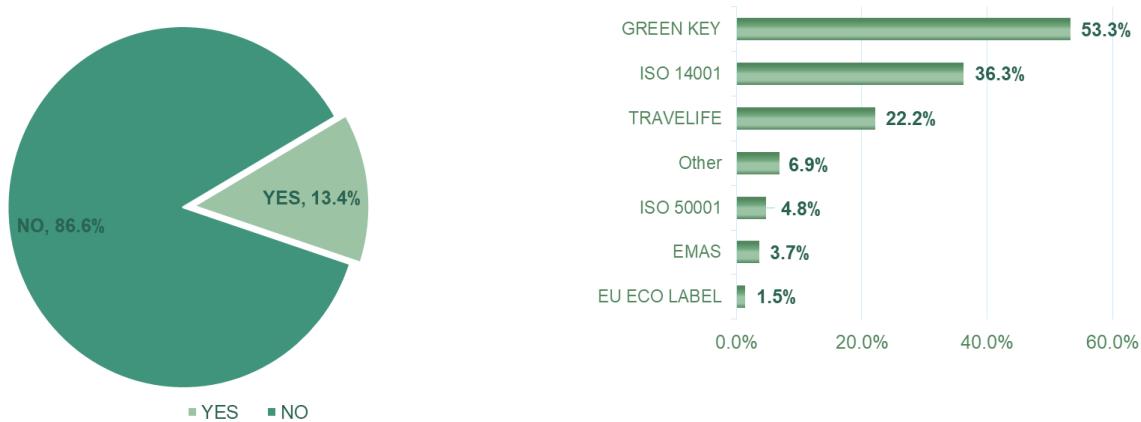


Fig. 6. a) Percentages of green certified hotels b) type of certification

One of the many challenges facing the hotel industry in our days is the management of various risks related to the safety of guests and staff but also to the reputation and financial stability of the company. (Vij, Madhu, 2019). Higher-category hotels are more likely to adopt **data measurement and risk assessment systems**, with 5-star hotels (22.8%) having the highest implementation rate, significantly above the overall mean of 6.4%. This trend suggests that upscale hotels prioritize risk management and data-driven decision-making to a greater extent.

Hotel design, renovations, and expansions aligned with sustainability principles

In Greece, many hotels are actively undertaking renovation projects that align with the latest sustainable practices, focusing on architecture and design, sustainable supply chains, material selection, and the integration of traditional lifestyles. According to the official RIT annual survey, Greek hoteliers invested over one billion euros in 2024 for property renovations and expansions, with nearly 20% of this amount dedicated to sustainability initiatives.

Hotel design, renovations, and expansions aligned with sustainability principles, by operation have been identified, measured and analyzed bringing out three dimensions of the topic. According to that 45% of the hotels follow the distinctive local character, respecting history, tradition, and people with no differentiation between seasonal and all year hotels. (Fig. 7). There is a slight differentiation between the upper three-star categories (3*-5*) that score above 50% with the lower ones (1*-2*) scoring below 40%.

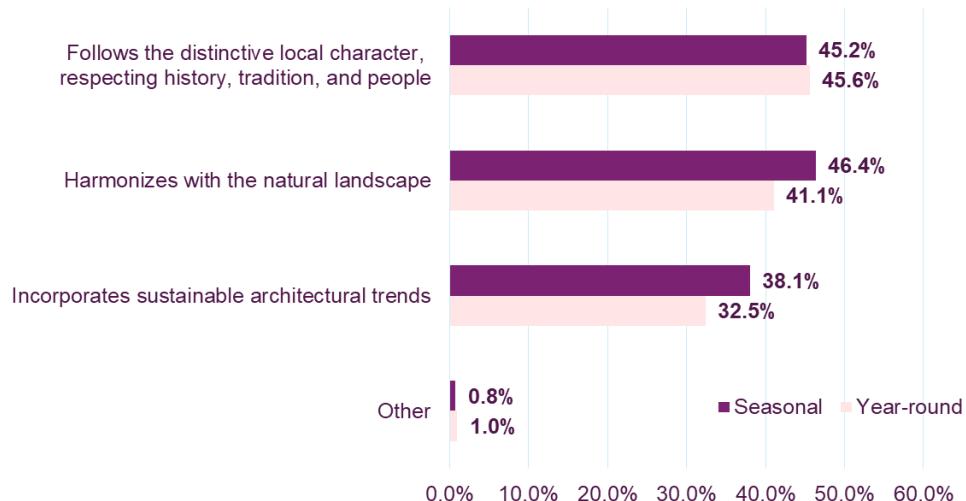


Fig. 7. Percentages of hotels with design, renovations, and expansions aligned with sustainability principles, by operation

On average, nearly half of all hotels (45.8%) maintain a design that harmonizes with the natural landscape, following an upward trend across star classifications (UpTr1*-5*), ranging from 26% to 63%. Seasonal hotels score slightly higher in this aspect compared to year-round establishments (Fig. 7). In terms of architecture, 36% of hotels in total incorporate sustainable architectural trends, with an UpTr1*-5* progression from 27% to 60%, again with seasonal hotels holding a slight advantage (Fig. 7).

Multivariable analysis results

Multivariate Factor Analysis (MFA) reveals one major underlying factor that explains 82.1% of total data variability illustrated in Figs 7, 8 & 9 by the vertical axis. The horizontal axis describes the implementation level of corporate management policy towards sustainability practices (use vs. non-use). The vertical axis accounts for a smaller portion of data variability interpretation, however it reveals two important differentiation areas (A & B).

A is defined as the bottom-right area that is dominated exclusively by hotel design/set up practices.

B is defined as the upper-right area where specific sustainability actions & employees training programs occur.

The analysis of ownership and use patterns of infrastructure related to energy management reveals four distinct groups of hoteliers (Fig. 8).

The ‘**Sustainable Pros**’ hotels account for 15.3% of the hotel population. Their name is justified by the fact that they have incorporated the entirety of sustainability actions into their corporate policies, with implementation levels exceeding 75% for each characteristic measured in the questionnaire. The vast majority of these hotels belong to the 4-star and 5-star categories (60%), while 1 in 3 are very large hotel units

(with over 100 rooms) and are located mainly - but not exclusively - in Crete or the South Aegean, at a rate of 60%.

The '**Employees Focused**' hotels account for 36.4% of the population. These hotels have adopted sustainability practices in their corporate policies, placing emphasis on implementing employee training programs on sustainability topics. Additionally, 60% of these hotels have undertaken actions for environmental protection. Their profile follows the population distribution, with a focus on small and medium-sized hotels (60%).

The '**Local Boutiques**' hotels account for 25.9% of the hotels. Although they do not have a strong corporate policy tailored to sustainability practices, they place significant importance on the design of the hotel to harmonize with the natural landscape and reflect the unique local character, respecting history, tradition, and people (70%-75%). Furthermore, 1 in 2 of these hotels has an energy efficiency certificate, and all have fire safety certificates, while 1 in 4 has participated in some Corporate Social Responsibility (CSR) initiative. Regarding their profile, the key characteristic is that over 50% are well-maintained family businesses, 3-star hotels (40%), operating year-round (~45%), and located in mountainous areas (14%).

The '**Indifferent**' hotels account for 22.4% of the hotels. These are primarily 1- and 2-star hotels (65%), with 90% being family-owned or small hotels. As their name suggests, they have not implemented any sustainability practices.

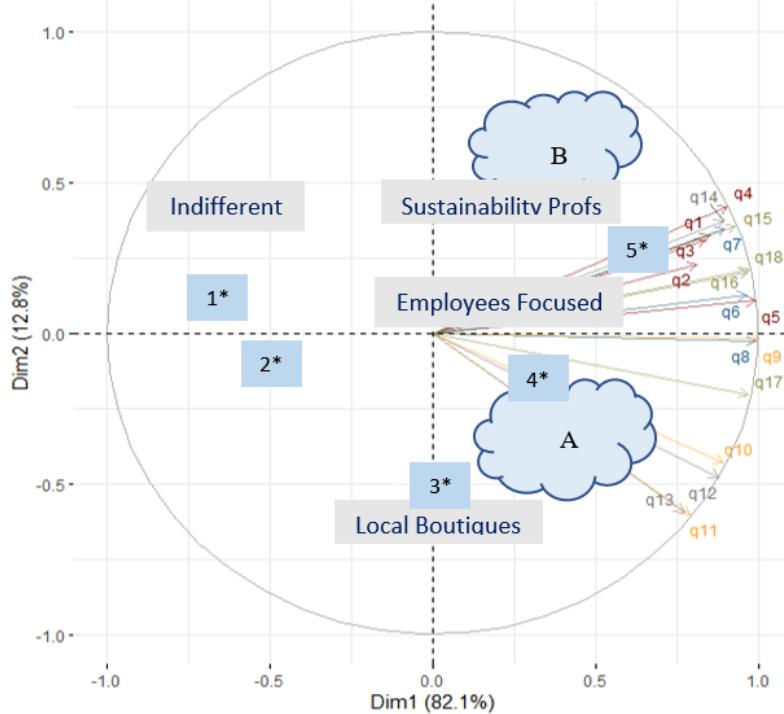


Fig. 8. MFA visualization with Factors, Areas and Star Category

The greatest dispersion/diversification in terms of corporate management policy adoption arises among hotels of different categories. As shown in Fig. 9, the hotel category is "spread" across the entire horizontal & vertical range of the map. Significant diversification also arises between hotels located in mountainous versus lowland areas, while no differentiations have been detected per hotel operation mode (seasonal vs. year-round).

Lastly, the Epirus-Thessaly regions, along with mid-range 3-star hotels, align more closely with the 'Local Boutiques' category, while Crete & South Aegean island luxury hotels demonstrate a very strong profile regarding sustainability practices adoption classified as Sustainability Pros. Hotels in the Peloponnese, Ionian Islands, South Aegean Islands, Macedonia, and Thrace, particularly in the 4-star category, show a significant emphasis on employee-focused sustainability initiatives.

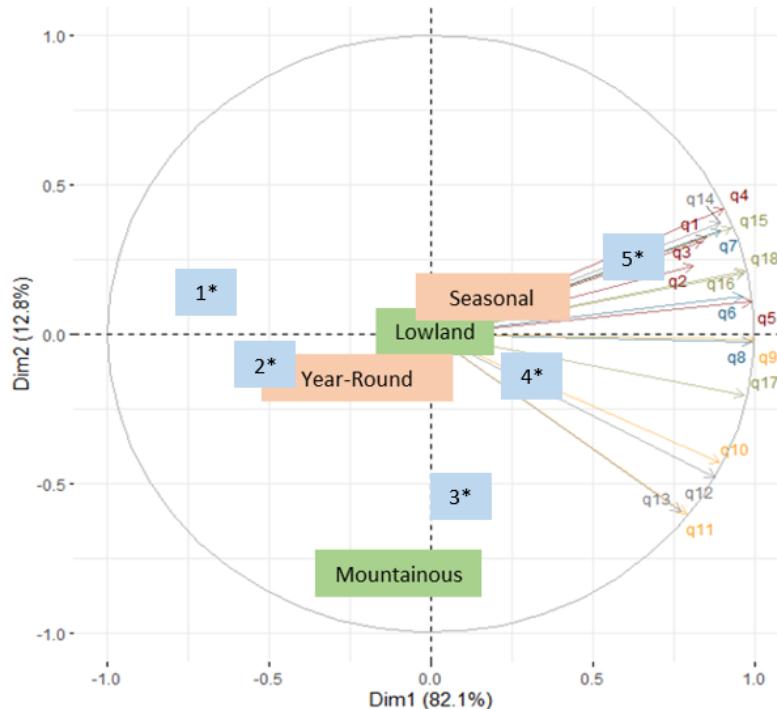


Fig. 9. MFA visualization with Operation, Location and Star Category

4 Conclusions

The Greek hotel industry is demonstrating a growing commitment to sustainability, with more than 40% of hoteliers actively engaging in environmental protection initiatives. This trend is particularly evident in high-end hotels (4-star and 5-star), where sustainability measures are more widely adopted. Training and awareness programs on sustainability topics, such as water management, energy conservation, recycling, and

local culture, are becoming more common. Nearly half of Greek hotels have implemented such programs, with an upward trend in higher-category hotels. Employees trained in sustainability practices show increased job satisfaction and actively engage in sustainability discussions with stakeholders. Around 30% of Greek hotels have introduced guest awareness programs, aiming to educate visitors on reducing their carbon footprint, supporting local communities, and engaging in sustainable tourism. Higher-category hotels show a stronger commitment to these initiatives.

Approximately 25% of Greek hotels have implemented CSR initiatives focusing on environmental protection and community engagement, with seasonal hotels showing higher participation. This highlights the industry's effort to contribute positively to local communities and ecosystems. Sustainability certifications are primarily found in luxury hotels, with 50% of 5-star hotels and 25% of 4-star hotels holding at least one certification. The most common certifications include GREEN KEY, ISO 14001, and TRAVELIFE, indicating a structured approach to sustainability compliance. In 2024, Greek hoteliers invested over one billion euros in renovations and expansions, with nearly 20% allocated to sustainability initiatives. These investments focus on sustainable architecture, supply chains, and material selection, demonstrating a shift toward eco-friendly infrastructure. Nearly half of all Greek hotels are designed to blend with the natural landscape, while 36% incorporate sustainable architectural trends. Seasonal hotels, as well as mid-to-high-end hotels, are leading in adopting sustainable design principles. Larger hotels, particularly in the 5-star category, are more likely to implement risk assessment and data measurement systems. This suggests that upscale hotels are prioritizing data-driven decision-making in their sustainability strategies.

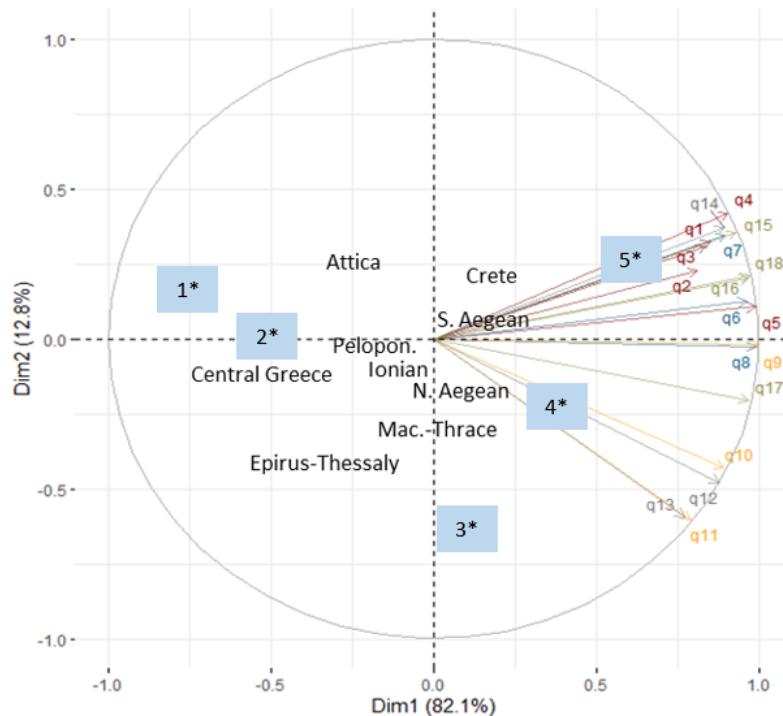


Fig. 10. MFA visualization with Region and Star Category

Multivariate analysis categorizes Greek hotels into four sustainability profiles (a) **Sustainability Pros:** High-end hotels (4-star and 5-star) with comprehensive sustainability integration, (b) **Employees-Focused Hotels:** Mid-sized hotels emphasizing staff training and engagement in sustainability, (c) **Local Boutiques:** Smaller hotels prioritizing traditional aesthetics and environmental harmony. (d) **Indifferent Hotels:** Primarily small, budget hotels with minimal sustainability adoption. While sustainability initiatives are widespread across Greece, certain regions, such as Crete and the South Aegean Islands, lead in adoption. Other areas, like Epirus-Thessaly, align more with the "Local Boutiques" category, emphasizing traditional design and local engagement. The findings indicate a positive trajectory in the Greek hotel industry's sustainability efforts, particularly among luxury hotels and well-established enterprises. However, smaller and budget hotels still face challenges in integrating ESG principles. Moving forward, policy support, incentives, and further awareness programs can help bridge the gap, ensuring that sustainability becomes a universal priority across all hotel categories.

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APPENDIX

Table 2. Research and Field Questions related to Sustainability Governance/Initiatives

Training & Awareness Programs	Sustainability Actions
q1. Energy Management q2. Recycling q3. Water Management q4. Ecology-Biodiversity q5. Local culture & Tradition q18. Sustainability guests' awareness	q6. Environment Protection q7. Preserving ecosystems and biodiversity q8. Promoting & Preserving the Cultural Heritage of the region q16. CSR actions related to environment & local community
Hotel Setup	Certifications & Risk Assessment
q9. Incorporates sustainable architectural trends q10. Harmonizes with the natural landscape q11. Follows the distinctive local character, respecting history, tradition, and people	q14. Environment/Energy/sustainability q15. Data measurement and risk factor calculation systems related to natural phenomena, climate change, biosecurity, and guest safety