

Circular Economy in the Restaurant Sector: Do Practices Go Hand in Hand?

António Melo¹, Daniel Azevedo¹, Susana Silva², Goretti Silva³, Ana Figueiredo¹ and Carla Melo¹

¹Escola Superior de Hotelaria e Turismo - Politécnico do Porto, Portugal - CiTUR - Centre for Tourism Research, Development and Innovation

²CiTUR, CEOS.PP, Escola Superior de Hotelaria e Turismo - Politécnico do Porto, Portugal

³Escola Superior de Tecnologia e Gestão - Politécnico de Viana do Castelo, Portugal - CiTUR - Centre for Tourism Research, Development and Innovation

antonio.melo@esht.ipp.pt

dazevedo@esht.ipp.pt

susanasilva@esht.ipp.pt

goretti@estg.ipv.c.pt

41190070@esht.ipp.pt

carlamelo@esht.ipp.pt

Abstract: The growing importance of sustainability has led the restaurant sector to explore circular economy practices to reduce waste and improve resource efficiency. This ongoing study examines the correlation between the adoption of one circular economy practice and the implementation of another within the restaurant sector. The study aims to identify specific practices that are related and assess the extent of these associations. A quantitative methodology was used with a survey that evaluated the adoption of 22 circular economy practices. Data collection was conducted between June and September 2023, resulting in 304 responses. Data were analyzed using SPSS version 28.0 with factor analysis employed to identify patterns of practice adoption. The results reveal that while some practices are indeed implemented together, such as energy-efficient equipment being strongly associated with monitoring energy consumption, many other practices did not exhibit significant correlations. For instance, waste reduction initiatives and water-saving measures often appeared isolated, without a consistent implementation linked to other practices. This suggests that restaurants may focus on aspects of circularity while neglecting others, indicating a fragmented rather than integrated approach. The findings point to key areas, such as waste management and energy efficiency, where more strategic interventions could encourage a holistic adoption of circular economy principles. These patterns underscore the need for further investigation into barriers that prevent cohesive practice implementation and opportunities for aligning efforts across multiple sustainability dimensions.

Keywords: Circular economy, Restaurant, Waste reduction, Water-saving

1. Introduction

In the last few years, sustainability has become a growing priority in the restaurant sector, with many establishments adopting circular economy (CE) practices to reduce waste and improve resource efficiency. This shift mirrors the increasing attention CE has garnered in research, where it is recognized as a strategy to address widespread socio-environmental issues, such as food waste, and to facilitate a sustainable transition within industries (Rabiu and Jaeger-Erben, 2022). Thus, the shift towards a sustainable and CE has gained considerable focus in recent years, especially within the food industry (Rabbi and Amin, 2024). Restaurants, and especially hotels, generate significant amounts of waste, including food waste, energy consumption, water usage (Rodríguez *et al.*, 2012), wastewater, along with hazardous materials and chemicals (Jones *et al.*, 2014).

CE practices can be adopted in hospitality settings at both the organizational and customer levels. Consequently, the implementation of these practices has been associated with promoting sustainable food production and consumption, while also encouraging sustainable behaviours (Klug and Niemand, 2021).

The CE model, which aims to extend the life cycle of products and minimize waste (European Parliament, 2023), has gained prominence as a solution to the environmental impacts of the food industry. However, the implementation of these practices in the sector is still little explored, especially about the interrelationship between different circular practices. Consequently, there is an urgent need for focused research exploring the application of circular practices to address sustainability issues (Geissdoerfer *et al.*, 2017)

This study aims to investigate the correlation between the adoption of different circular economy practices in restaurants, identifying which are often implemented together and which areas still have isolated approaches. It also contributes to the existing literature, by highlighting the areas of the restaurant sector that need strategic

interventions to promote a more holistic adoption of the circular economy and by providing insights into the factors that can facilitate the implementation of sustainable practices in a more integrated way.

This paper is structured into five sections: an introduction, a theoretical framework, methodology, presentation and discussion of results, and conclusions.

2. Theoretical Framework

A holistic approach is essential to address the challenges of building a sustainable future (Bocken *et al.*, 2014). Key elements of a pathway to a sustainable economy (adapted from Jackson, 2009) might include, among others: a system that promotes the reduction of consumption, or imposes personal and institutional limits or quotas on energy, goods, water, etc.; a closed-loop system where waste is not allowed to enter the environment, prioritizing reuse, repair, and remanufacturing over recycling; and a system that focuses on delivering functionality and experiences, rather than emphasizing product ownership.

The intricate interrelationship between the circular economy and the three critical resources - water, energy, and food - lies in the fact that food systems are considered among the most polluting, significantly contributing to greenhouse gas emissions and environmental degradation (Kamińska *et al.*, 2021). The transition to a circular economy presents a unique opportunity to foster synergies for adopting water reuse technologies, renewable energy sources, and sustainable food systems as alternatives to traditional approaches for ensuring water, energy, and food security (Naidoo *et al.*, 2021). According to these authors, adopting the principles of the circular economy in the field of water and energy is fundamental, through sanitation, renewable and clean energies, and the reuse of water. The strategy for water circularity should begin at the top of the waste hierarchy, focusing on water use reduction, and extend to the recovery of energy and materials from wastewater (Samberger, 2022). This author points out that significant energy savings can be achieved in the water sector by fully exploiting the available energy efficiency and recovery opportunities: thermal energy from wastewater can be harnessed for space heating and cooling. Malheiro *et al.* (2020) have argued that achieving cost reductions in this context can be accomplished by lowering water and energy consumption, in addition to implementing effective management systems to control these resources.

The Circularity Gap Report (Circle Economy, 2024) mentions some practices that should be implemented in the food system, namely: prioritizing satiating and healthy foods with a lower environmental impact, prioritizing the production and consumption of local, seasonal and organic products, minimizing food loss and recovering waste by following the food waste hierarchy throughout the supply chain and, at consumer level, through better transport and storage management, more refrigeration and intelligent planning and technology at consumer and food service level.

According to the Madeira Circular website, the CE practices to be implemented in the restaurant sector are: establishing a commitment against food waste by preserving food properly, working with local suppliers, making the most of food, adjusting portions, making customers aware of food waste, establishing partnerships with mobile applications to prevent food waste, establishing partnerships with social institutions and recovering organic waste; be proactive in reducing disposable packaging by eliminating disposable packaging as much as possible, reducing use from suppliers to customers and eliminating the use of plastic and single-use crockery; knowing the technologies that can support this transition and whenever possible, reuse, repair, renovate, donate, sell second-hand or recycle.

According to the AHRESP's (2021) *Guide to Good Practices for Circular and Sustainable Catering*, various sustainable practices are recommended across multiple components of restaurant operations. In terms of food and drink, some examples include creating seasonal menus, using a wide variety of plant-based ingredients, buying local produce, and adjusting portion sizes to reduce food waste. Regarding energy, the guide emphasizes practices such as minimizing the use of gas, selecting energy suppliers with environmental certification, monitoring energy consumption, and regularly maintaining equipment to ensure efficiency. In the area of water, the guide suggests using tap water where possible and avoiding washing dishes under running water, which can significantly reduce water usage. For packaging, it recommends using reusable containers and promoting the recycling of packaging provided at the establishment. As for infrastructure management, some of the suggested practices include investing in the durability of new equipment, recycling equipment that is no longer reusable or repairable, and opting for second-hand or reconditioned kitchen equipment. When it comes to consumables, the guide advises using cleaning products that carry the EcoLabel, opting for refillable products, and transitioning to electronic invoices to reduce paper consumption. With respect to transportation and suppliers, some recommended practices include sourcing fresh, seasonal products from local suppliers and using electric vehicles

for deliveries. Finally, in terms of waste management, the guide suggests practices such as recycling and composting food waste, which contribute to minimizing environmental impact.

3. Methodology

This study aims to identify specific practices in the restaurant sector that are related to each other and to assess the extent of these associations, contributing to a better understanding of the implementation of CE practices. A quantitative approach was adopted, using a survey as the data collection tool. This approach allowed for a systematic and objective analysis of the practices implemented by the participants. The population of this study consisted of restaurants located in four regions of Portugal: Coimbra, Alto Minho, Cávado and Ave, and the Metropolitan Area of Porto. The selection of participants was based on criteria of accessibility and availability to take part in the study, resulting in a sample of 304 valid responses and the data was collected between June and September 2023. The data was analysed using SPSS software version 28.0, which enabled a factor analysis to be carried out, identifying latent factors responsible for the association between the variables. All ethical procedures were strictly observed, and the participants were informed about the objectives of the study and the use of the data.

4. Results

This chapter presents the results of the study on the association between circular economy practices implemented in restaurants and other sustainable practices. The analysis was based on a correlation matrix, which reveals the relationships between various practices, such as food utilisation, waste reduction, energy efficiency, among others.

There is a strong correlation between utilisation and food management practices, namely: valuing vegetarian/vegan options ($r = 0.473$), care in plating and adjusting the portion served to the customer ($r = 0.461$), conservation and regeneration of excess production for later use ($r = 0.528$). These results suggest that practices focused on reducing waste and fully utilising food tend to be adopted simultaneously.

The purchase of local, seasonal and preferably bulk products has a strong correlation with preference for environmentally responsible suppliers: preference for suppliers with more environmentally responsible production methods ($r = 0.640$), preference for suppliers with more environmentally responsible distribution ($r = 0.599$). This suggests that sustainability practices are closely linked to the choice of suppliers that follow responsible methods.

Waste separation practices by category and quantification/valorisation of the waste generated are strongly correlated ($r = 0.566$ and $r = 0.474$, respectively), which implies that organisations that implement effective waste management often also quantify and value this waste.

There is a significant correlation between monitoring practices and optimisation of energy and water use, such as: monitoring meters and energy and water bills ($r = 0.666$), adjusting thermostats and optimising energy efficiency ($r = 0.738$). This reflects a tendency for energy and resource efficiency practices (such as water and energy) to be implemented together.

It can also be seen that there are moderate to strong correlations between sustainable product purchasing practices, such as: purchasing used or sustainable equipment and utensils and replacing equipment with more energy-efficient models ($r = 0.671$), preventive monitoring of equipment and use of energy-efficient equipment ($r = 0.584$).

As for weaker relationships, which suggest that the application of certain practices happens in isolation, the practice of sending surplus production to social support institutions showed weaker correlations with other practices, which suggests that this may be an isolated practice. The provision of filtered tap water in the space also showed weak correlations with other practices, suggesting that it is not strongly associated with other environmental practices in a consistent way.

5. Discussion and Conclusions

The literature review emphasizes the importance of reducing consumption and waste as a part of a CE (Bocken et al., 2014; Jackson, 2009). The results from this research show a strong correlation between practices that aim to utilize food more efficiently and reduce waste, such as adjusting portion sizes, valuing vegetarian/vegan options, and regenerating excess production for later use. Specifically, the high correlations suggest that these practices are being adopted together, reflecting a holistic approach to waste reduction and food management,

as suggested by Bocken et al. (2014). This aligns with the literature's emphasis on minimizing waste and optimizing resource use in a closed-loop system (Kamińska et al., 2021).

Practices related to food waste, such as utilising all parts of food and regenerating excess production, tend to be correlated with conscious use of resources, which suggests an integrated approach to sustainability.

Energy and water management is another axis with strong correlations, indicating that monitoring and optimisation practices are often adopted in a coordinated manner, supporting the idea that resource efficiency is a primary component of sustainability in the sector. These results reflect the principles put forth by Samberger (2022) and Malheiro et al. (2020), who emphasize the importance of energy and water efficiency as central to the CE.

In summary, CE practices, especially those related to food recovery and efficient resource management, are often associated with a range of other sustainable practices within the organizations analysed. The implementation of one practice, such as optimizing food utilization or energy efficiency, appears to facilitate the adoption of other related practices, creating a virtuous cycle of sustainability. This observation resonates with the literature's emphasis on an interconnected system that fosters sustainable practices across multiple dimensions (e.g., food, energy, water), as outlined by Naidoo et al. (2021) and Circle Economy (2024).

References

- AHRESP & Turismo de Portugal (2021) *Guia de boas práticas para uma restauração circular e sustentável*. Lisbon: Turismo de Portugal. Available at: <https://business.turismodeportugal.pt/SiteCollectionDocuments/sustentabilidade/guia-boas-praticas-para-restauracao-circular-e-sustentavel.pdf>
- Bocken, N., Short, S., Rana, P., and Evans, S. (2014) 'A literature and practice review to develop sustainable business model archetypes'. *Journal of Cleaner Production*, 65, pp. 42 – 56. Available at: <https://doi.org/10.1016/j.jclepro.2013.11.039>
- Circle Economy (2024) *The Circularity Gap Report 2024*. Amsterdam: Circle Economy. Available at: <https://www.circularity-gap.world>
- European Parliament (2023) *Circular economy: definition, importance and benefits*. Available at: <https://www.europarl.europa.eu/topics/en/article/20151201STO05603/circular-economy-definition-importance-and-benefits> (Accessed: 7 November 2024).
- Geissdoerfer, M., Savaget, P., Bocken, N., and Hultink, E. (2017) 'The Circular Economy – A new sustainability paradigm?'. *Journal of Cleaner Production*, 143, pp. 757 – 768. Available at <https://doi.org/10.1016/j.jclepro.2016.12.048>
- Jackson, T. (2009) *Prosperity without Growth: Economics for a Finite Planet*. London: Earthscan.
- Jones, P., Hiller, D., and Comfort, D. (2014) 'Sustainability in the global hotel industry'. *International Journal of Contemporary Hospitality Management*, 26(1), pp. 5 -17. Available at: <https://doi.org/10.1108/IJCHM-10-2012-0180>
- Kamińska, A., Bajan, B., Pawłowski, K., Genstwa, N., and Zmyślona, J. (2021) 'Greenhouse gas emissions intensity of food production systems and its determinants'. *PLoS ONE*, 16(4) :e0250995. Available at: DOI: 10.1371/journal.pone.0250995
- Klug, K., and Niemand, T. (2021) 'The lifestyle of sustainability: Testing a behavioral measure of precycling'. *Journal of Cleaner Production*, 297, 126699. Available at: <https://doi.org/10.1016/j.jclepro.2021.126699>
- Madeira Circular (n.d.) *Fechar o Ciclo e Nas Empresas*. Available at: <https://madeiracircular.madeira.gov.pt>
- Malheiro, M., Sousa, B., Liberato, D., and Liberato, P. (2020) 'Sustainability in Tourism And Hospitality: Trends And Challenges'. Available at: <https://www.researchgate.net>
- Naidoo, D., Nhamo, L., Lottering, S., Mpandeli, S., Liphadzi, S., Modi, A., Trois, C., and Mabhaudhi, T. (2021) 'Transitional Pathways towards Achieving a Circular Economy in the Water, Energy and Food Sectors', *Sustainability*, 13(17), 9978. Available at: <https://doi.org/10.3390/su13179978>
- Rabbi, M., and Amin, M. (2024) 'Circular economy and sustainable practices in the food industry: A comprehensive bibliometric analysis', *Cleaner and Responsible Consumption*, 14, 100206. Available at <https://doi.org/10.1016/j.clrc.2024.100206>
- Rabiau, M., and Jaeger-Erben, M. (2022) 'Appropriation and routinisation of circular consumer practices: A review of current knowledge in the circular economy literature', *Cleaner and Responsible Consumption*, 7, 100081. Available at: <https://doi.org/10.1016/j.clrc.2022.100081>
- Rodríguez, J., Almeida, M., Celemin, M., and Rubio, L. (2012) 'Use of different sustainability management systems in the hospitality industry. The case of Spanish hotels', *Journal of Cleaner Production*, 22(1), pp. 76 – 84. Available at: <https://doi.org/10.1016/j.jclepro.2011.09.024>
- Samberger, C. (2022) 'The role of water circularity in the food-water-energy nexus and climate change mitigation'. *Energy Nexus*, 6, 100061. Available at: <https://doi.org/10.1016/j.nexus.2022.100061>