

A Work Project, presented as part of the requirements for the Award of a Master's degree in  
International Management from the Nova School of Business and Economics.

TOURISM AS A CATALYST FOR MADEIRA ISLAND'S ZERO-WASTE TRANSITION

JOANA INÊS DE ARAÚJO  
TANQUE

Work project carried out under the supervision of:

Graham Miller

17/12/2024

## **Abstract**

This study explores how tourism can drive Madeira to become a Zero Waste Island. Through a mixed-methods approach, including 21 structured interviews and a survey, findings reveal the potential of tourism to drive Zero Waste initiatives, positioning it as a model for the island. Tourism's influence extends beyond economic contributions, inspiring sustainable waste practices among residents and industries. Key strategies for the successful implementation of Zero Waste were identified, and associated challenges were addressed. This research advances the understanding of Zero Waste as a framework within tourist islands, offering actionable insights to drive sustainable development in Madeira and similar destinations.

***Keywords:** Sustainable Tourism, Madeira Island, Tourism Management, Zero Waste, Circular Economy, Waste Management*

## **Acknowledgements**

I want to thank my advisor, Graham Miller, for helping me pursue a topic which speaks so much to my heart: Madeira Island, my home, the place I will always return to. I am deeply proud to be from this island, and it brings me immense joy that this paper contributes to making it an even better place. To my friends and colleagues, who have been integral to my academic journey, thank you for living it all with me. To my family, thank you for your precious support and love throughout this process: Diogo, my biggest fan and best friend; my sisters, whom I am so proud of; and my parents, to whom I owe the world.

This work used infrastructure and resources funded by Fundação para a Ciência e a Tecnologia (UID/ECO/00124/2013, UID/ECO/00124/2019 and Social Sciences DataLab, Project 22209), POR Lisboa (LISBOA-01-0145-FEDER-007722 and Social Sciences DataLab, Project 22209) and POR Norte (Social Sciences DataLab, Project 22209).

**Table of Contents**

*1. Introduction* ..... 2  
*2. Literature Review* ..... 3  
*3. Contextual Background* ..... 7  
*4. Methodology & Results* ..... 10  
*5. Discussion* ..... 19  
*6. Conclusion* ..... 24  
*7. References* ..... 26  
*8. Appendix* ..... 38

**1. Introduction**

“Madeira – Sustainable for All” has been the motto of Madeira Island as a tourist destination since 2022 (Jesus 2023). But is it all that sustainable?

Since the COVID-19 pandemic, Madeira has been experiencing a surge in tourism, hitting record numbers in 2023 with 2.1 million visitors – a 32% increase compared to 2019 (DREM, 2024). While some argue that Madeira is still far from experiencing overtourism (Teixeira and Ribeiro 2019; Majdak, Almeida and Mosz 2022), others have highlighted issues such as overloaded infrastructures and tourist sites, rising cost of living, environmental degradation and increased waste and pollution (Luís 2024; Majdak, Almeida and Nowakowska 2021).

Although tourism is crucial for the region’s economy, accounting for 28.8% of the Gross Domestic Product (GDP) and 17% of employment (DREM 2022), it also generates 41.9% to 46.6% of the solid waste produced per resident (Martins and Cró 2021). As such, the rise in waste generation driven by growing tourism and the resulting pressure on waste management systems (WMS) is a significant threat to Madeira (DMO 2024). Adding to these concerns is the current municipal solid waste (MSW) management system, which is heavily dependent on incineration (82% in 2023). The incinerator has reached its full capacity as of 2024, while the recycling rate remains low at just 13% (SRAPA and DRAM 2024; Ribeiro 2024).

As one of Madeira’s key sectors and a significant contributor to waste generation, tourism holds substantial potential for driving change, especially due to its economic and social

influence. Transforming tourism waste practices could inspire industries, businesses, and residents to adopt similar approaches, paving the way for Madeira to become a “Zero-Waste” (ZW) island. Rooted in the circular economy, ZW requires systemic changes across production, consumption, and the WMS, with coordinated efforts from all sectors. While tourism alone cannot achieve this ambitious goal, it can potentially lead the transition.

Studies have established a positive correlation between tourism and increased MSW generation, with tourists’ producing more waste per capita than residents (Mateu-Sbert et al., 2013; Rodríguez, Florido and Jacob, 2020). Improper waste management leads to irreversible consequences, and managing such systems on tourist islands presents added challenges (Ezeah, Fazakerley, and Byrne 2015). While ZW strategies have mainly targeted urban areas (Pietzsch, Ribeiro and Medeiros 2017; Simon, McQuibban, and Condamine 2020; Shenyoputro & Jones 2023; Dileep 2007), efforts to adapt ZW to islands remain limited to a few cases (Gourgoura 2024; Rosa 2018). Tourism has been shown to aid the transition toward a circular WMS in small islands (Ferronato et al. 2023); however, no research has examined how tourism can drive the implementation of ZW and reshape the WMS and residents’ behaviours on tourist islands like Madeira. This study aims to fill this gap.

Research objectives include examining the current state of tourism and waste management in Madeira, assessing tourism’s potential to drive ZW initiatives, and identifying effective strategies to achieve it. The methodology adopted a mixed-methods approach, integrating stakeholder interviews for qualitative insights and a tourist survey for quantitative analysis.

## **2. Literature Review**

As the state of the world progressively deteriorates, with six out of nine planetary boundaries exceeded, it becomes crucial to address the root cause: the models of human society (Richardson et al. 2023). Emerging frameworks aim to shift paradigms, with tourism,

a major and growing industry, playing a key role in contributing to and mitigating environmental impacts. This section examines these frameworks and their potential gaps.

Sustainable tourism emerged in response to growing environmental pressure at tourist destinations. Essentially, it addresses the needs of tourism stakeholders while safeguarding the long-term viability of the sector and the environment (Yang et al. 2023). Sustainable tourism and waste management are closely linked, as ineffective waste handling undermines tourism sustainability (Joseph, Kallarakal and Varghese 2020). While a popular concept, some argue that the unclear measurement criteria (Liu 2003; Mika 2015), the lack of incentives to adopt (Fuchs 2023), and resistance to limit consumption in tourism (Mika 2015), create barriers to implementation. Research lacks depth in exploring practical applications, with neither visitors nor the sector fully embracing it (Yang et al. 2023).

Regenerative tourism surfaced to address the limitations of sustainable tourism development (Bellato, Frantzeskaki, and Nygaard 2022). It goes beyond traditional sustainability by revitalising the destination's community, nature and economy rather than merely preserving the status quo. It is not another type of tourism, but a holistic approach aimed at repairing past damage while improving systems (Amorim et al. 2023). Its key principles include place-specific and bottom-up strategies, leveraging local assets, and promoting community involvement (Holliday and Reed 2021; Bellato, Frantzeskaki, and Nygaard 2022; Dredge 2022). However, critics argue that the concept lacks an economic foundation for developing resilient communities (Cave & Dredge 2020).

This concept is closely linked with circular economy (CE) principles, which aim to “keep products and materials in circulation for as long as possible through activities such as maintenance, reuse, refurbishment, remanufacturing, recycling, and composting” (ESCAP 2024), ultimately eliminating waste. There is a growing interest in incorporating CE into tourism research, especially in waste management, though it is still in its early stages (Kabil

et al. 2024). Most studies remain centred on micro-level perspectives, namely hotels and restaurants (Renfors 2023), while the integration of CE within the broader industry is limited and far from a complete transition to this model (Rodríguez, Florido and Jacob 2020).

Although fundamentally different, the latter concepts overlap in several aspects. The following section will explore how these ideas apply to tourist island destinations.

Research highlights the interdependent relationship between waste and tourist islands, which face unique challenges, including geographic isolation, transient populations, reliance on imported goods, and a tourism-driven economy (Ezeah, Fazakerley, and Byrne 2015; Koliotasi, Abeliotis, and Tsartas 2023; Santamarta et al. 2014; Singh et al. 2023). Such difficulties have led to a reliance on incineration and landfills (Ferronato et al. 2023).

The EU Waste Framework Directive prioritises waste prevention, followed by recycling, incineration, and finally landfilling (European Union 2024). Some studies show that incineration poses minimal health or environmental risks (De Titto and Savino 2019; Reis et al. 2004) and does not substitute recycling but rather supports it by handling non-recyclable waste (Bandarra et al. 2021). However, a larger body of literature argues against this. Critics highlight that Waste-to-Energy incineration produces higher carbon emissions than the EU's electricity grid and requires a constant waste supply, discouraging waste reduction (Vähk 2019). Moreover, incineration depletes resources that could otherwise be recovered, limiting material circularity (Berkemeier and Fonseca 2019; Potting et al. 2017). A long-term solution could require zero-incineration and zero-landfill systems (Zaman 2013). Proposed strategies include tailored waste management, preserving on-island material stocks to reduce imports, door-to-door collection, Extended Producer Responsibility (EPR), and eco-taxes (Ezeah, Fazakerley and Byrne 2015; Santamarta et al. 2014).

What role can tourism play in this? While tourists often feel disconnected from waste issues (Chen, Ruijs, and Wesseler 2005), studies found that tourism can aid the transition

toward a circular WMS through projects funded by tourist taxes (Ferronato et al. 2023). MSW collection can remain high with increased visitors (Rada, Zatelli, and Mattolin 2014), but reducing MSW as tourism grows remains a challenge. Tourism's impact on waste is complex: early increases raise waste, but after a certain stage, technological innovations and changes in tourism policies can lead to waste reductions (Martins and Cró 2021).

One widely proposed innovation is adopting a ZW approach (Ezeah, Fazakerley, and Byrne 2015; Martins and Cró 2021). A peer-reviewed definition describes ZW as preserving resources through “responsible production, consumption, reuse, and recovery” – banning incineration or discharges that harm the environment or human health (Simon, McQuibban, and Condamine 2020). From a linear to a circular WMS, it demands a complete elimination or a substantial reduction of waste generation. Besides the environmental benefits, ZW strengthens communities, the economy, and industries – much like a regenerative system. It fosters citizen engagement, reduces disposal costs, and enhances resilience (Pietzsch, Ribeiro, and Medeiros 2017; Simon, McQuibban, and Condamine 2020).

This concept is gaining traction in the tourism industry (Rojabi, Saufi, and Diswandi 2020). A standout success is Tilos, which became the first certified ZW island in 2023. Heavily reliant on tourism (Kaldellis 2021), Tilos achieved a 43% reduction in MSW generation and a 94% recycling rate in just two years, strengthened community ties, and enhanced its appeal as a destination (Gourgoura 2024). Sardinia is another notable example (Rosa 2018), though its progress has been slower and less pronounced, likely due to its larger size and population. Both cases suggest that ZW in tourist islands can be successful.

As with any disruptive model, ZW faces political and cultural barriers and stakeholder resistance (Pietzsch, Ribeiro, and Medeiros 2017; Gourgoura 2024). ZW initiatives often fail due to underestimating the changes needed and an overreliance on end-of-pipe solutions rather than behavioural and systemic changes (Krausz 2012). Thus, success criteria include

product redesign, prohibiting harmful materials, education initiatives for both residents and tourists, and long-term planning (Krausz 2012; Pietzsch, Ribeiro, and Medeiros 2017; Simon, McQuibban, and Condamine 2020). A ZW guide for islands recommends reducing waste to lower shipping expenses of recyclables and managing biowaste locally (Simon, McQuibban, and Condamine 2020). However, gaps persist in understanding how to adapt these strategies to local contexts (Linglin, 2024; Pietzsch, Ribeiro, and Medeiros, 2017).

To the best of the author's knowledge, no research has yet been done on how tourism can drive the adoption of ZW within a tourist destination, influencing the WMS and residents' behaviours, especially within Madeira's context. This study focuses on addressing that gap.

### **3. Contextual Background**

#### **3.1. Madeira Island Overview**

Madeira, a Portuguese island classified as one of the EU's Outermost Regions, lies 978 km southwest of Lisbon in the Atlantic Ocean (De Almeida 2016). Its archipelago covers an area of 800 km<sup>2</sup> and has a population of roughly 256,000 on its two inhabited islands, Madeira and Porto Santo. Madeira's population density is three times higher than the national average, especially in southern municipalities (DREM 2024).

Its economy is strongly dependent on the service sector, particularly tourism. Key agricultural products include bananas, wine and sugar cane. The region is recognised for its rich natural diversity, featuring an endemic flora and a Mediterranean climate. Artisanal fishing, embroidery and folk dances are part of its vibrant culture (DMO 2024a).

#### **3.2. Tourism in Madeira**

As one of the world's oldest tourist destinations, Madeira has been renowned for its hospitality since the 15th century (Vieira 2008). Today, the region is highly dependent on tourism, representing 28.8% of GDP and 17% of employment (DREM 2022). Madeira, honoured as the "World's Leading Island Destination" for ten consecutive years

(Hugo 2024), achieved the EarthCheck Silver Certification for sustainable destinations in 2023 (Lusa 2023). At the same time, 2023 was a record-breaking year with 2.1 million guests, alongside increased revenue and tourist density (DREM 2024). In 2024, tourism in Madeira continued to break records monthly (Cardoso 2024), showing no signs of slowing down.

While Madeira has not yet reached the point of overtourism, there are exceptions and emerging signs of concern (Teixeira & Ribeiro 2019; Majdak, Almeida and Mosz 2022; Majdak and Almeida 2022), including strained infrastructure and tourist sites, environmental degradation, the rising cost of living for residents and increased waste generation (Luís 2024; Majdak, Almeida and Nowakowska 2021). As such, local authorities have set limits on “traditional” accommodation capacity to 40,000 beds until 2027 and dispersed tourists from the capital city to rural areas (Majdak and Almeida 2022). In addition, a waste collection fee and capacity limits for nature trails will be introduced in 2024 (Rodrigues 2024; Livramento 2024), as well as a tourist tax of two euros per night in municipalities (Lusa 2024).

### **3.3. Waste Management in Madeira**

Águas e Resíduos da Madeira (ARM) manages MSW treatment, sharing waste collection with six non-member municipalities. Treatment facilities include an incinerator, landfills, and a composting facility. The incinerator, operational since 2003, treats up to 126,000 tons annually and generates electricity (75% fed into the grid), with the resulting ash sent to landfills. On average, municipalities pay 82.5€ per ton to incinerate waste (ARM 2023). The composting facility processes green waste, distributing compost free of charge. Recyclable materials are sent to mainland Portugal for recovery (Pedro et al. 2023).

In 2023, Madeira’s MSW peaked at 124,299 tons, averaging 484 kg per capita (Appendix 2). Of this, 82% was incinerated, 13% recycled, 4% composted, and 1% sent to landfill (Appendix 3). MSW comprised 87% mixed waste, all incinerated, and 13% recyclables (Appendix 4). Mixed waste primarily comprised biowaste (48%) and recyclables (31%),

indicating potential for improved separation (Appendix 5). Additionally, the plastic collection had a contamination rate of 37% (SRAPA and DRAM 2024).

ARM's main challenges include high costs, limited scale, complex territory, and coordination with municipalities (Pedro et al. 2023). These obstacles hinder the progress of Madeira's 2035 MSW goals – 25% selective collection, 50% preparation for reuse and recycling, and 1.2% landfill usage – which currently fall short of EU targets. In 2023, these stood at 12.5%, 23.8%, and 0.1% respectively. The primary focus should be reducing overall MSW generation alongside increasing recycling rates (EEA 2022). This urgency arises as the incinerator, operating at 105% capacity in November 2024, is strained by rising tourism. Adding a third incinerator line was proposed, a costly investment (Ribeiro 2024).

### **3.4. Link Between Tourism and Waste in Madeira**

Tourism accounts for 41.9% to 46.6% of the solid waste generated per resident in Madeira (Martins & Cró 2021). Due to the high influx of visitors, irregular waste disposal has been observed, particularly in the island's most popular tourist areas (Hugo 2024).

Tourism drives increased waste generation up to a turning point, which in Madeira is 2.12–2.32 million lodged guests (Martins & Cró 2021). With 2.1 million visitors in 2023 and numbers rising, waste could decrease if appropriate measures are adopted.

The DMO has launched several strategies, including a Regional Environmental Fund and four Green Teams to engage the community (DMO 2022). However, a recent study on CE practices in Madeira's tourism sector reveals a limited yet growing adoption. While basic recycling efforts exist, comprehensive CE initiatives remain constrained by financial costs and bureaucratic complexity (Almeida et al. 2024). As such, recommendations for Madeira's WMS include tourist charges reflecting the full cost of MSW management (Martins & Cró 2021) and Pay-As-You-Throw (PAYT) systems, in which fees are based on the generation of mixed waste. This approach is particularly relevant since current tariffs are tied to water

usage rather than waste production (Alves, Silva, and Soares 2020).

#### 4. Methodology & Results

Qualitative and quantitative methods were employed to analyse stakeholders' and tourists' perceptions regarding tourism and ZW initiatives in Madeira, as well as best practices from Tilos ZW Island. While both approaches were integrated to offer richer insights and enhance the study's relevance to various stakeholders (Maxwell 1998; Verhoef and Casebeer 1997), most conclusions are based on qualitative research, which was more extensive and detailed.

##### 4.1. Qualitative Method

Semi-structured interviews were conducted online and in person, following a guide aligned with the research objectives (Appendix 6 and 7). Open-ended questions encouraged participants to reveal their perspectives, an effective approach for gaining deep insights into complex issues (Ruslin et al. 2022). A total of 18 participants, all current or former residents of Madeira, were interviewed to provide insights about the island, along with 3 participants involved in the Tilos Island ZW project, who shared best practices.

*Table 1: Interview Participants*

Name	Profession/Position	Institution
David Andrade	Hotel Manager in Madeira	Hotel Sentido Galomar
Miguel Medeiros	Hotel Manager in Madeira	Hotel Pestana Royal Premium
Raul Gonçalves	Hotel Manager in Madeira	Hotel Quinta da Serra
António Almeida	President of Madeira's Tourism Observatory	University of Madeira
João Lemos	Researcher and PhD in the field of tourism	N/A
Lúis Araújo	Ex-President of Tourism of Portugal	Turismo de Portugal
Tomás Ramos	Professor of Sustainability Assessment and Planning	NOVA University of Lisbon
Pedro Freitas	Senior Technician in the Regional Tourism Office	Madeira's Regional Government
Manuel Ara	Regional Director of the Environment And Climate Action	Madeira's Regional Government
Manuel Filipe	President of the Institute of Forests and Nature Conservation	Madeira's Regional Government
Célia Pesseguero	President of Ponta do Sol Municipality	Madeira's Regional Government
Ricardo Nascimento	President of Ribeira Brava Municipality	Madeira's Regional Government
Nélia Gonçalves	Vice-President of ARM	ARM
Rui Rodrigues	Vice-president of cultural and environmental association	RETOIÇA, Madeira
Elsa Araújo	President of environmental NGO's Centre of Madeira	QUERCOS
António Rodrigues	Ex-President of environmental NGO in Madeira	COSMOS
Maria Fernandes	Owner of 3 Airbnb Properties in Madeira	N/A
Catherine Cahu	Tourist Restaurant Manager in Madeira	Manifattura Di Gelato
Maria Kamma	Mayor of Tilos Island	Government of Tilos
Ismael Rienda	Zero Waste Auditor for Tilos Island	Zero Waste Europe
Athanasios Polychronopoulos	CEO	Polygreen (Tilos ZW Project)

At this point, information saturation was reached, a commonly used criterion for determining sample size (De Souza Minayo 2017). Explicit consent was obtained for transcription, done with AI software. The chosen method to analyse interviews was thematic analysis, given its flexibility and theoretical freedom (Herzog, Handke and Hitters 2019). The process began with deductive coding, based on the interview guide's main themes, and expanded to inductive coding as new themes emerged. This hybrid approach produced five main codes for interviews about Madeira, and three for Tilos (Appendix 8). The Delve software was used to organise codes and transcript excerpts, aiding in their categorisation.

#### **4.1.1. Results**

The first five sections focus exclusively on interviews about Madeira, while the final section explores Tilos' journey as the first ZW island and its best practices.

##### ***Current State of Tourism***

Madeira's strong dependence on tourism and a growing younger tourist base were noted. Tourists were seen as valuing environmental practices and willing to pay more for eco-certified accommodations. They often inquired about waste disposal options. However, concerns arose that younger, budget-conscious tourists showed less awareness.

Despite tourism's success in raising revenue, especially for local businesses, there was an "excess of success" in the promotion of a few locations, resulting in increased traffic, waste, and strain on local resources, negatively affecting residents' lives. Additionally, the unregulated growth of local accommodations (Airbnb) seemed to contribute to a decline in service quality. Tourism stakeholders unanimously acknowledged a significant increase in tourism intensity but differed on whether it was excessive. Some stated, "Over-tourism, not yet. Heavily overloaded areas, yes", while others cautioned, "We are at the saturation point, the 4th phase of Butler's model, and decline will soon follow". A "disconnect between Madeira's certification as a sustainable destination and the reality on the ground" was also

noted, with a hotel manager implying “No one discussed tourism sustainability with me or the hotel”. To address the rise in tourism, a waste tax was introduced on popular nature trails, alternative trails were promoted, and a tourist tax of 2 euros per night was introduced. Additionally, incinerator facilities were prepared for capacity expansions.

### ***Current State of Waste Management***

The general opinion on MSW management was positive, indicating that waste was largely collected, urban spaces remained clean, and “most needs are covered”. However, the waste tariff was criticised for being linked to water consumption rather than waste production.

The multi-municipal WMS was a topic of debate. While ARM-managed municipalities could reduce administrative burdens and enhance access to EU funds, some experienced fewer collection points, longer waste collection time, and higher MSW fees than non-adherent municipalities, which reported greater flexibility and responsiveness to residents.

Despite expressing uncertainty about the current WMS, most identified incineration as the primary method for MSW treatment. Some regarded it as an “excellent solution,” noting that it “produces energy from waste, reduces the resulting product to nearly zero, and eliminates the need for landfilling”. Additionally, this system was deemed capable of absorbing all MSW and relatively low in emissions, which have been monitored and “continue to have reasonable levels”. However, many viewed the incinerator as a barrier to adopting sustainable solutions, criticising its environmental impact and questioning its classification as renewable energy. Alternatively, ARM’s composting centre for green waste was praised for “working well and clearing the stock”. Nonetheless, gaps were noted in solutions for bio-waste and construction material disposal, as well as repair centres. The negative impact of waste on quality of life was largely acknowledged, emphasising the need for proactivity and a focus on waste reduction: “We urgently have to produce less waste”.

### ***Barriers to Sustainability and ZW in Madeira***

**Social:** Cultural resistance, scepticism, individualistic attitudes and low environmental awareness, stood as barriers: “The biggest challenge is sometimes not the resources we use, but the people. Not everyone has the same environmental consciousness”. Composting initiatives faced resistance, as many hesitated to use ARM’s compost due to concerns about its quality. Many residents lacked proper waste separation practices, often placing all waste in one bag or failing to flatten recyclables. Additionally, improper disposal of bulky and hazardous waste was identified, alongside high contamination rates. Consumerism stood out, with a growing reliance on imported goods, impulsive purchases, and excessive packaging contributing to rising waste volumes. Items were mostly replaced rather than repaired. Finally, a gap in public awareness and education on waste management was observed.

**Economic:** Madeira’s linear economy stood as a barrier, with rising production and consumption driving up waste and excessively packed products designed with planned obsolescence. Efforts to reduce packaging in the hotel industry often faced logistical and cost-related obstacles with suppliers, as “there isn’t always much willingness to cooperate”. Economic growth is prioritised in Madeira, particularly within tourism, limiting shifts toward sustainable practices: “We place the economy above the environment and above people. And this is wrong; there’s still much to do to reach a CE”. Financial limitations also hindered innovation, as radical sustainable practices often required substantial investments. Establishments faced time and space constraints, with busy schedules leading to improper disposal and limited space for recycling bins hindering waste management. Tourism growth, Madeira’s main economic driver, raised concerns over the island’s ecological limits and waste management. In a mature market with diverse visitor expectations, implementing radical sustainable measures could prove complex due to uncertain tourist enthusiasm.

**Geographical:** Madeira’s steep landscape made transportation and waste collection complex and costly, particularly in remote areas. Import reliance added to these constraints,

as most goods had to be shipped to the island. These came with substantial plastic packaging, as food safety during transport remained challenging.

**Current WMS:** Experts observed that reliance on incineration, a costly investment, creates a lock-in effect that limits funds for alternative solutions, often cheaper and more sustainable. The incinerator is “perverse” given its dependency on a steady waste supply to remain viable, discouraging efforts to reduce waste production. Concerns were raised that this reliance led to complacency, with residents assuming that all waste would ultimately be burned, reducing motivation for separating or minimising waste. One alternative, composting, was regarded as complex, facing issues such as limited scalability.

**Government:** The governance of Madeira’s WMS was seen as lacking ambition and effective action, given that “the government has unilaterally set Madeira’s targets at half of the European standards”. Still, government officials expressed scepticism about meeting such targets due to “stagnation” in the area of MSW. Moreover, insufficient regulation and monitoring in this area allowed establishments to operate with minimal accountability. Business owners faced no restrictions on waste production if they paid the fees, and no system was in place to recognise or enforce good environmental practices. Additionally, authorities’ insufficient communication efforts and absence of coordination left residents unaware of waste management, resulting in limited adoption of sustainable practices.

### ***Zero Waste Perceptions***

**Current Practices:** Funchal offers door-to-door waste collection, and most hotels reported eliminating plastic and monitoring food consumption. However, “Madeira is far from being sustainable”, not fully conforming with a CE. Insufficient waste reduction efforts and educational projects and a lack of targeted initiatives for tourists were reported.

**Relevance to Madeira:** ZW was seen as highly relevant and potentially transformative, with a sustainability expert stating, “For a land as insular as ours, zero is the topic.” With

unique natural resources and limited land, Madeira must strive to implement a CE. Given that the EU requires these actions, “ZW is both beneficial and mandatory in the long-term”.

**Benefits:** Reduced waste generation leads to fewer emissions from transportation and collection while reducing landfill and incinerator use. In terms of tourism, becoming a ZW destination would boost Madeira’s appeal to eco-conscious tourists. Hotel managers also noted that “financially, our sustainable efforts have been fully compensated by increased demand and higher rates we can charge”, indicating a high return for these investments.

**Tourism as a driver:** Tourism was widely seen as a critical driver for ZW in Madeira. A tourism stakeholder remarked, “The tourism sector is the driving force behind sustainable practices. It is no coincidence that Madeira’s sustainability certification came from the tourism board”. Tourism’s high visibility and influence could inspire sustainable behaviours across the island. Another tourism expert noted, “In Madeira, deciding whether to start with residents or tourism is difficult. But by beginning with tourism collaborators, you can easily reach the population – almost everyone here is connected to tourism in some way”. As tourism-related businesses implemented sustainable practices in response to eco-conscious tourists, these efforts could encourage residents to adopt similar behaviours. To drive change, “Madeira needs to strike in three areas: tourism collaborators, residents and tourists”. However, concerns were expressed about relying solely on tourism, possibly neglecting the engagement of residents and the impact of a multi-sector approach: “We cannot think solely of tourism; ZW won’t succeed, as it is just one part of the equation”.

**Barriers & Critiques:** Full adherence to ZW was considered ambitious and difficult to achieve due to Madeira’s WMS and the large daily waste volume. Setting high reduction and recycling targets was deemed “completely unrealistic and demotivating”. Additionally, ZW’s ecological impact was questioned; even with robust recycling, the island’s need to ship materials contributed to a considerable carbon footprint, given the lack of a market for

recycling infrastructure. Critiques extended to the term itself, with some arguing that ZW was “theoretically and practically limited” and “misleading, as ZW makes people feel it’s unachievable”, thus better framed within the broader theme of CE. Others emphasised the potential burden on tourism, with concerns about ZW not aligning with market dynamics.

### ***Required Shifts for Zero Waste***

**Social:** Consumers (residents and tourists) would need to consider the environmental impact of their purchases and focus on reducing waste at the source. Local associations play crucial roles in driving this behavioural change, and civic responsibility would be essential.

**Collaborative action and learning:** Information dissemination, coordination, and community engagement could effectively tackle the island’s waste challenges. Collaboration between the public and tourism sectors was encouraged to leverage local knowledge and align regulations. Successful examples of ZW destinations suggest learning opportunities for Madeira: “Authorities should visit successful islands to become aware and inspired to change their policies”. Additionally, access to contact and knowledge networks should be facilitated.

**Government interventions:** Regulation imposing waste production limits must be adopted, alongside enforcement and monitoring. A system similar to the HACCP was proposed, evaluating operators’ waste practices, providing recommendations, and imposing fines. A balance between penalties and rewards was suggested, such as discounts on utility bills and PAYT, as well as financial aid and programs supporting innovation. Moving toward a CE would be crucial, reducing dependency on imported goods and enhancing local production. However, “many issues could be resolved with simple, small-scale solutions”: for instance, at large events, vendors could pay a refundable deposit for proper waste management. Regarding the WMS, decentralisation was favoured to address community issues, with a balanced approach: localised waste campaigns, collection, and smaller-scale treatments alongside centralised processing and sorting infrastructure. Community

composting was proposed for remote areas to eliminate bio-waste transport, like Porto Santo, set to pilot this approach. Educating residents on compost quality and securing proper certification could grow its demand. Door-to-door collection with waste weighing was recommended, as well as reducing reliance on incineration to focus on composting, sorting, and repair facilities. However, legislation alone would be insufficient. Targeted communication to change behaviour, such as media campaigns promoting simple practices and emphasising health, environmental, and financial benefits, should be implemented: “Unfortunately, it’s easier to get through to them by showing how much they’ll save”.

### ***Tilos ZW Island – best practices***

Tilos’ ZW journey was initiated and funded by a private company, standing on four pillars: initial assessment, public engagement, infrastructure development and collaboration. It took six months to transition from incineration to a composting and recycling-focused system. Initiatives included door-to-door collection, an app to track waste production, business incentives, and information/tools for residents and tourists. Initially met with scepticism, the transition was eased through regular communication. Tourism served as a catalyst for promoting ZW, driving visitors to positively contribute and to “view Tilos as a unique travel destination”. Still, challenges were faced in maintaining stakeholder engagement, managing non-recyclable shipments off the island, and scaling to meet growing tourism demands. Despite its larger scale, Madeira was considered “highly capable” of transitioning into a ZW island, especially given ZW Europe’s flexible goals for tourist islands. Recommendations include conducting a waste audit, engaging the public, establishing partnerships to share expertise and costs, and emphasising the economic and ecological benefits for public support. A tailored solution would be essential.

## **4.2. Quantitative Method**

A survey targeting tourists evaluated their perceptions of Madeira’s WMS and willingness

to support ZW initiatives (Appendix 9). Hosted on Microsoft Forms, it was distributed through online networks and displayed at three prominent tourist sites and two hotels in Madeira. Sixty participants responded, all of whom had visited Madeira at least once.

Respondents came from 18 countries, mainly within Europe (88%). Most were aged 18-29 (67%), highlighting a largely younger base. Additionally, 65% of respondents were visiting Madeira for the first time, and 65% stayed in apartments or Airbnb. Chi-square tests were conducted in the Jamovi platform to identify statistically significant associations between variables, which were analysed by examining contingency tables (Appendix 10).

#### **4.2.1. Results**

During their stay in Madeira, most tourists (62%) noticed some waste reduction efforts and a minority (38%) noticed none. Regarding the ease of separating waste and finding recycling bins, mixed experiences were reported. Most accommodations (70%) did not provide information about waste management (e.g., sorting, composting, recycling), with only 30% of respondents receiving it. The most chosen measures to reduce waste were special equipment for proper separation (21%), elimination of single-use plastics (20%), and providing information on how to separate waste (19%). Other options included mandatory taxes (12%) and financial benefits (9%). All respondents expressed willingness to take actions to reduce waste, and 73% indicated that Madeira being a ZW island would make it more appealing as a destination, while 27% stated it would not change their perception.

#### ***Chi-Square Analysis of Associations***

Visitors who received waste management information at their accommodation were significantly more likely to notice waste reduction efforts and perceive waste separation and recycling as easier. First-time visitors were significantly less likely to notice waste reduction efforts, find separation and recycling easy or receive waste management information at their accommodation. Repeat visitors accounted for all cases where many efforts to reduce waste

were noticed. Additionally, younger respondents (18–29) were significantly less likely to receive waste management information at their accommodation and exhibited a more diverse range of preferences for waste reduction measures when compared to older respondents. No significant associations were found for the accommodation type or the appeal of Madeira as a ZW island. Similarly, most respondents demonstrated consistently high willingness to take actions to reduce waste regardless of other variables.

## **5. Discussion**

The study set out to explore Madeira's potential to transition into a ZW island, with tourism as the driving force. This section reflects on the research process, discussing implications, limitations and recommendations for future research.

Findings highlight the strong relevance of ZW to Madeira's context, as waste reduction should be the main priority in an insular territory. A key theoretical contribution of this paper is that tourism can be a critical driver of the shift towards ZW. In Madeira, tourism's high visibility, influence, and role as a pioneer of sustainable measures position it to inspire ZW behaviours among residents and other sectors, facilitating the transition toward a circular WMS, as Ferronato et al. (2023) proposed. Tilos' experience as the first ZW island reinforces this idea, demonstrating tourism's pivotal role in advancing such practices.

Quantitative findings contribute to existing research by revealing that most tourists are willing to adopt ZW practices and view Madeira as a ZW island more appealing as a destination. Qualitative insights further suggest that ZW practices could strengthen Madeira's image, differentiate it from competitors, and attract eco-conscious tourists, as demonstrated in Tilos, positioning it as a unique destination. This supports broader evidence from Gourgoura (2024), showing that adopting ZW practices enhances a destination's attractiveness while addressing waste challenges. This is particularly relevant given the growing perception that tourists increasingly value environmental practices and are open to paying a premium for sustainable

options. These outcomes help address concerns that ZW initiatives may not align with visitor expectations, engagement, or the established tourism market dynamics.

However, results underscored tourism's dual role as a challenge and an opportunity in Madeira's transition to a ZW island, similar to the experience in Tilos. Significant gaps in Madeira's waste and tourism management reinforce the need for solutions as rising tourism strains the WMS. While the sector boosted the economy, its rapid growth was poorly managed, leading to overcrowded areas, increased waste, and pressure on local resources.

Additionally, a gap was identified between Madeira's certification as a sustainable destination and the practical implementation of sustainable practices. While some efforts are in place within Madeira's tourism sector (Almeida et al., 2024), they remain insufficient due to a lack of regulation and standardised practices. This supports Rodríguez, Florido and Jacob (2020), who noted the limited integration of CE principles in the tourism industry.

Similarly, quantitative findings revealed that while tourists are aware of some waste reduction efforts in Madeira, most accommodations do not provide waste management information, which could support easier separation and recycling. Although qualitative results suggested that hotels lead in sustainable practices, quantitative results did not confirm an association between accommodation type and the provision of waste management information, revealing gaps across all types. Unexpectedly, younger tourists received less waste management information at accommodations than older visitors. This discrepancy may stem from generational differences in communication preferences (Venter 2017). As Madeira's tourism demographic shifts toward a younger audience, promoting waste management practices should be generation-appropriate, leveraging digital technologies. Research on ZW has shown that its success depends on providing proper information and training (Krausz 2012; Simon, McQuibban, and Condamine 2020).

Critical barriers to adopting ZW in Madeira were identified, such as cultural resistance,

financial priorities, and limited government ambition, consistent with findings from Fuchs (2023), Pietzsch, Ribeiro, and Medeiros (2017) and Gourgoura (2024). Island-specific challenges, such as steep orography, insularity, and reliance on imports, further complicated waste management, aligning with prior studies (Ezeah, Fazakerley, and Byrne 2015; Wang, Lee and Mokhtar 2021). Heavy reliance on incineration creates three key obstacles: dependency on a steady waste supply, which discourages waste reduction; a lock-in effect, limiting the adoption of cheaper, sustainable alternatives; and resident complacency, discouraging waste separation due to the perception that most waste is incinerated. The first two align with by Gutberlet et al. (2020) and Vähk (2019), while resident complacency resulting from incineration likely leads to high contamination rates and recyclables in mixed waste. Although Bandarra et al. (2021) argue that incineration complements recycling, this study shows the importance of addressing its behavioural challenges.

Furthermore, two major critiques of the ZW concept in Madeira were identified: 1) The increasing environmental and financial burden of shipping recyclables off the island, exacerbated by the absence of an industrial base to support local recycling, and 2) The overly ambitious nature of ZW goals, which may discourage participation and effort. While ZW's primary goal is waste reduction, it may also increase recyclables. A practical starting point lies in reducing waste volumes and decentralising bio-waste treatment, helping offset recyclables' shipping (Simon, McQuibban, and Condamine 2020). Additionally, the flexible targets set by ZW Europe for tourist destinations offer a more achievable framework.

To achieve ZW and surpass these barriers, societal changes, collaborative action, legislation and awareness campaigns are required. Aligning with Krausz (2012), who stressed the importance of fundamental behavioural changes, both residents and tourists should embrace environmentally conscious consumption habits. Addressing Madeira's waste challenges requires a collective effort, combining public-private collaboration, community

engagement, and knowledge networks. For Madeira in general, a hybrid WMS emerged as ideal, combining centralised processing and sorting with decentralised collection and small-scale treatments like community composting. This approach balances economies of scale with standardised operations, reduces transport costs for remote areas, and fosters community involvement (Verma 2024) while tailoring solutions to specific needs (Dredge 2022).

Given the complexity of implementing ZW, requiring a paradigm shift in Madeira, a phased approach could prove effective. Starting with the tourism sector as a pilot project – similar to using Porto Santo as a smaller-scale testing ground – could provide a blueprint for broader adoption. Tilos' ZW project also suggests the role of the private sector in initiating such projects. Policy-wise, findings suggest actionable strategies for the tourism industry:

- Prioritise local production and collaborate with local producers and external suppliers to optimise and reduce packaging;
- Create legislation enforcing waste production limits and better waste practices, and linking the waste tariff with its generation (rather than water consumption);
- Balancing penalties and rewards for proper waste management practices, with systems like PAYT (Alves, Silva, and Soares 2020) and market incentives;
- Establishing a team of officials to verify compliance in tourism establishments, similar to the HACCP system, to ensure adherence and continuous improvement;
- Standardising door-to-door collection with waste-weighing and identification;
- Adopting local bio-waste composting, ensuring proper certification for the compost, as well as creating repair and refurbishment units for other materials;
- Supporting innovation, providing financial aid to tourism operators, and facilitating access to knowledge networks;
- Enhancing waste reduction communication efforts through media campaigns targeting residents and tourists, highlighting economic and ecological benefits; and

ensuring clear waste management information available at all accommodations.

Communication must aim for simplicity and foster automatic behaviours.

The focus should be on 3 key groups: tourism collaborators (e.g., hotels and entertainment providers), residents, and tourists. By engaging these groups and showing tangible results in the tourism sector, a foundation for a comprehensive ZW transition can be built.

Findings emphasised the need to gradually reduce Madeira's reliance on incineration for a more sustainable WMS. With the incinerator at full capacity (Ribeiro 2024), this presents an opportune moment for the tourism industry to adopt alternative treatment methods, offering a more effective solution than expanding the incinerator. Tourism's potential impact can be estimated using Martins and Cró's (2021) findings and 2023 data about Madeira's WMS, while assuming that tourism contributes 41.9-46.6% uniformly across all waste categories. Locally composting tourism bio-waste could cut incineration by 20-22%, while proper sorting of recyclables could reduce it by 13-15%. Combined, these measures in the tourism sector alone could reduce Madeira's incinerated MSW by 33-37% and save 2.9 to 3.2 million euros in incineration costs (Appendix 11). While these improvements focus merely on treatment, adding waste reduction efforts would further amplify the sector's impact. However, ZW efforts should not rely exclusively on the tourism sector, as this risks overlooking residents' engagement and limiting its impact. Tourism may serve as a catalyst for ZW in Madeira, but it must be part of a broader, island-wide strategy to be effective.

While this paper offers insightful contributions to the role of tourism in driving ZW initiatives in Madeira, several limitations must be acknowledged. Sampling bias may be present, as qualitative data might not adequately represent all stakeholder groups, and the small survey sample size, with an overrepresentation of younger participants, might limit the findings' generalisability. Given that research is focused on Madeira's context, broader applicability is further restricted. Additionally, social desirability bias may have influenced

participants to provide socially acceptable rather than truthful responses (Grimm 2010), impacting the reliability of the data. Finally, a cautious interpretation of results is required: survey data analysed through Chi-square tests can identify associations but not causality, and assumptions about tourism's impact, such as attributing its contribution uniformly across all waste categories, may oversimplify the complexities of waste generation.

As such, future research on Madeira should build on the insights from this paper by conducting larger-scale studies to validate residents' and tourists' perceptions of ZW and assess tourism's role in its promotion. Developing a comprehensive ZW framework tailored to Madeira is advisable, alongside evaluating the feasibility of establishing local recycling infrastructure to reduce dependence on exporting recyclables. Exploring effective methods for engaging locals and tourists in ZW initiatives would be beneficial. Additionally, investigating how tourism can positively contribute to the island beyond waste management, thereby becoming a regenerative force, is recommended. More broadly, there is a need for studies focusing on ZW practices in island settings and examining tourism's specific role.

## **6. Conclusion**

This study aimed to explore tourism as a catalyst for positive changes on Madeira Island, particularly in starting its ZW journey. As the key economic driver of Madeira, tourism is one of the largest contributors to waste generation. Therefore, it could significantly change how Madeira views, creates and treats waste.

Based on a qualitative and quantitative analysis of residents' and tourists' perceptions, it can be concluded that ZW is highly relevant and viable for Madeira, and the tourism sector has a pivotal role in advancing its transition to ZW. This sector's prominence and influence position it as a driver for sustainable waste practices, inspiring both residents and other sectors to follow. Besides differentiating Madeira's image as a genuinely sustainable tourist destination, adopting ZW would align it closely with a CE while involving the community.

As tourism on the island expands, it is imperative to transform existing systems to decouple waste production from its growth. This will require addressing gaps in waste management and public awareness through collaborative efforts and targeted policies.

While Madeira's ZW project should not rely solely on the tourism sector, it could be the starting point, leveraging its current role as an advancer of sustainable practices. Given the complexity of adopting a general ZW system in Madeira, using tourism as a pilot project and showing tangible results could encourage participation from other sectors. This project should focus on three key groups: tourism collaborators, residents, and tourists. These groups can be effectively reached by implementing targeted media awareness campaigns while considering Madeira's evolving tourist demographic, effective legislation, and monitoring.

Adopting waste reduction strategies – such as prioritising local production, minimising packaging, and setting waste production limits – alongside alternative waste treatment methods like local bio-waste composting and establishing repair or refurbishing centres can significantly impact waste management in the tourism sector. Door-to-door collection with producer identification, penalties and rewards, and financial aid for collaborators to adopt innovations were identified as optimal solutions. However, these measures alone are insufficient without some degree of societal transformation and collaboration.

While sampling bias might limit the generalizability of results, this study deepens the understanding of integrating ZW within island tourism contexts, offering insights that can inform sustainable development strategies for Madeira and similar destinations. Future research should focus on conducting larger-scale studies, creating a ZW framework tailored to Madeira, and exploring additional ways tourism can positively contribute to the island.

Practitioners should reevaluate tourism's role, recognising its potential to extend beyond being merely Madeira's economic driver. Because a destination is only good to visit as long as it is good to live in, tourism could also become a driving force for Madeira's regeneration.

## 7. References

- Aires, Joana. 2024. “Madeira regista números recorde em 2023 e aumenta capacidade aérea este ano.” TNEWS. February 29, 2024. <https://tnews.pt/madeira-regista-numeros-recorde-em-2023-e-aumenta-capacidade-aerea-este-ano/>.
- Almeida, António, Machado, Cármen Florido, Marta Jacob, and Carlos Rodriguez. 2024. “Economia Circular No Setor Do Turismo: Ponto De Situação Na Gran Canária E Na Madeira.” *Journal of Tour Sm & Development* 45: 275–89. <https://doi.org/10.34624/rtd.v45i0.32453>.
- Alves, Leonel, Susana Silva, and Isabel Soares. 2020. “Waste Management in Insular Areas: A Pay-As-You-Throw System in Funchal.” *Energy Reports* 6 (December): 31–36. <https://doi.org/10.1016/j.egy.2020.10.024>.
- Amorim, Marlene, Marta Ferreira Dias, Filipa Brandão, Raquel Castro Madureira, Rui Costa, Zélia Breda, Cristina Guardado, Marcela Lopes, and Bruna Pedro. 2023. “Understanding Regenerative Tourism as a Catalyst for Sustainable Economies: An Analysis of Selected Practices.” *International Scientific Conference ERAZ. Knowledge Based Sustainable Development*, January, 325–33. <https://doi.org/10.31410/eraz.2023.325>.
- ARM. 2023. “Tarifário dos serviços de águas e resíduos - 2024 serviços em alta.” [https://arm.pt/wp-content/uploads/2023/12/RESUMO-PUBLICACAO-NET\\_TARIFARIO-ALTA\\_2024\\_CORRIGIDO-TARIFARIO-VERAO\\_FINAL.pdf](https://arm.pt/wp-content/uploads/2023/12/RESUMO-PUBLICACAO-NET_TARIFARIO-ALTA_2024_CORRIGIDO-TARIFARIO-VERAO_FINAL.pdf).
- Bandarra, Beatriz S., Joana L. Pereira, Rui C. Martins, Alex Maldonado-Alameda, Josep M. Chimenos, and Margarida J. Quina. 2021. “Opportunities and Barriers for Valorizing Waste Incineration Bottom Ash: Iberian Countries as a Case Study.” *Applied Sciences* 11 (20): 9690. <https://doi.org/10.3390/app11209690>.

- Bellato, Loretta, Niki Frantzeskaki, and Christian A. Nygaard. 2022. “Regenerative tourism: a conceptual framework leveraging theory and practice.” *Tourism Geographies* 25 (4): 1026–46. <https://doi.org/10.1080/14616688.2022.2044376>.
- Berkemeier, Rui, and Susana Fonseca. 2019. “The Hidden Costs of Incineration: The Case of Madeira and Azores.” ZERO, Associação Sistema Terrestre Sustentável. [https://zerowasteurope.eu/wp-content/uploads/2019/11/zero\\_waste\\_europe\\_cs\\_madeira\\_azores\\_en.pdf](https://zerowasteurope.eu/wp-content/uploads/2019/11/zero_waste_europe_cs_madeira_azores_en.pdf).
- Cardoso, Francisco José. 2024. “2024 continua a registar máximos em hóspedes, dormidas e proveitos no alojamento turístico.” DNOTICIAS.PT. October 14, 2024. <https://www.dnoticias.pt/2024/10/14/423324-2024-continua-a-registar-maximos-em-hospedes-dormidas-e-proveitos-no-alojamento-turistico/>
- Cave, Jenny, and Dianne Dredge. 2020. “Regenerative tourism needs diverse economic practices.” *Tourism Geographies* 22 (3): 503–13. <https://doi.org/10.1080/14616688.2020.1768434>.
- Chen, M.C., A. Ruijs, and J. Wesseler. 2005. “Solid Waste Management on Small Islands: The Case of Green Island, Taiwan.” *Resources Conservation and Recycling* 45 (1): 31–47. <https://doi.org/10.1016/j.resconrec.2004.12.005>.
- De Almeida, António Manuel Martins. 2016. “Modelling Tourism Demand in Madeira since 1946: And Historical Overview based on a Time series approach.” *Journal of Spatial and Organizational Dynamics* 4 (2): 145–56. <https://digituma.uma.pt/bitstream/10400.13/2931/1/Modelling%20tourism%20demand%20in%20Madeira%20since%201946Ant%c3%b3nioAlmeida.pdf>.
- De Souza Minayo, Maria Cecília. 2017. “Amostragem E Saturação Em Pesquisa Qualitativa: Consensos E Controvérsias.” (Sampling and saturation in qualitative research:

- consensus and controversy). *Revista Pesquisa Qualitativa* 5 (7): 1–12.  
<http://rpq.revista.sepq.org.br/index.php/rpq/article/view/82>.
- De Titto, Ernesto, and Atilio Savino. 2019. “Environmental and health risks related to waste incineration.” *Waste management & research : the journal of the International Solid Wastes and Public Cleansing Association, ISWA* vol. 37,10: 976-986.  
doi:10.1177/0734242X19859700
- Dileep, M. R. 2007. “Tourism and Waste Management: A Review of Implementation of ‘Zero Waste’ at Kovalam.” *Asia Pacific Journal of Tourism Research* 12 (4): 377–92.  
doi:10.1080/10941660701823314.
- DMO. 2022. “Plano De Ação 2022-2030 da Sustentabilidade do Destino Madeira.” Approved by Eduardo Jesus. [https://sustainableforall.visitmadeira.com/wp-content/uploads/2024/02/Plano\\_de\\_acao\\_2022-2030.pdf](https://sustainableforall.visitmadeira.com/wp-content/uploads/2024/02/Plano_de_acao_2022-2030.pdf).
- DMO. 2024. “Avaliação de Risco Madeira.” Approved by Eduardo Jesus.  
<https://sustainableforall.visitmadeira.com/wp-content/uploads/2024/02/Avaliacao-de-Risco.pdf>.
- DMO. 2024a. “Madeira’s Tourism Sustainability Management Policy.” Approved by Eduardo Jesus. [https://sustainableforall.visitmadeira.com/wp-content/uploads/2024/02/MAD02\\_01-Sustainability-Policy-29-jan-2024.pdf](https://sustainableforall.visitmadeira.com/wp-content/uploads/2024/02/MAD02_01-Sustainability-Policy-29-jan-2024.pdf).
- Dredge, Dianne. 2022. “Regenerative Tourism: Transforming Mindsets, Systems and Practices.” *Journal of Tourism Futures* 8 (3): 269–81. <https://doi.org/10.1108/jtf-01-2022-0015>.
- DREM. 2022. “Conta Satélite Do Turismo Da Região Autónoma Da Madeira 2019.”  
<https://estatistica.madeira.gov.pt/en/download-now-3/economic/contaseconomicas-gb/contaseconomicas-cst-gb/contaseconomicas-cst-emfoco-gb/send/54-counta-satelite-emfoco/15453-em-foco-2019.html>.

DREM. 2023. “Resultados Definitivos dos CENSOS 2021.”

<https://estatistica.madeira.gov.pt/download-now/social/popcondsoc-pt/popcondsoc-censos-pt/popcondsoc-censos-emfoco-pt/send/47-censos-emfoco/15577-em-foco-censos-2021-resultados-definitivos-1.html>.

DREM. 2024. “Análise dos principais resultados definitivos ano de 2023.”

<https://estatistica.madeira.gov.pt/download-now/economica/turismo-pt/turismo-emfoco-pt/emfoco-turismo-pt/send/46-turismo-emfoco/17577-em-foco-2023.html>.

EEA. 2022. “Reaching 2030’s residual municipal waste target — why recycling is not

enough.” <https://www.eea.europa.eu/publications/reaching-2030s-residual-municipal-waste>.

ESCAP. 2024. “The Secrets to Unlocking the Next Frontier for a Circular Economy in the Asia-Pacific Region”. United Nations ESCAP, Trade, Investment and Innovation Division, November 2024. Bangkok.

<https://repository.unescap.org/handle/20.500.12870/7491>

European Union. 2024. “DIRECTIVE 2008/98/EC.”

<http://data.europa.eu/eli/dir/2008/98/2018-07-05>.

Ezeah, Chukwunonye, Jak Fazakerley, and Timothy Byrne. 2015. “Tourism Waste Management in the European Union: Lessons Learned from Four Popular EU Tourist Destinations.” *American Journal of Climate Change* 04 (05): 431–45.

<https://doi.org/10.4236/ajcc.2015.45035>.

Ferronato, Navarro, Adeline Mertenat, Christian Zurbrügg, and Vincenzo Torretta. 2023.

“Can Tourism Support Resource Circularity in Small Islands? On-field Analysis and Intervention Proposals in Madagascar.” *Waste Management & Research the Journal for a Sustainable Circular Economy* 42 (5): 406–17.

<https://doi.org/10.1177/0734242x231187561>.

- Fuchs, Kevin. 2023. "Navigating the Fine Line of Sustainable Tourism: A Critical Analysis with Implications for Tourism Planning." *Journal of Environmental Management and Tourism* 14 (4): 1908. [https://doi.org/10.14505/jemt.v14.4\(68\).02](https://doi.org/10.14505/jemt.v14.4(68).02).
- Fugas, and Lusa. 2023. "Madeira com certificação mundial de Destino Turístico Sustentável: nível prata, a caminho do ouro." *PÚBLICO*, February 25, 2023. <https://www.publico.pt/2023/02/25/fugas/noticia/madeira-certificacao-mundial-destino-turistico-sustentavel-nivel-prata-caminho-ouro-2040257>.
- Gourgoura, Eftychia S. 2024. "Κυκλική Οικονομία Και Κυκλικά Επιχειρηματικά Μοντέλα Και Πολιτικές Στον Ελληνικό Χώρο. Η Περίπτωση Της Τήλου" (Circular Economy and Circular Business Models and Policies in the Greek Context: The Case of Tilos). University of Western Attica. <http://dx.doi.org/10.26265/polynoe-6105>
- Grimm, Pamela. 2010. "Social Desirability Bias." <https://doi.org/10.1002/9781444316568.WIEM02057>
- Gutberlet, Jutta, Torleif Bramryd, and Michael Johansson. 2020. "Expansion of the Waste-Based Commodity Frontier: Insights From Sweden and Brazil." *Sustainability* 12 (7): 2628. <https://doi.org/10.3390/su12072628>.
- Herzog, Christian, Christian W. Handke and Erik Hitters. 2019. "Analyzing Talk and Text II: Thematic Analysis." *PSN: Other Political Methods: Qualitative & Multiple Methods (Topic)*: n.pag.
- Holliday, Michelle, and Bill Reed. 2021. "A Regenerative Approach to Tourism in Canada." Destination Canada. [https://www.destinationcanada.com/sites/default/files/archive/1872-A%20Regenerative%20Approach%20to%20Tourism%20in%20Canada/A-Regenerative-Approach-to-Tourism-in-Canada\\_EN.pdf](https://www.destinationcanada.com/sites/default/files/archive/1872-A%20Regenerative%20Approach%20to%20Tourism%20in%20Canada/A-Regenerative-Approach-to-Tourism-in-Canada_EN.pdf).

- Hugo, Victor. 2024. “Foram os serviços da CMF que colocaram os sacos de lixo no miradouro do Areeiro?” DNOTICIAS.PT. August 14, 2024.  
<https://www.dnoticias.pt/2024/8/14/416272-foram-os-servicos-da-cmf-que-colocaram-os-sacos-de-lixo-no-miradouro-do-areeiro/>.
- Jesus, Eduardo. 2023. “Madeira Tourism—always Proactive Toward Sustainability.” *Worldwide Hospitality and Tourism Themes* 15 (6): 664–68.  
<https://doi.org/10.1108/whatt-09-2023-0114>.
- Joseph, Emilda K., Tomy K. Kallarakal, and Bindi Varghese. 2020. “Sustainable Tourism Development In The Backwaters Of South Kerala, India: The Local Government Perspective.” *GeoJournal of Tourism and Geosites* 33 (4): 1532–37.  
<https://doi.org/10.30892/gtg.334sp113-604>.
- Kabil, Moaaz, Al Fauzi Rahmat, Mihály Hegedűs, Bernadett Galovics, and Lóránt Dénes Dávid. 2024. “Circular Economy and Tourism: A Bibliometric Journey through Scholarly Discourse.” *Circular Economy* 2 (1). <https://doi.org/10.55845/hgwo7144>.
- Kaldellis, John K. 2021. “Supporting the Clean Electrification for Remote Islands: The Case of the Greek Tilos Island.” *Energies* 14 (5): 1336.  
<https://doi.org/10.3390/en14051336>.
- Koliotasi, Aglaia-Spyridoula, Konstadinos Abeliotis, and Paris-Georgios Tsartas. 2023. “Understanding the Impact of Waste Management on a Destination’s Image: A Stakeholders’ Perspective.” *Tourism and Hospitality* 4 (1): 38–50.  
<https://doi.org/10.3390/tourhosp4010004>.
- Krausz, Robert. 2012. “All For Naught? A Critical Study of Zero Waste to Landfill Initiatives.” Lincoln University.  
[https://researcharchive.lincoln.ac.nz/bitstream/10182/5301/3/Krausz\\_phd.pdf](https://researcharchive.lincoln.ac.nz/bitstream/10182/5301/3/Krausz_phd.pdf).

- Linglin, Zhou. 2024. “A Bibliometric Review of Zero Waste in the Built Environment Using VOSviewer: Evolution, Hotspots, and Prospects.” *Frontiers in Environmental Science* 11. <https://doi.org/10.3389/fenvs.2023.1326458>.
- Liu, Zhenhua. 2003. “Sustainable Tourism Development: A critique.” *Journal of Sustainable Tourism* 11 (6): 459–75. <https://doi.org/10.1080/09669580308667216>.
- Livramento, Marco. 2024. “Limite de capacidade diária avança nos percursos pedestres mais procurados.” DNOTICIAS.PT. July 12, 2024. <https://www.dnoticias.pt/2024/7/12/412677-limite-de-carga-avanca-nos-percursos-pedestres-mais-procurados/>.
- Luís, Miguel Fernandes. 2024. “Será que a Madeira não apresenta sinais de ‘excesso de turismo’?” DNOTICIAS.PT. September 27, 2024. <https://www.dnoticias.pt/2024/9/27/421397-sera-que-a-madeira-nao-apresenta-sinais-de-excesso-de-turismo/>.
- Lusa. 2024. “Taxa turística já é aplicada em mais de 25 municípios - quais?” *Idealista/News*, August 28, 2024. <https://www.idealista.pt/news/ferias/turismo/2024/08/28/65479-taxa-turistica-ja-e-aplicada-em-mais-de-25-municipios-quais>.
- Majdak, Piotr, and Antonio Manuel Martins De Almeida. 2022. “Pre-Emptively Managing Overtourism by Promoting Rural Tourism in Low-Density Areas: Lessons from Madeira.” *Sustainability* 14 (2): 757. <https://doi.org/10.3390/su14020757>.
- Majdak, Piotr, Antonio Almeida, and Anna Nowakowska. 2021. “Smart Island and Sustainable Tourist Development with the Example of Madeira. Part 2: Analysis of Expectations of Local Community and Tourists.” *EUROPEAN RESEARCH STUDIES JOURNAL XXIV* (Issue 4B): 507–22. <https://doi.org/10.35808/ersj/2672>.

- Majdak, Piotr, Jakub Mosz, and António Manuel Martins De Almeida. 2022. "Overtourism: The impact of tourism on Madeira's social and economic environment." *Studia Ecologiae Et Bioethicae* 20 (2): 79–88. <https://doi.org/10.21697/seb.2022.09>.
- Martins, António Miguel, and Susana Cró. 2021. "The impact of tourism on solid waste generation and management cost in Madeira Island for the period 1996–2018." *Sustainability* 13 (9): 5238. <https://doi.org/10.3390/su13095238>.
- Mateu-Sbert, Josep, Ignacio Ricci-Cabello, Ester Villalonga-Olives, and Elena Cabeza-Irigoyen. 2013. "The impact of tourism on municipal solid waste generation: The case of Menorca Island (Spain)." *Waste Management* 33 (12): 2589–93. <https://doi.org/10.1016/j.wasman.2013.08.007>.
- Maxwell, Daniel G. 1998. "Can Qualitative and Quantitative Methods Serve Complementary Purposes for Policy Research?: Evidence from Accra." *FCND*, January. <https://doi.org/10.22004/ag.econ.97042>.
- Mika, Mirosław. 2015. "Sustainable tourism: a critique of the academic feasibility of the concept." *Turyzm/Tourism* 25 (1): 9–17. <https://doi.org/10.2478/tour-2014-0015>.
- Pedro, Sérgio, Eliana Santos, João Castro, José Ponte, António Lorena, Catarina Silva, Margarida Gomes, and Rita Pombo. 2023. "Plano De Ação Da Estratégia De Resíduos Urbanos Da ARM." *Águas E Resíduos Da Madeira, S.A.* <https://arm.pt/projeto/plano-de-acao-da-estrategia-de-residuos-urbanos-da-arm/>
- Pietzsch, Natália, José Luis Duarte Ribeiro, and Janine Fleith de Medeiros. 2017. "Benefits, Challenges and Critical Factors of Success for Zero Waste: A Systematic Literature Review." *Waste Management* 67: 324–53. <https://doi.org/10.1016/j.wasman.2017.05.004>.

- Potting, José, M.P. Hekkert, E. Worrell, and Aldert Hanemaaijer. 2017. *Circular Economy: Measuring innovation in the product chain*.  
<https://dspace.library.uu.nl/handle/1874/358310>.
- Rada, E. C., C. Zatelli, and P. Mattolin. 2014. “Municipal solid waste selective collection and tourism.” *WIT Transactions on Ecology and the Environment*, April.  
<https://doi.org/10.2495/wm140161>
- Reis, M. Fátima, Carla Sampaio, Pedro Aguiar, J. Maurício Melim, J. Pereira Miguel. 2004. “Body burdens and dietary intake: First results from dioxins and dioxin-like compounds in the population from Madeira Island, Portugal. Part 1 - Biomonitoring in blood of the general population living near a solid waste incinerator.” *Organohalogen Compounds*, 66, 2702-2708
- Renfors, Sanna-Mari. 2023. “Circular Economy in Tourism: A System-Level Approach.” *International Conference on Tourism Research* 6 (1): 261–66.  
<https://doi.org/10.34190/ictr.6.1.1171>.
- Ribeiro, Carla. 2024. “Meia Serra a 105% Pensa Na Terceira Linha” (Meia Serra at 105% Thinking of a Third Line). *JM Madeira*, November 14, 2024.
- Richardson, Katherine, Will Steffen, Wolfgang Lucht, Jørgen Bendtsen, Sarah E. Cornell, Jonathan F. Donges, Markus Drüke, et al. 2023. “Earth beyond six of nine planetary boundaries.” *Science Advances* 9 (37). <https://doi.org/10.1126/sciadv.adh2458>.
- Rodrigues, Carolina. 2024. “Governo prepara conjunto de medidas para disciplinar o Turismo.” *DNOTÍCIAS.PT*. July 5, 2024 <https://www.dnoticias.pt/2024/7/5/411946-governo-prepara-conjunto-de-medidas-para-disciplinar-o-turismo/>.
- Rodríguez, Carlos, Carmen Florido, and Marta Jacob. 2020. “Circular Economy Contributions to the Tourism Sector: A Critical Literature Review.” *Sustainability* 12 (11): 4338. <https://doi.org/10.3390/su12114338>.

- Rojabi, Siti Hamdiah, Akhmad Saufi, and Diswandi Diswandi. 2020. "Developing Zero Waste Halal Tourism Community in Lombok." *International Journal of Multicultural and Multireligious Understanding* 7 (8): 194–205.  
<https://doi.org/10.18415/ijmmu.v7i8.1843>.
- Rosa, Ferran. 2018. "The Story of Sardinia - Case Study." Zero Waste Europe.  
<https://zerowasteurope.eu/wp-content/uploads/edd/2018/02/10.pdf>.
- Ruslin, Saepudin Mashuri, Muhammad Sarib Abdul Rasak, Firdiansyah Alhabsyi Alhabsyi, and Hijrah Syam. 2022. "Semi-structured Interview: A Methodological Reflection on the Development of a Qualitative Research Instrument in Educational Studies." *IOSR Journal of Research & Method in Education (IOSR-JRME)* 12 (February).  
<https://doi.org/10.9790/7388-1201052229>.
- Santamarta, Juan C., Jesica Rodríguez-Martín, M. Paz Arraiza, and J.V. López. 2014. "Waste Problem and Management in Insular and Isolated Systems. Case Study in the Canary Islands (Spain)." *IERI Procedia* 9 (January): 162–67.  
<https://doi.org/10.1016/j.ieri.2014.09.057>.
- Shenyoputro, K., and Thomas E. Jones. 2023. "Reflections on a two-decade journey toward zero waste: A case study of Kamikatsu town, Japan." *Frontiers in Environmental Science* 11 (April). <https://doi.org/10.3389/fenvs.2023.1171379>.
- Simon, Joan Marc, Jack McQuibban, and Pierre Condamine. 2020. "The Zero Waste Masterplan: Turning the Vision of Circular Economy into a Reality for Europe". Zero Waste Europe. [https://zerowastecities.eu/wp-content/uploads/2020/07/2020\\_07\\_07\\_zwe\\_zero\\_waste\\_cities\\_masterplan.pdf](https://zerowastecities.eu/wp-content/uploads/2020/07/2020_07_07_zwe_zero_waste_cities_masterplan.pdf).
- Singh, Simron J, Allison Elgie, Dominik Noll, and Matthew J Eckelman. 2023. "The Challenge of Solid Waste on Small Islands: Proposing a Socio-metabolic Research

- (SMR) Framework.” *Current Opinion in Environmental Sustainability* 62 (March): 101274. <https://doi.org/10.1016/j.cosust.2023.101274>
- SRAPA and DRAM. 2024. “Relatório Anual - Gestão De Resíduos Urbanos 2023.” Secretaria Regional de Agricultura Pescas e Ambiente. Direção Regional do Ambiente e Mar. [https://www.madeira.gov.pt/Portals/12/Documentos/Ambiente/Res%20e%20Economia%20Circular/RARU%202023\\_VF.pdf](https://www.madeira.gov.pt/Portals/12/Documentos/Ambiente/Res%20e%20Economia%20Circular/RARU%202023_VF.pdf).
- Teixeira, Diogo, J. Cadima Ribeiro. 2019. “Residents’ perceptions of the tourism impacts on a mature destination: the case of Madeira Island.” *J Of Tourism and Hospitality Management* 7 (4). <https://doi.org/10.17265/2328-2169/2019.04.001>.
- Vähk, Janek. 2019. “The Impact of Waste-to-Energy Incineration on Climate”. Zero Waste Europe. [https://zerowasteurope.eu/wp-content/uploads/edd/2019/09/ZWE\\_Policy-briefing\\_The-impact-of-Waste-to-Energy-incineration-on-Climate.pdf](https://zerowasteurope.eu/wp-content/uploads/edd/2019/09/ZWE_Policy-briefing_The-impact-of-Waste-to-Energy-incineration-on-Climate.pdf)
- Venter, Elza. 2017. “Bridging the Communication Gap Between Generation Y and the Baby Boomer Generation.” *International Journal of Adolescence and Youth* 22 (4): 497–507. <https://doi.org/10.1080/02673843.2016.1267022>.
- Verhoef, Marja J, and Ann L Casebeer. 1997. “Broadening Horizons: Integrating Quantitative and Qualitative Research.” *Canadian Journal of Infectious Diseases and Medical Microbiology* 8 (2): 65–66. <https://doi.org/10.1155/1997/349145>.
- Verma, Ganesh. 2024. “A Comparative Study on Environmental and Economic Benefits of Centralized Versus Decentralized Solid Waste Management Systems.” *International Journal for Research in Applied Science and Engineering Technology* 12 (6): 1775–81. <https://doi.org/10.22214/ijraset.2024.63416>.
- Vieira, Alberto. 2008. “A História do Turismo na Madeira: Alguns Dados para uma Breve Reflexão [The History of Tourism in Madeira: Some Data for a Brief Reflection]” *TURISMO: Revista de la Escuela Universitaria de Turismo Iriarte*, no. 0: 95–118.

- Wang, Kylie Ching Mun, Khai Ern Lee, and Mazlin Mokhtar. 2021. "Solid Waste Management in small Tourism Islands: an Evolutionary Governance approach." *Sustainability* 13 (11): 5896. <https://doi.org/10.3390/su13115896>
- Yang, Yuetao, Gowhar Ahmad Wani, V. Nagaraj, Mohammad Haseeb, Sameer Sultan, Md. Emran Hossain, Mustafa Kamal, and Syed Mehmood Raza Shah. 2023. "Progress in Sustainable Tourism Research: An analysis of the comprehensive literature and future research Directions." *Sustainability* 15 (3): 2755. <https://doi.org/10.3390/su15032755>.
- Zaman, Atiq Uz. 2013. "Measuring Waste Management Performance Using the 'Zero Waste Index': The Case of Adelaide, Australia." *Journal of Cleaner Production* 66 (November): 407–19. <https://doi.org/10.1016/j.jclepro.2013.10.032>.

## 8. Appendix

### *Appendix 1 – List of abbreviations*

AI – Artificial Intelligence

ARM – Águas e Resíduos da Madeira [Water and Waste Management of Madeira]

CE – Circular Economy

DMO – Destination Management Organization

EPR - Extended Producer Responsibility

EU – European Union

GDP – Gross Domestic Product

HACCP – Hazard Analysis Critical Control Points

MSW – Municipal Solid Waste

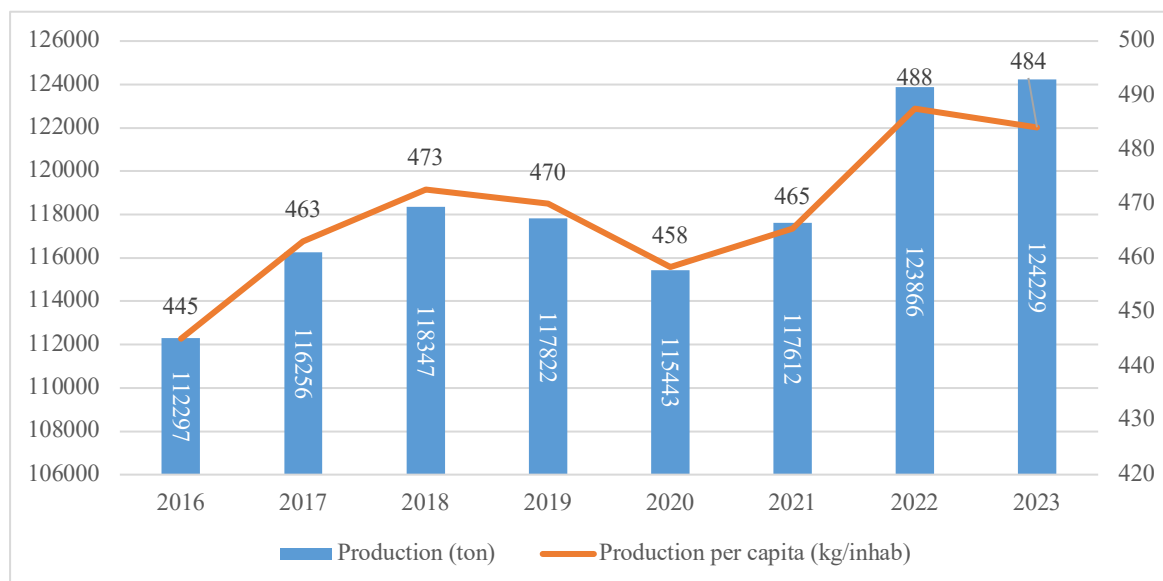
PAYT – Pay as You Throw

WMS – Waste Management System

ZW – Zero Waste

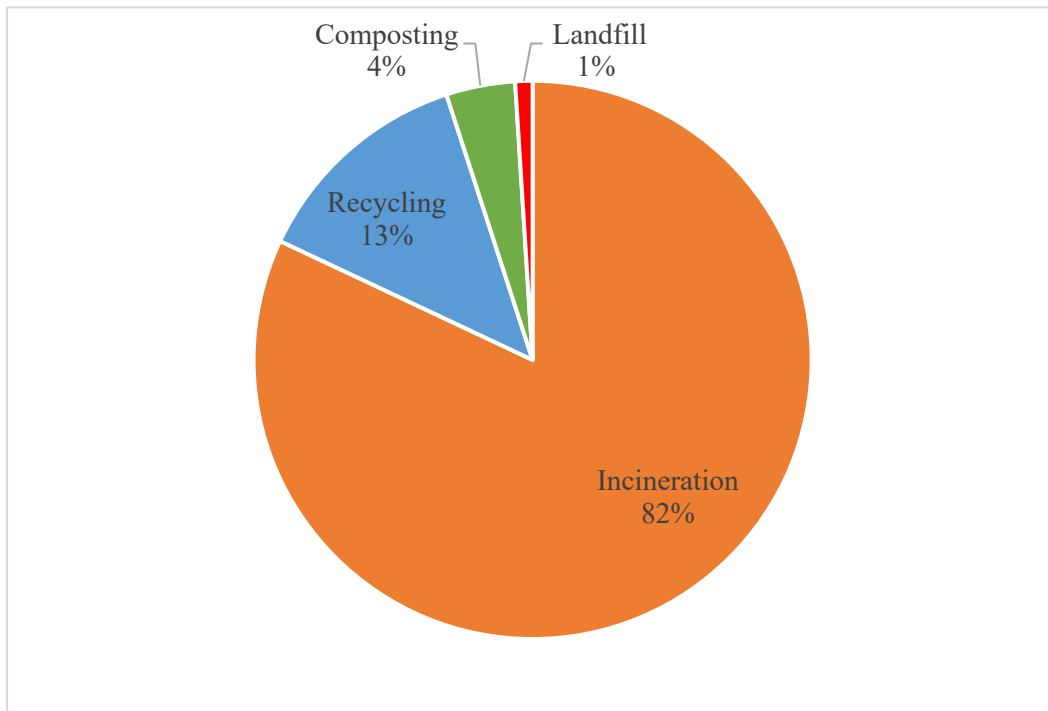
### *Appendix 2 – Waste production in Madeira Island (2016 – 2023)*

Source: SRAPA and DRAM 2024



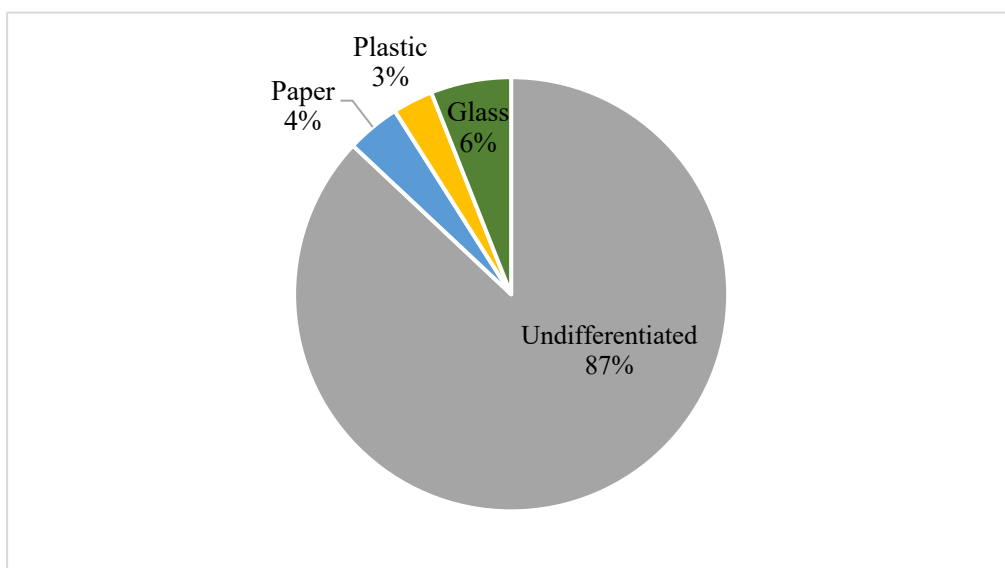
***Appendix 3 – Treatment of MSW in Madeira Island (2023)***

Source: SRAPA and DRAM 2024



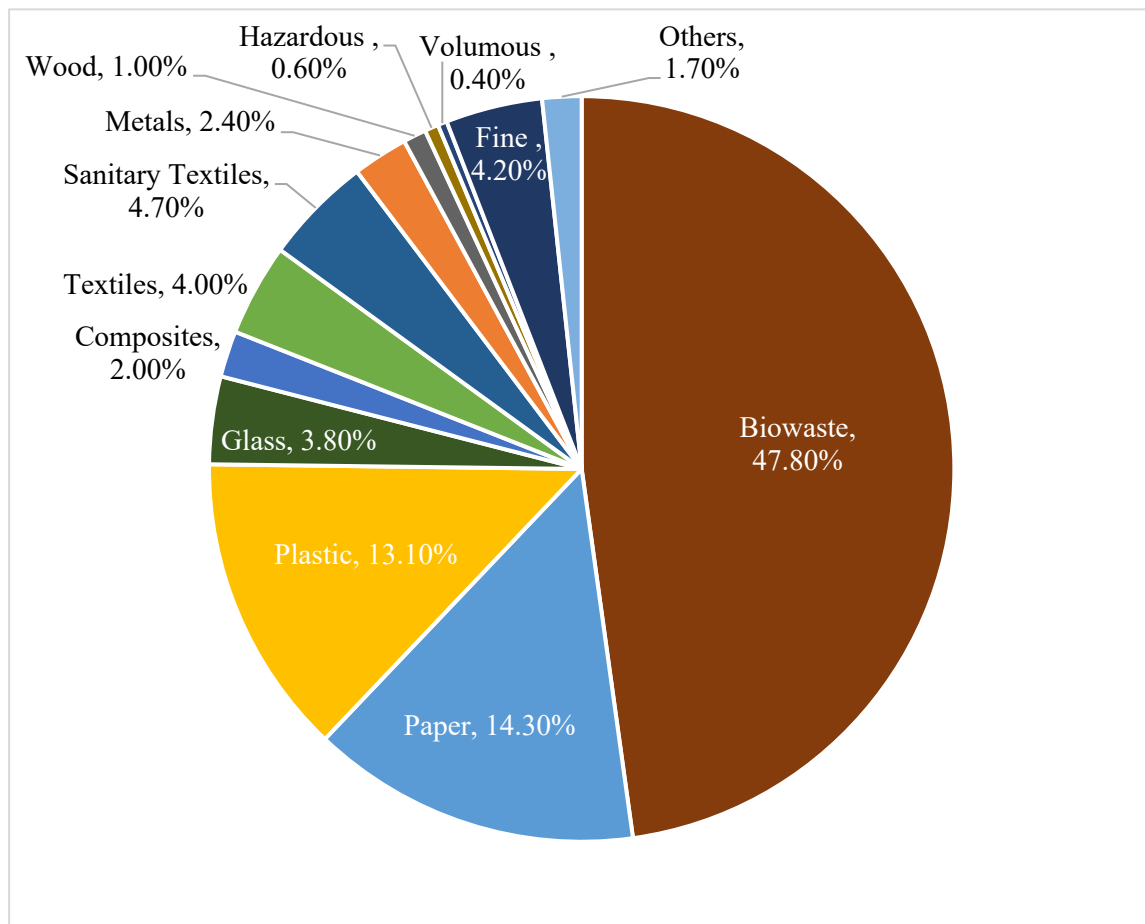
***Appendix 4 – Collection of MSW in Madeira Island (2023)***

Source: SRAPA and DRAM 2024



## *Appendix 5 – Undifferentiated MSW Composition in Madeira Island (2023)*

Source: SRAPA and DRAM 2024



## *Appendix 6 - Qualitative research: Interview guides*

### **Interview Guide 1: Madeira Island**

1. How would you describe Madeira's current waste management system? Are there areas in this process that could be improved in any way? Do you have any ideas you'd like to implement, particularly in the tourism industry?

- *For tourism operators (hotels, Airbnbs, restaurants) and municipality entities only:*  
How would you describe the waste management process in your business/municipality, from the moment it is generated until it is disposed of? What motivated the implementation of current practices?

2. What do you think is the impact of the rapid growth in tourism, particularly since the pandemic, on waste production and management in Madeira?
3. A concept that is gaining prominence, especially in tourist destinations, is zero-waste. It's based on a circular economy, which sees waste as a resource and a way of saving/making money. The central aim is to reduce waste production as much as possible, while promoting reuse, recycling and eliminating landfill and incineration. This measure has already been successfully implemented on other tourist islands, such as Tilos in Greece, the 1st Zero Waste Island, which in just 2 years has managed to reduce its waste production by 40% and recycle 90% of the total, which was previously incinerated. Residents have received training and equipment, and tourists have been given information and tools for sorting waste, including an app to track their waste production. Do you think there are currently any measures focussed on reducing waste, in Madeira in general but also within the tourism sector?
4. Madeira's current waste treatment system consists of 80% incineration, 13% recycling, 4% composting, and 3% landfill. What is your opinion on this system? In what ways do you think it supports or hinders the adoption of reduction practices?
5. Would the concept of zero waste be relevant and viable for Madeira, and for the tourism sector? What would be the main benefits and obstacles to its long-term implementation?
6. In your opinion, what changes would be needed, both in the tourism industry and on the island in general, to adopt zero waste practices more effectively?
7. Could the tourism sector drive the Zero Waste movement to reduce waste and raise awareness, inspiring other sectors and residents to adopt these practices?

## **Interview Guide 2: Tilos Island**

1. What were the key factors that motivated Tilos to adopt a zero-waste approach? Were there specific challenges or opportunities that influenced this decision?
2. Could you describe the most critical steps that were taken to transition Tilos into a ZW island, especially in the early stages?
3. How long did it take to disable the incinerator and move to composting and recycling? What do you do with materials that cannot be recycled?
4. Were there any policies/regulations from the government that facilitated this transition, as well as local/international partnerships, namely with the tourism sector?
5. How did the local community and businesses initially react to the shift towards zero waste? What strategies were used to engage them and ensure their participation?
6. How has the tourism sector adapted to the zero-waste initiatives? Have tourists responded positively, and have there been any particular strategies for managing waste generated by visitors?
7. What role do you believe the tourism sector played in the zero-waste transition?
8. What have been the biggest challenges in maintaining and expanding the zero-waste practices on Tilos?
9. Based on your experience, do you believe Madeira Island, with nearly 260,000 inhabitants and relying on 82% incineration, could adopt the same strategy?

## ***Appendix 7 – Qualitative research: Transcripts***

### **Transcript 1: Interview about Madeira Island**

**Question:** I'd like to ask if you have any knowledge of Madeira's current waste management system or a general idea and if you could describe it.

**Answer:** Well, a series of campaigns were initially accepted concerning waste sorting, which involved people sorting their waste at home and putting it in the appropriate containers. This has been going on for a few years now. It was a policy that was implemented throughout the country. Naturally, there are municipalities where there has been a greater commitment, but what happens here in Madeira is that people don't respect it; a lot of people continue to put rubbish out without sorting it properly.

**Question:** And about the treatment system in Meia Serra, do you know how it's done?

**Answer:** I've visited Meia Serra. They do manage to do some sorting there. Above all, the green organics, the leftover materials from agriculture, from the gardens, they manage to make that so-called chip and put it together to make compost. But a lot of the waste goes to the incinerator, a lot of it goes to burn, and that produces electricity, on the one hand, but on the other hand, there's also the pollution aspect, the problem of the dioxins, which are environmentally harmful. And it ends up creating a certain comfort that it's all going to be burnt, and people generally don't worry too much about sorting or other solutions. Applying the 3Rs - reducing, recycling and reusing - should ideally be much stronger. There are even municipalities in mainland Portugal where measures are being taken in this direction. For example, they have eco points, where people who hand in their sorted rubbish receive credits, which can be used to top up the water bill or other benefits for the users themselves.

**Question:** Could this process be improved in any way? Do you have any ideas you'd like to implement, particularly in the tourism industry?

**Answer:** Yes, this whole process here in Madeira could be improved. In fact, there needs to be a more effective campaign among the population, hotels and so on. It's important to educate consumers about the 3Rs policy. In fact, what's missing from this 3Rs policy is another R, which is the R for responsibility. For us, for an island, waste is complicated. Because there are transport costs to export these products, which has negative consequences.

**Question:** What do you think is the impact of the rapid growth in tourism, particularly since the pandemic, on waste production and management in Madeira?

**Answer:** There has been a lot of waste production, not to mention the overloading of the destination. It's complicated, and the existing systems must be intensified. Above all, there has to be a bigger campaign because more people are using it, and more people are producing waste. Up until now, things have been resolved, but the tourism growth we're experiencing will lead to more people producing waste in the future. And so, we're going to have complicated situations. The people who visit us are generally more aware of these environmental issues. However, this could lead to problems for residents because, with this greater consumption, the municipalities that collect waste will probably either keep up with this growth, intensifying by having more people working and more equipment, or there will be situations of accumulation. The tourism sector in the region is growing at an ungoverned pace, so if growth is ungoverned or unplanned, so will the rest.

**Question:** A concept that is gaining prominence, especially in tourist destinations, is zero-waste. It's based on a circular economy, which sees waste as a resource and a way of saving/making money. The central aim is to reduce waste production as much as possible, while promoting reuse, recycling and eliminating landfill and incineration. This measure has already been successfully implemented on other tourist islands, such as Tilos in Greece, the 1st Zero Waste Island, which in just 2 years has managed to reduce its waste production by 40% and recycle 90% of the total, which was previously incinerated. Residents have received training and equipment, and tourists have been given information and tools for sorting waste, including an app to track their waste production. Practices that meet this concept could include the elimination of single-use plastics, provision of reusable objects (e.g. bottles, bags), fees/taxes that penalise waste production, and financial benefits for low waste

production/reuse/recycling. Do you think there are currently any measures focussed on reducing waste, in Madeira in general but also within the tourism sector?

**Answer:** Unfortunately, there is some work at this level, but it is insufficient. Why exactly? Because we're seeing a period in which there have been major improvements in the household economy, and they often don't look at their waste. In other words, the idea that when we go to the supermarket, buying products that have less waste is naturally important. But people often don't look at that, precisely because they're not thinking about the fact that they're probably paying for rubbish. When we buy certain products, a price is often applied to the rubbish. I vividly remember a campaign that took place around plastics, where the big stores offered plastic bags. They started to be paid for, but that didn't result in a reduction, people continue to use them, even if they pay. There are other campaigns, such as those that happen a lot at parties, where they often put out cups that people have to pay for. But you can see that people often continue to throw the cup away, even if they have paid for it. In other words, with this consumerism, people don't care about the value of plastic. And that has to be part of education campaigns, and there will probably have to be greater penalisation. When it starts to "hurt", people will probably think about cutting back.

**Question:** The current treatment system consists of 80% incineration, 13% recycling, 4% composting, and 3% landfill. In what ways do you think this system supports or hinders the adoption of reduction practices?

**Answer:** Of course, incineration is an "easy way" to look at a lot of waste. And we often weigh up the advantages, which are producing electricity and a significant reduction in this waste volume, but we don't think about the costs, about the environmental impacts that this has. The ideal would be to focus more on reduction, recycling and reuse, but this exaggerated consumerism is even more significant with this increase in tourism. We must continue to invest in policies that reduce incineration because it's an expensive process that pollutes the

environment. Other alternatives would be much more beneficial. Then, for example, there's the question of composting, all organic material should be chipped.

**Question:** Would the concept of zero waste be relevant and viable for Madeira, and for the tourism sector? What would be the main benefits and obstacles to its long-term implementation?

**Answer:** Without a doubt, it's as viable as anywhere else. And highly relevant, especially given our geographical limitations. This region has its own geography, and culturally and politically, it's very different from other regions. It has its limitations, all of which stem from a territory with very peculiar characteristics. We could, in fact, have much more incisive campaigns on the issue of waste. I see that nowadays, there are machines, such as washing machines, cookers, fridges, and water heaters, that often break down, and there are parts on sale that are relatively cheap, but people buy them new out of convenience. Then there's also the fact that we're in a period of great consumerism; people are always changing furniture, cars, and cell phones, and people don't repair anything these days. And then something new comes along, they throw away the old stuff that they still had, that could still be used. The barriers for Madeira are not only socio-economic but also very institutional and political.

**Question:** In your opinion, what changes would be needed, both in the tourism industry and on the island in general, to adopt zero waste practices more effectively?

**Answer:** This is a question that involves a lot of education. However, the big problem also has to do with political issues. We're in a period in which major decisions are made in electoral cycles. Statistics are often what matters. Often, certain measures are taken for the election's benefit. In other words, not so much thought is given to the good that certain decisions would bring, but above all, what counts are the votes. Waste management is often ignored. The worst is that there are no limits to the production of waste, so hotels and

institutions can produce all they want as long as they pay. There should be limits. And monitoring, because currently, there's no way to identify who does good or wrong.

**Question:** Do you think promoting this reduction of waste and even better separation at the base could be done through financial benefits or penalties?

**Answer:** Yes, that's right. There are already penalties for those who produce, but the biggest penalty is for the consumer. But what we see is that people don't think about it, they don't pay attention to it. They often just look at the final price. Here, it would be important to do what is done, for example, with tobacco. Put information on the packaging saying that this material can be recycled or recyclable; if it isn't, it has these costs. Whether it's the penalty or the benefit, I would perhaps go more for the benefit, this situation could help people adhere to better practices.

**Question:** Finally, do you think the tourism sector could be the driving force behind this movement to reduce waste and raise awareness, inspiring other sectors and residents to adopt these practices?

**Answer:** Yes, generally, our tourists are usually from countries that have more intense environmental policies than ours; that is, they generally have higher levels of education and greater environmental awareness. Then, there are day-to-day practices that the local residents often copy. There has to be a plan to involve the various players, including the most important economic activities, and tourism is one of them. The plans could be geared towards this sector or a kind of sub-plan. One part is the role of the state, and the other is the role of private agents, mostly in the tourism sector. The private sector has to want to do it, but there's a long way from wanting to do it to do it, and it doesn't just depend on the will of these agents. It has to be the state that establishes procedural and operational rules and criteria for these players, particularly in tourism, because voluntary action is not enough to bring about these changes.

## **Transcript 2:** *Interview about Tilos Island*

**Question:** What were the key factors that motivated Tilos to adopt a zero-waste approach? Were there specific challenges or opportunities that influenced this decision?

**Answer:** The primary motivation for Tilos was our commitment to sustainability and environmental protection. As a small island, we are particularly vulnerable to the impacts of climate change and pollution. Sustainable waste management was crucial for preserving our natural beauty and biodiversity. Additionally, the lack of space for traditional waste disposal methods (landfills). This limitation became an opportunity to innovate and lead by example. The growing global awareness of the environmental crisis aligned perfectly with our vision to make Tilos a beacon of ecological responsibility.

**Question:** Could you describe the most critical steps that were taken to transition Tilos into a ZW island, especially in the early stages?

**Answer:** We began with an initial assessment, an audit of the island's waste streams to understand the volume and types of waste produced. Then we moved to public engagement, informing and educating residents and businesses on waste separation and sustainable practices was fundamental. We also did infrastructure development, establishing the Circular Innovation Center and eliminating the landfill. Collaboration was important, and our partnership with Polygreen through the "Just Go Zero" initiative, along with support from the South Aegean Region and the Solid Waste Management Authority, helped us build the necessary capacities and implement innovative solutions.

**Question:** How long did it take to disable the incinerator and move to composting and recycling? What do you do with materials that cannot be recycled?

**Answer:** It took approximately six months to complete the transition from incineration to a system focused on composting and recycling. Non-recyclable materials are minimised

through careful waste management and are sent to cement industries to be used as renewable fuel.

**Question:** Were there any policies/regulations from the government that facilitated this transition, as well as local/international partnerships?

**Answer:** Government policies encourage recycling and promote the circular economy. The South Aegean Region and the Solid Waste Management Authority (FODSA) played a crucial role by offering technical guidance and coordination, ensuring that our efforts align with regional strategies. However, the cornerstone of our success was the partnership with Polygreen through the "Just Go Zero" initiative. Polygreen not only provided expertise and innovative solutions but also fully funded the project. This financial and technical support enabled us to transition swiftly and effectively to a zero-waste system tailored to the needs of Tilos. This collaboration highlights the importance of visionary partnerships in driving sustainable change, even in small, remote communities like ours.

**Question:** How did the local community and businesses initially react to the shift towards zero waste? What strategies were used to engage them and ensure their participation?

**Answer:** At first, there was skepticism, as changing habits is never easy. However, the community quickly realized the long-term benefits. Workshops, hands-on demonstrations, and regular communication helped ease the transition. Businesses were incentivized through programs recognizing sustainable practices, and residents were provided with the necessary tools and information to make waste separation simple and efficient.

**Question:** How has the tourism sector adapted to the zero-waste initiatives? Have tourists responded positively, and have there been any particular strategies for managing waste generated by visitors?

**Answer:** Tourists have responded overwhelmingly positively, viewing Tilos as a unique and responsible travel destination. Hotels and restaurants adopted waste separation and

composting practices. Reusable items replaced single-use plastics, and information campaigns targeted visitors to ensure their cooperation.

**Question.** What role do you believe the tourism sector played in the zero-waste transition?

**Answer:** The tourism sector played a dual role: as a challenge, due to increased waste during peak seasons, and as a catalyst for promoting our zero-waste ethos. Sustainable tourism has become a cornerstone of our identity, demonstrating that visitors can contribute positively. This sector can indeed be a driver of similar initiatives if managed thoughtfully, as eco-conscious travelers increasingly prioritize such destinations.

**Question:** What have been the biggest challenges in maintaining and expanding the zero-waste practices on Tilos?

**Answer:** One major challenge is ensuring long-term engagement from all stakeholders. It's easy for enthusiasm to wane, so continuous education and reminders are essential. Another issue is dealing with non-recyclable materials and the cost of transporting them off-island. Lastly, scaling our practices while balancing the needs of growing tourism has required constant adaptation and innovation.

**Question:** Based on your experience, do you believe Madeira Island, with nearly 260,000 inhabitants and relying on 82% incineration, could adopt the same strategy?

**Answer:** Absolutely. While the scale is significantly larger, the principles remain the same. Start by conducting a waste audit to understand Madeira's specific challenges. Focus on education and public engagement from the outset, and establish partnerships with environmental organisations to share expertise and costs. It's also crucial to develop localised solutions tailored to the island's geography, economy, and culture. Finally, emphasise the economic and ecological benefits to gain public and political support. Madeira has the potential to lead by example, just like Tilos, showing that even larger communities can prioritise sustainability over convenience.

**Appendix 8 – Thematic Analysis Coding**

**Table 1: Coding for interviews about Madeira Island**

Main Category	Subcategory	Sub-subcategory	Number of Participants (N=18)	Number of Transcript excerpts	
<b>Current Waste Management</b>	Description	Processes and treatment	13	40	
		Uncertainty on topic	7	19	
		Sustainability consciousness	9	19	
	Current ZW practices	Recycling and separation	10	29	
		Composting	6	20	
		Raising awareness	5	9	
		Reuse	5	14	
		Reduce	5	19	
		Optimism	-	17	47
		Criticism	-	14	25
<b>Current Tourism State</b>	Description	-	12	31	
	Criticism	-	5	8	
	Tourism's Impact	-	17	49	
	Adaptation to increase in tourism	-	11	25	
	Tourist's perceptions	-	11	22	
<b>Barriers to Sustainability</b>	Social	Cultural resistance	10	26	
		Neglected waste practices	9	37	
		Consumerism	9	20	
		Lack of information/education	8	23	
	Economic	Financial prioritisation	4	7	
		Lack of resources	5	15	
		Lack of time and space	3	14	
		Linear economy	8	15	
		Investment/expensive	5	10	
		Tourism sector	8	15	
	Government	Geographical	-	11	19
		Current WMS	-	15	27
		Poor waste management	12	36	
		Poor tourism management	7	23	

		Lack of community engagement	6	9
		Inaction/corruption	7	12
<b>Zero Waste</b>	Lack/non-existence	-	9	29
	Relevance to Madeira	-	17	37
	Benefits	-	11	18
	Criticism	-	9	20
	Tourism as driver	-	18	35
<b>Changes needed</b>	Social	-	10	23
	Collaborative action/learning	-	7	15
	Government	Legislation	15	44
		Incentives & financial support	11	18
		Tourism management	7	20
		Waste management	13	45
		Local economy	8	20
		Awareness campaigns	18	65

**Table 2:** *Coding for interviews about Tilos Island*

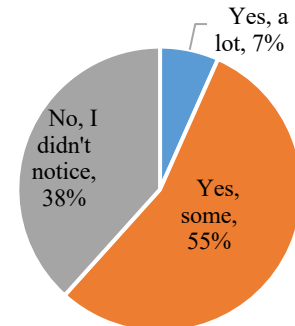
Main Category	Subcategory	Sub-subcategory	Number of Participants (N=3)	Number of Transcript excerpts
<b>Previous WMS</b>	Description	-	2	3
<b>Zero Waste</b>	Initiative and motivation	-	3	3
	Processes	Public engagement	3	6
		Eliminate incinerator and landfills	2	2
		Door to door collection	2	2
		Bio-waste composting	2	2
		Incentives to businesses	1	1
	Tourism sector	Role in Zero Waste project	3	3
		Impact of Zero Waste	2	3
<b>Success criteria for Madeira</b>	WMS	Door to door collection	1	1
	Public engagement	-	3	3
	Partnerships	-	2	2

## Appendix 9 – Survey Questions and Answers

### Questionnaire: Understanding How Tourism Can Drive Sustainable Practices in Madeira

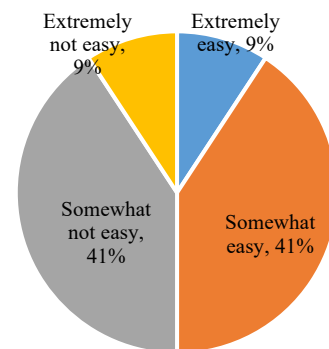
1. During your stay in Madeira, did you notice any efforts to reduce waste or promote waste sustainability at your accommodation or tourist sites?

- Yes, a lot
- Yes, some
- No, I didn't notice



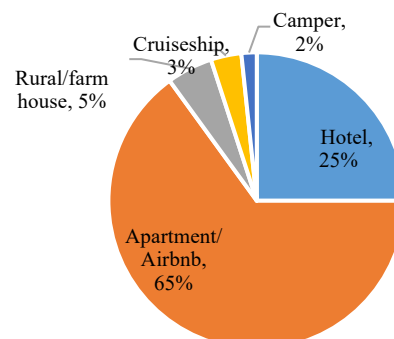
2. How easy was it to separate waste or to find recycling bins during your stay?

- Extremely easy
- Somewhat easy
- Neutral
- Somewhat not easy
- Extremely not easy



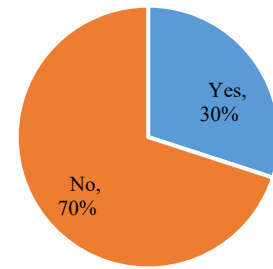
3. What type of accommodation did you stay in during your visit?

- Apartment/Airbnb
- Hotel
- Rural/farmhouse
- Cruise ship
- Other (please specify)



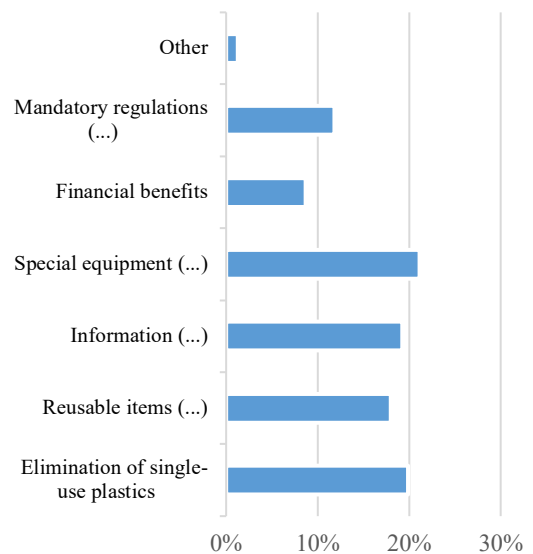
4. Did the accommodation you stayed at provide information or instructions about managing waste (e.g., sorting, recycling, composting, reducing)?

- Yes
- No



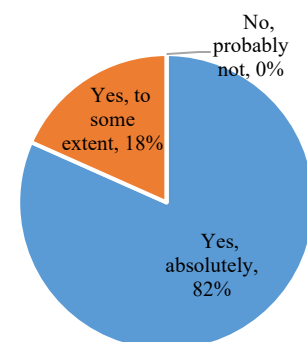
5. Which measures would help you reduce waste during your stay in Madeira? (You can select multiple options)

- Elimination of single-use plastics
- Reusable items provided (e.g., bottles, bags)
- Information about how to separate waste
- Special equipment for proper separation at accommodation
- Financial benefits (e.g., discounts for sustainable choices)
- Mandatory regulations or taxes discouraging waste production
- Other (please specify)



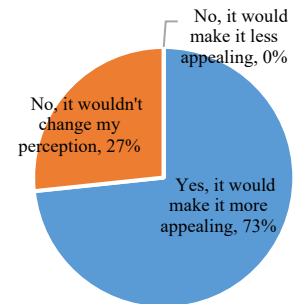
6. Would you be willing to take actions that directly reduce waste, such as the ones described in the last question, during your stay in Madeira?

- Yes, absolutely
- Yes, to some extent
- No, probably not



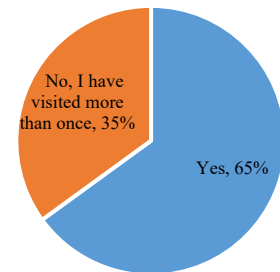
7. Zero-waste is a concept grounded in the circular economy, which views waste as a resource. It aims to significantly reduce waste production by prioritizing reuse and recycling, ultimately eliminating the need for landfills and incineration. Would Madeira be more appealing to you as a tourist if it were a Zero-Waste island?

- Yes, it would make it more appealing
- No, it wouldn't change my perception
- No, it would make it less appealing



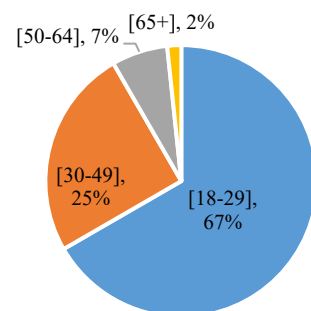
8. Was this your first time visiting Madeira?

- Yes
- No, I have visited more than once



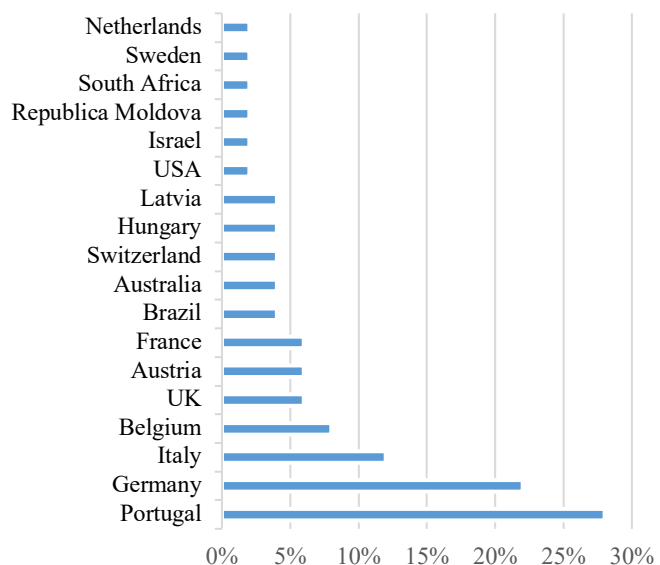
9. Please select your age group.

- 18–29
- 30–49
- 50–64
- 65+



10. Where do you come from?

- Portugal
- France
- Italy
- Germany
- Other (please specify)



*Appendix 10 – Quantitative research: Chi-square analysis and contingency tables*

**Figure 1: Question 1 and Question 2**

Contingency Tables

Q1: Efforts to reduce waste noticed		Q2: Ease of finding recycling bins					Total
		Extremely easy	Extremely not easy	Neutral	Somewhat easy	Somewhat not easy	
No, I didn't notice	Observed	0	2	2	7	12	23
	Expected	1.917	1.917	2.300	8.433	8.433	23.000
	% within row	0.0%	8.7%	8.7%	30.4%	52.2%	100.0%
	% within column	0.0%	40.0%	33.3%	31.8%	54.5%	38.3%
Yes, a lot	Observed	3	0	0	1	0	4
	Expected	0.333	0.333	0.400	1.467	1.467	4.000
	% within row	75.0%	0.0%	0.0%	25.0%	0.0%	100.0%
	% within column	60.0%	0.0%	0.0%	4.5%	0.0%	6.7%
Yes, some	Observed	2	3	4	14	10	33
	Expected	2.750	2.750	3.300	12.100	12.100	33.000
	% within row	6.1%	9.1%	12.1%	42.4%	30.3%	100.0%
	% within column	40.0%	60.0%	66.7%	63.6%	45.5%	55.0%
Total	Observed	5	5	6	22	22	60
	Expected	5.000	5.000	6.000	22.000	22.000	60.000
	% within row	8.3%	8.3%	10.0%	36.7%	36.7%	100.0%
	% within column	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

χ<sup>2</sup> Tests

	Value	df	p
χ <sup>2</sup>	28.432	8	<.001
N	60		

Nominal

	Value
Phi-coefficient	NaN
Cramer's V	0.487

**Figure 2: Question 1 and Question 4**

Contingency Tables

Q1: Efforts to reduce waste noticed		Q4: Information on waste management provided		
		No	Yes	Total
No, I didn't notice	Observed	19	4	23
	Expected	16.100	6.900	23.000
	% within row	82.6%	17.4%	100.0%
	% within column	45.2%	22.2%	38.3%
Yes, a lot	Observed	0	4	4
	Expected	2.800	1.200	4.000
	% within row	0.0%	100.0%	100.0%
	% within column	0.0%	22.2%	6.7%
Yes, some	Observed	23	10	33
	Expected	23.100	9.900	33.000
	% within row	69.7%	30.3%	100.0%
	% within column	54.8%	55.6%	55.0%
Total	Observed	42	18	60
	Expected	42.000	18.000	60.000
	% within row	70.0%	30.0%	100.0%
	% within column	100.0%	100.0%	100.0%

$\chi^2$  Tests

	Value	df	p
$\chi^2$	11.076	2	0.004
N	60		

Nominal

	Value
Phi-coefficient	NaN
Cramer's V	0.430

**Figure 3: Question 1 and Question 8**

Contingency Tables

Q1: Efforts to reduce waste noticed		Q8: First time visiting Madeira		
		No, I have visited more than once	Yes	Total
No, I didn't notice	Observed	6	17	23
	Expected	8.050	14.950	23.000
	% within row	26.1%	73.9%	100.0%
	% within column	28.6%	43.6%	38.3%
Yes, a lot	Observed	4	0	4
	Expected	1.400	2.600	4.000
	% within row	100.0%	0.0%	100.0%
	% within column	19.0%	0.0%	6.7%
Yes, some	Observed	11	22	33
	Expected	11.550	21.450	33.000
	% within row	33.3%	66.7%	100.0%
	% within column	52.4%	56.4%	55.0%
Total	Observed	21	39	60
	Expected	21.000	39.000	60.000
	% within row	35.0%	65.0%	100.0%
	% within column	100.0%	100.0%	100.0%

$\chi^2$  Tests

	Value	df	p
$\chi^2$	8.272	2	0.016
N	60		

Nominal

	Value
Phi-coefficient	NaN
Cramer's V	0.371

**Figure 4: Question 2 and Question 4**

Q2: Ease of finding recycling bins		Q4: Information on waste management provided		
		No	Yes	Total
Extremely easy	Observed	1	4	5
	Expected	3.500	1.500	5.000
	% within row	20.0%	80.0%	100.0%
	% within column	2.4%	22.2%	8.3%
Extremely not easy	Observed	5	0	5
	Expected	3.500	1.500	5.000
	% within row	100.0%	0.0%	100.0%
	% within column	11.9%	0.0%	8.3%
Neutral	Observed	6	0	6
	Expected	4.200	1.800	6.000
	% within row	100.0%	0.0%	100.0%
	% within column	14.3%	0.0%	10.0%
Somewhat easy	Observed	11	11	22
	Expected	15.400	6.600	22.000
	% within row	50.0%	50.0%	100.0%
	% within column	26.2%	61.1%	36.7%
Somewhat not easy	Observed	19	3	22
	Expected	15.400	6.600	22.000
	% within row	86.4%	13.6%	100.0%
	% within column	45.2%	16.7%	36.7%
Total	Observed	42	18	60
	Expected	42.000	18.000	60.000
	% within row	70.0%	30.0%	100.0%
	% within column	100.0%	100.0%	100.0%

$\chi^2$  Tests

	Value	df	p
$\chi^2$	17.662	4	0.001
N	60		

Nominal

	Value
Phi-coefficient	NaN
Cramer's V	0.543

**Figure 5: Question 2 and Question 8**

Contingency Tables

Q2: Ease of finding recycling bins		Q8: First time visiting Madeira		
		No, I have visited more than once	Yes	Total
Extremely easy	Observed	3	2	5
	Expected	1.750	3.250	5.000
	% within row	60.0%	40.0%	100.0%
	% within column	14.3%	5.1%	8.3%
Extremely not easy	Observed	2	3	5
	Expected	1.750	3.250	5.000
	% within row	40.0%	60.0%	100.0%
	% within column	9.5%	7.7%	8.3%
Neutral	Observed	3	3	6
	Expected	2.100	3.900	6.000
	% within row	50.0%	50.0%	100.0%
	% within column	14.3%	7.7%	10.0%
Somewhat easy	Observed	11	11	22
	Expected	7.700	14.300	22.000
	% within row	50.0%	50.0%	100.0%
	% within column	52.4%	28.2%	36.7%
Somewhat not easy	Observed	2	20	22
	Expected	7.700	14.300	22.000
	% within row	9.1%	90.9%	100.0%
	% within column	9.5%	51.3%	36.7%
Total	Observed	21	39	60
	Expected	21.000	39.000	60.000
	% within row	35.0%	65.0%	100.0%
	% within column	100.0%	100.0%	100.0%

$\chi^2$  Tests

	Value	df	p
$\chi^2$	10.689	4	0.030
N	60		

Nominal

	Value
Phi-coefficient	NaN
Cramer's V	0.422

**Figure 6: Question 4 and Question 8**

Contingency Tables

Q4: Information on waste management provided		Q8: First time visiting Madeira		
		No, I have visited more than once	Yes	Total
No	Observed	10	32	42
	Expected	14.700	27.300	42.000
	% within row	23.8%	76.2%	100.0%
	% within column	47.6%	82.1%	70.0%
Yes	Observed	11	7	18
	Expected	6.300	11.700	18.000
	% within row	61.1%	38.9%	100.0%
	% within column	52.4%	17.9%	30.0%
Total	Observed	21	39	60
	Expected	21.000	39.000	60.000
	% within row	35.0%	65.0%	100.0%
	% within column	100.0%	100.0%	100.0%

$\chi^2$  Tests

	Value	df	p
$\chi^2$	7.706	1	0.006
N	60		

Nominal

	Value
Phi-coefficient	0.358
Cramer's V	0.358

**Figure 7: Question 4 and Question 9**

Contingency Tables

Q4: Information on waste management provided		Q9: Age group				Total
		18-29	30-49	50-64	65+	
No	Observed	32	8	1	1	42
	Expected	28.000	10.500	2.800	0.700	42.000
	% within row	76.2%	19.0%	2.4%	2.4%	100.0%
	% within column	80.0%	53.3%	25.0%	100.0%	70.0%
Yes	Observed	8	7	3	0	18
	Expected	12.000	4.500	1.200	0.300	18.000
	% within row	44.4%	38.9%	16.7%	0.0%	100.0%
	% within column	20.0%	46.7%	75.0%	0.0%	30.0%
Total	Observed	40	15	4	1	60
	Expected	40.000	15.000	4.000	1.000	60.000
	% within row	66.7%	25.0%	6.7%	1.7%	100.0%
	% within column	100.0%	100.0%	100.0%	100.0%	100.0%

$\chi^2$  Tests

	Value	df	p
$\chi^2$	8.175	3	0.043
N	60		

Nominal

	Value
Phi-coefficient	NaN
Cramer's V	0.369



Contingency Tables

Q5: Measures to reduce waste		Q9: Age group				Total
		18-29	30-49	50-64	65+	
	% within row	100.0%	0.0%	0.0%	0.0%	100.0%
	% within column	2.5%	0.0%	0.0%	0.0%	1.7%
Mandatory regulations or taxes discouraging waste production;	Observed	1	0	0	0	1
	Expected	0.667	0.250	0.067	0.017	1.000
	% within row	100.0%	0.0%	0.0%	0.0%	100.0%
	% within column	2.5%	0.0%	0.0%	0.0%	1.7%
Mandatory regulations or taxes discouraging waste production;Special equipment for proper separation at accommodation;Financial benefits (e.g., discounts for sustainable choices);	Observed	1	0	0	0	1
	Expected	0.667	0.250	0.067	0.017	1.000
	% within row	100.0%	0.0%	0.0%	0.0%	100.0%
	% within column	2.5%	0.0%	0.0%	0.0%	1.7%
Reusable items provided (e.g., bottles, bags);	Observed	2	1	0	0	3
	Expected	2.000	0.750	0.200	0.050	3.000
	% within row	66.7%	33.3%	0.0%	0.0%	100.0%
	% within column	5.0%	6.7%	0.0%	0.0%	5.0%
Reusable items provided (e.g., bottles, bags);Elimination of single-use plastics;	Observed	1	0	0	0	1
	Expected	0.667	0.250	0.067	0.017	1.000
	% within row	100.0%	0.0%	0.0%	0.0%	100.0%
	% within column	2.5%	0.0%	0.0%	0.0%	1.7%
Reusable items provided (e.g., bottles, bags);Elimination of single-use plastics;Information about how to separate waste;Special equipment for proper separation at accommodation;Mandatory regulations or taxes discouraging waste production;	Observed	1	0	0	0	1
	Expected	0.667	0.250	0.067	0.017	1.000
	% within row	100.0%	0.0%	0.0%	0.0%	100.0%
	% within column	2.5%	0.0%	0.0%	0.0%	1.7%
Reusable items provided (e.g., bottles, bags);Information about how to separate waste;Special equipment for proper separation at accommodation;Financial benefits (e.g., discounts for sustainable choices);	Observed	0	0	1	0	1
	Expected	0.667	0.250	0.067	0.017	1.000

## Chi Tests

	Value	df	p
Chi <sup>2</sup>	151.583	117	0.017
N	60		

## Nominal

	Value
Phi-coefficient	NaN
Cramer's V	0.918

Contingency Tables

Q5: Measures to reduce waste		Q9: Age group				Total
		18-29	30-49	50-64	65+	
	% within row	0.0%	0.0%	100.0%	0.0%	100.0%
	% within column	0.0%	0.0%	25.0%	0.0%	1.7%
Reusable items provided (e.g., bottles, bags);Special equipment for proper separation at accommodation;	Observed	2	2	0	0	4
	Expected	2.667	1.000	0.267	0.067	4.000
	% within row	50.0%	50.0%	0.0%	0.0%	100.0%
	% within column	5.0%	13.3%	0.0%	0.0%	6.7%
Reusable items provided (e.g., bottles, bags);Special equipment for proper separation at accommodation;Financial benefits (e.g., discounts for sustainable choices);Mandatory regulations or taxes discouraging waste production;	Observed	1	0	0	0	1
	Expected	0.667	0.250	0.067	0.017	1.000
	% within row	100.0%	0.0%	0.0%	0.0%	100.0%
	% within column	2.5%	0.0%	0.0%	0.0%	1.7%
Special equipment for proper separation at accommodation;Information about how to separate waste;Reusable items provided (e.g., bottles, bags);Elimination of single-use plastics;	Observed	1	0	0	0	1
	Expected	0.667	0.250	0.067	0.017	1.000
	% within row	100.0%	0.0%	0.0%	0.0%	100.0%
	% within column	2.5%	0.0%	0.0%	0.0%	1.7%
Special equipment for proper separation at accommodation;Mandatory regulations or taxes discouraging waste production;	Observed	0	1	0	0	1
	Expected	0.667	0.250	0.067	0.017	1.000
	% within row	0.0%	100.0%	0.0%	0.0%	100.0%
	% within column	0.0%	6.7%	0.0%	0.0%	1.7%
Special equipment for proper separation at accommodation;Mandatory regulations or taxes discouraging waste production;Elimination of single-use plastics;Financial benefits (e.g., discounts for sustainable choices);	Observed	1	0	0	0	1
	Expected	0.667	0.250	0.067	0.017	1.000
	% within row	100.0%	0.0%	0.0%	0.0%	100.0%
	% within column	2.5%	0.0%	0.0%	0.0%	1.7%
Total	Observed	40	15	4	1	60
	Expected	40.000	15.000	4.000	1.000	60.000
	% within row	66.7%	25.0%	6.7%	1.7%	100.0%
	% within column	100.0%	100.0%	100.0%	100.0%	100.0%

**Appendix 11 – Calculations of tourism’s impact on Madeira’s WMS**

**Sources:** ARM (2023); SRAPA and DRAM (2024)

	Madeira 2023	Tourism 2023	
		41.90%	46.60%
Total MSW (ton)	124229	52052	57891
Mixed waste (ton)	108079	45285	50365
Bio-waste (ton)	51878	21737	24175
Recyclables (ton)	33721	14129	15714
Total incineration cost (€) [Calculation: Mixed waste x 82.5€]	€8,916,536	€3,736,029	€4,155,106
Reduction in total incineration with new treatment [Calculation: Bio-waste + Recyclables]	-	35866 or 33%	39889 or 37%
Savings in incineration cost with new treatment (€) [Calculation: Reduction in incineration x 82.5€]	-	€2,958,935	€3,290,844