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# Tackling Single-Use-Plastic in small touristic islands to reduce marine litter: co-identifying the best mix of policy interventions

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Marine litter is a worldwide issue affecting local communities with increasing environmental and economic impacts, with Single-Use-Plastic (SUP) pollution being of specific concern. The tourism industry has been identified as one of the major sectors contributing to marine plastic pollution therefore in need to take urgent actions. Small islands are particularly vulnerable and need locally adapted strategies to effectively tackle this issue. This study proposes the use of a participative system-based approach to co-design, with local stakeholders, a roadmap tackling Single-Use-Plastic (SUP) in the hospitality industry of small Greek touristic islands. Policy, industry, civil society and academia representatives were involved in a participative co-creation process to co-identify the best mix of policy instruments and innovations (social and technological) adapted to the local island context, capable of reducing plastic consumption and littering in the island while fostering behavioural change (from consumers and local businesses perspective). Results show the lack of knowledge and awareness, the limited financial resources and expertise, and the low efficiency of the waste management system as the main challenges. A roadmap of short and mid-term actions, based on the Circular Economy reduce, reuse, recycle principles was co-developed, including raising awareness campaigns across stakeholder groups, positive economic incentives, development of capacity building and partnerships within the quadruple helix (academia, business, public authorities and civil society representatives), forming the basis of the municipal island free SUP strategy. The active involvement of public and private actors as well as the civil society, empowering local actors and developing trust across stakeholder groups are key factors to develop a successful strategy able to tackle plastic pollution locally. Pilot experiments also proved to be a determinant for the adoption of sustainable solutions in the context of small islands.

## KEYWORDS

marine litter, participative approach, island, co-production and co-learning, system thinking approach, single-use-plastics

## 1. Introduction

Over the past 20 years, an increased number of scientific publications and reports from international organisations (Alessi and Di Carlo, 2018; Ellen MacArthur Foundation, 2016; UNEP, 2016; Abalansa et al., 2020; Aretoulaki et al., 2020; OECD, 2022b) have documented the rising problem of marine litter and plastic pollution, in particular, a man-made environmental pollutant that has reached the most remote islands on Earth (Barnes, 2005). Plastic makes up most of the debris in the ocean (Bergmann et al., 2015; Galgani et al., 2015); leakage in the marine environment is estimated at 22 Mt. (megatonnes) in 2019 (OECD, 2022a) and alarming predictions for the coming decades (leakage to be doubled by 2060, cf. OECD, 2022b) leading to a situation where oceans around the globe will contain more marine litter than fish by 2050 (Ellen MacArthur Foundation, 2016). This extensive plastic-based contamination of the marine environment is directly linked to the mass consumption and unsustainable production systems which characterize our modern societies (Rangel-Buitrago et al., 2020), where cheap plastic-based products are widely used (Lebreton et al., 2017), often for a very short time (e.g., SUP items) in comparison to the durability of the material itself (Szteiová, 2010). This pro-consumerism system is reaching its limits with regards to the environmental damage which it generates, such as habitat degradation, plastic contamination of the food chain, death of marine vertebrate through entanglement and ingestion (Reisser et al., 2013; Kühn et al., 2015; UNEP, 2016; Delia, 2021). This anthropogenic damage is dramatically changing the face of the Earth, creating a new era shaped by humans: the Anthropocene; where plastic is proposed as a key geological indicator (Zalasiewicz et al., 2016). To tackle the challenge, urgent societal and behavioural changes (from the supply to the demand side) are needed before tipping points are reached and the damage is irreversible. A variety of policy instruments have already been identified, from regulatory (e.g. ban on plastic bags), market-based instruments (e.g. deposit-refund schemes), voluntary agreements (e.g. public-private agreements; memorandums of understanding), to awareness campaigns (e.g. beach clean-ups), as well as local examples of successful initiatives known as best practices (UNEP, 2016, 2018; Alpizar et al., 2020). However the effective implementation of these solutions with demonstrable results is still limited, questioning the capacity of local communities to effectively implement policies and replicate successful initiatives.

Small island communities are particularly vulnerable to marine litter impacts (Lachmann et al., 2017). Beside facing additional challenges when it comes to prevention and mitigation measures (e.g. higher infrastructure cost, limited resources, remoteness) (Eckelman et al., 2014), small islands are often characterized by high ecological value (Monteiro et al., 2018) which make them more sensitive to plastic exposure and pollution. From an economic point of view, small islands are dependent on few sectors (Boto and Biasca, 2012), with coastal tourism (“sea, sun, sand” model) being often the dominant economic activity. This sector relies particularly on the good environmental status of coastal-marine ecosystems (i.e. clean beaches and sea). As cleanness is a determining factor of tourism attractiveness (Cabezas-Rabadán et al., 2019), marine litter represents an economical risk and additional costs for the sector, and the local community in general (Watkins et al., 2015; Newman et al., 2015; Rodríguez et al., 2020; Chatziparaskeva et al., 2022). However, the tourism sector is also part of the problem, as a source of marine litter (Chatziparaskeva et

al., 2022; UNEP 2019), by creating additional pressures on a generally weak island waste management systems, due to higher volume of waste to be managed locally during the tourist season (Hoellein et al., 2015). Beach tourists have also been associated with unsustainable practices and littering (Eastman et al., 2013), further aggravating the waste issue. In the island context, it creates an additional burden where solid wastes are already poorly managed, characterized by low recycling rate and insufficient reuse of items, under-developed infrastructures, insufficient law enforcement, small market sizes and dis-economies of scale (Eckelman et al., 2014; Fuldauer et al., 2019; Tyedmers et al., 2020).

Knowing that the top ten most collected items on the beach are Single-Use-Plastic (SUP) items released close to large urban or tourist areas (Bergmann et al., 2015; Wilson and Verlis, 2017), with a peak during summer tourism season (Thiel et al., 2013; Hoellein et al., 2015; Alessi and Di Carlo, 2018), this research chose to focus on Single-Use-Plastic in the hospitality industry in small highly touristic islands in the Mediterranean Sea, as a means to tackle marine litter. There is an urgency to support island communities in developing concrete strategies to better manage waste and mitigate negative impacts of anthropogenic coastal development, as they are key drivers of marine litter (European Commission et al., 2014; Jambeck et al., 2015).

In the context of the implementation of the European Commission’s SUP Directive, which has banned the use of certain SUP items since 2021 (e.g. straws, stirrers, plastic cutlery), and imposes measures to reduce the consumption of other SUPs (i.e. food and beverage containers) (European Commission, 2018), this study looked at mitigation measures tackling SUP litter prior to release in the marine environment. To that end, the study focused on fostering sustainable practices in the local hospitality industry to reduce the production of waste, as suggested by Mohee et al. (2015). The objective of the study was to co-develop a roadmap in collaboration with local public authorities to phase out SUP items in the hospitality industry. It is based on a strong multi-stakeholder engagement process and real-world experiments within the business ecosystem; a stakeholder group which is less addressed within the literature (Garcia-Vazquez et al., 2021). A qualitative and participatory system innovation approach (Mulgan and Leadbeater, 2013; De Vicente López and Matti, 2016; Alamanos et al., 2022) was used to identify the best mix of policy instruments adapted to the specific island context. Exploratory research was conducted in three different small touristic islands in the Eastern part of the Mediterranean Sea where common challenges and barriers were identified, highlighting the uniqueness of the island context but also the shared challenges (Gkoltsiou and Mouggiakou, 2021). The full roadmap development was implemented on one of the islands (Corfu, in the Greek Ionian Sea) providing short and mid-term actions targeting businesses, consumers, and public authorities.

This study seeks to further enrich the literature on marine litter and island sustainability by exploring the opportunities given by combining qualitative system thinking and transition management approaches, empowering local communities and bridging the science-policy-society gap in order to tackle sustainability challenges. It gives a concrete example of stakeholder engagement processes based on the strong multi-actor participatory approach, engaging public authorities and the hospitality industry in order to co-develop solutions to phase out the use of SUPs for the reduction of marine pollution, paving the way to sustainability transformation on the islands.

## 2. Study area

The Mediterranean Sea is one of the most impacted sea basins in the world by plastic pollution (Sharma et al., 2021), it represents 1% of the world's water but harbours around 7% of global microplastics; the so-called Mediterranean "plastic trap" (Suaria et al., 2016). The majority of this plastic is from land-based sources (Papadimitriou and Allinson, 2022). In the region, the tourism sector is responsible for a 40% increase of marine litter during summer (Galgani et al., 2014), thus the urgent need for the sector to take action (Sharma et al., 2021). Within the Mediterranean countries, Greece is representative of the marine plastic litter struggle, with an estimate of 11 500 tonnes of plastics, ending up in the Greek seas every year (above two thirds washes onto the coastlines within a year), mainly due to coastal activities (Dalberg Advisors, 2019). In the context of the Greek islands, different key factors need to be taken into consideration when it comes to waste and marine litter issues. The country is characterised by structural waste management issues which include low capacity from municipalities, lack of know-how, lack of recycling infrastructures, difficulties in implementing separate collections, low public engagement towards good practices and low trust in public authorities. Greece has one of Europe's lowest *per capita* volumes of processing and recycling plastic waste (cf. Eurostat) while individuals consume coffees and other take away food products which use disposable packaging like SUPs on a daily basis. This generates considerable volumes of waste which often end up in landfills, where there is a risk of leakage into the environment. Plastic straws, cups, bags, and other packaging items are commonly found on beaches (Kouvara et al., 2022). Finally, the Greek islands have to deal with intense coastal tourism and recreational activities which are responsible for an increase in waste of up to 26% every year (Alessi and Di Carlo, 2018). Greece receives three times more visitors than its own population, with small islands welcoming millions of beachgoers in a few months. This creates extensive pressures on the waste management system, which is generally not designed to cope with the excess of waste generated by this seasonal activity. As a result, plastic litter leaking into the marine environment is common. It is worth mentioning that the COVID-19 pandemic has not necessarily further increased SUP litter in the Greek coastal areas despite an increase in use during the same period (Kouvara et al., 2022).

The study site included three Greek touristic islands of different sizes and characteristics. Ikaria is a small island of 255 km<sup>2</sup> with a population of 8,312 inhabitants, part of the North Eastern Aegean Sea, close to Turkey. Famous for its nature and surf beach, the island attracts more and more tourists during the religious feasts celebrating the Saints' Days ("panagiria" in Greek), where thousands of people gather in the villages throughout the summer to eat, drink, and dance. These events are sources of very high consumption of plastic waste that is not recycled and ends up in landfill. The second island, Syros (83.6 km<sup>2</sup> for 21,507 inhabitants), located in the Cyclades region (South Aegean Sea) is not as touristic as its neighboring islands, Mikonos, Paros, or Santorini. Nevertheless, the island has very popular beach bars and restaurants as well as a high number of cafés due to its year-long resident community and the vibrant city, Ermoupoli, the capital of the Cyclades region. Therefore, the consumption of SUP items and plastic waste produced is substantial. The island of Corfu (Kérkyra), the seventh biggest Greek island (593 km<sup>2</sup>), is a hot spot for coastal tourism activity in Greece, located

in the Northwest part of the Ionian Sea. It comprises a population of approximately 102,000 inhabitants and attracts more than 1,300,000 tourists from abroad annually. Corfu is in the top five most visited Greek islands, having to manage approximately 9,000 tons of garbage at the peak of the season, with only 5 to 7% being recycled; the rest ends up in landfills, (many illegal) increasing the risk of soil and water contamination. As anywhere else in Greece, high consumption levels of SUP items (cups, straws, bags, bottles) can be observed in the local community on a daily basis. Beach littering and plastic leakage in the marine environment are common features. In Corfu, the waste management issue is even more sensitive, following a major waste management crisis in the middle of the 2018 Summer season which aggravated the situation and created a feeling of distrust between citizens and the municipality.

## 3. Materials and methods

### 3.1. A participatory system-based approach

Phasing out the use of SUP items is a sustainability problem with systemic challenges which requires a transformative change in consumer habits, business models, and processes. We used a challenge-led system mapping process (Matti et al., 2020) based on system innovation and a transition management approach (Loorbach, 2007, 2014; Roorda et al., 2014), a transdisciplinary, participatory methodology used in the field of sustainability transition in order to deal with persistent problems and facilitate sustainable change (Brugge and Rotmans, 2007). It is used to trigger processes of change that transform the way societal systems meet societal needs; these are fundamental shifts in structures, mindsets, and practices, involving multi-actor engagement from many different domains and scale-levels in problem-solving-oriented activities, co-production of knowledge, and co-design of solutions in an iterative process (Geels and Schot, 2007; Roorda and Akinsete, 2013; Durose et al., 2022). The highly participatory process enables stakeholders to take into account a diversity of perspectives while managing potential actors' disagreements between stakeholders in their response to sustainability challenges by outlining a direction of change (Smith et al., 2005). Transition management ultimately aims to influence the direction and pace of societal change dynamics, contributing to sustainability by creating space for new ways of organizing, doing, and thinking. It supports collective empowerment, eventually bringing about a desired sustainable transition (Loorbach and Rotmans, 2006). System innovation (Idil Gaziulusoy, 2015; Schlaile and Urmetzer, 2019) and system thinking theories (Bosch et al., 2007; Espinosa et al., 2008; Marshall and Farahbakhsh, 2013; Arnold and Wade, 2015) are mobilized to look at the system as a whole, better understand the complexity of the local context and relations (interconnectivity and interdependency of actors, drivers, barriers and opportunities) of each part of the system, and support policy-makers in designing innovative policies for sustainable change (Edler and Fagerberg, 2017). In the case of marine litter and SUP, we aim to analyze the systemic challenges across the social-ecological system of the island from the upstream (preventing the consumption of plastic) to the downstream (responding to plastic leakage in the environment), examining the different aspects of the problem, the existing opportunities (successful existing initiatives), and the emerging solutions (e.g., social and

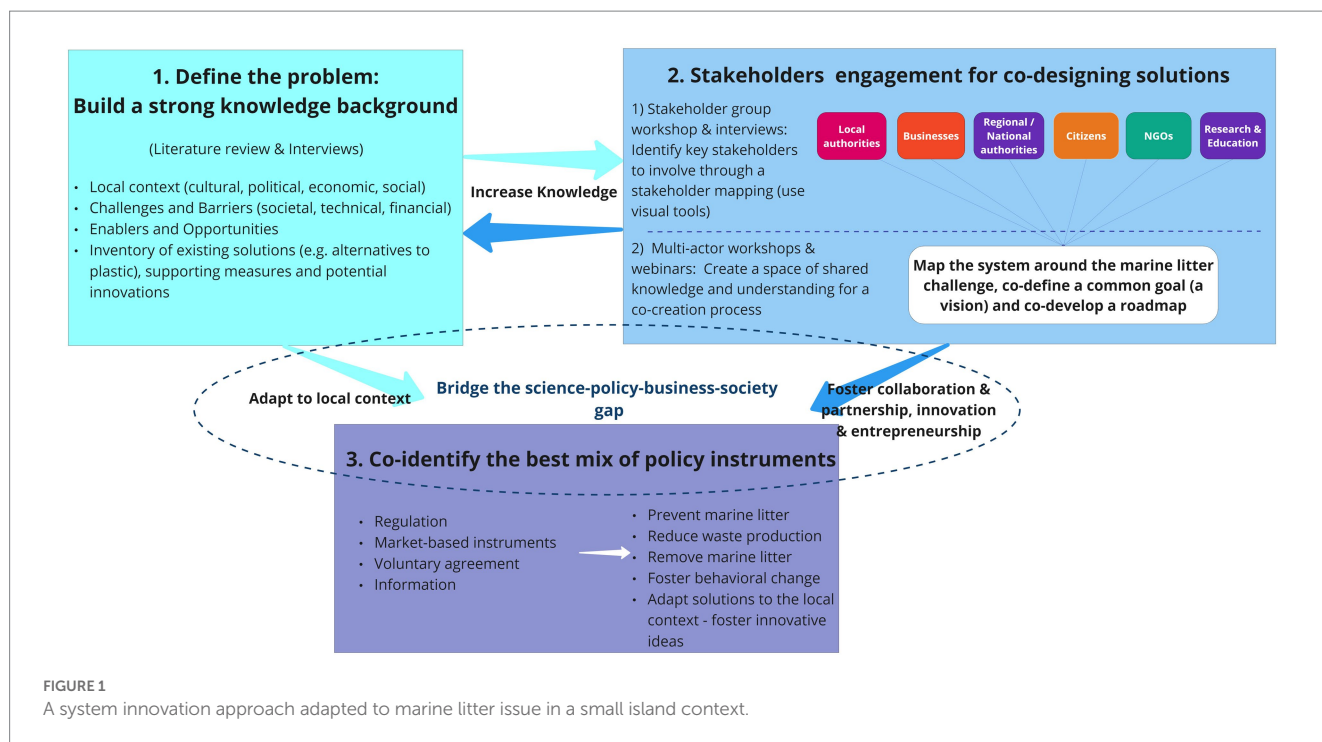


FIGURE 1 A system innovation approach adapted to marine litter issue in a small island context.

technological innovations adapted to the local context); the whole time involving key stakeholders from the quadruple helix (academia, industry, public sector, and civil society).

The methodology consists of three steps (cf. Figure 1 below):

1. Building a strong knowledge base to understand the challenge and the system.
2. Developing a stakeholder engagement process in order to create a space to gain a shared knowledge and understanding of the system and the challenge through the implementation of an arena for the co-creation of activities, allowing knowledge exchange and the identification of solutions. Here, experiments are set up to enable the local community to explore alternative options in terms of business models and consumer behaviours, to accelerate change along the path towards a sustainable transformation (Schäpke et al., 2018).
3. Co-design, with the municipality, a “roadmap for change,” a portfolio of actions, based on a common goal (a vision) at the community level. The end result is set to be used as a municipal strategic planning document (Miedzinski et al., 2022), a pathway to phase out SUP uses for the sustainability of the island. The process uses a mix of participatory methods (interviews, workshops, and webinars) and real-world experiments.

### 3.2. Defining the problem and background knowledge

A system mapping approach (Matti et al., 2020; European Commission, 2021) was used to build the knowledge background, consisting of mapping (1) the local context paying particular attention

to key cultural (norms and values), political (policy framework in place and governance arrangement), economic (market characteristics related to SUP), and social aspects; (2) the existing challenges and barriers as well as enablers and opportunities related to the reduction of marine litter and SUP uses; and (3) the local stakeholders’ network to engage the key actors within the community, using mapping tools (De Vicente López and Matti, 2016).

A social survey was conducted targeting local businesses from the food and beverage industry (cafes, bars, beach bars, restaurants, hotels) on the 3 islands, so as to better understand a number of parameters including the local business context, the level of awareness on the issue of plastic waste, the main practices regarding the use of SUP items, the potential hurdles, barriers, and needs for the transition to alternative practices from the business perspective. Following the identification of the environmental, societal and technical challenges as well as the associated resources gaps, a literature review of existing solutions to tackle the relevant challenges was conducted. Examples of innovative and successful solutions were used as seeds for imagination (Raudsepp-Hearne et al., 2020) during the co-design process, feeding the discussion with stakeholders taking part in the roadmap co-creation exercise.

### 3.3. Engaging stakeholders and experiments

Following the stakeholder mapping and exploratory interviews with key stakeholders (the municipality and local experts), a participatory process is implemented with the engagement of representatives of the civil society, the hospitality industry, and local policy makers, during a series of ideation workshops.

A closer collaboration is developed with the municipality as the entity responsible for implementing the island territorial

development strategy, and for the waste management system. The municipality is in a position to influence drive the transition to sustainability when it comes to marine litter and land-based solid waste production and pollution. Recognized as the “problem owner” of the issue to be tackled, the municipality was engaged from the very beginning of the process to secure their ‘buy-in’; working closely with the research team leading the process, contributing and validating each step.

In parallel, local experiments are conducted within the stakeholder engagement phase, inviting stakeholders (local businesses and consumers) to test sustainable alternatives to SUP items (reusable straws and deposit-refund cup system) as a means to trigger behavioral and transformational change (Nevens et al., 2013; Voytenko et al., 2015) in the hospitality industry. Businesses which showed high interest in participating in the project during “STEP 1” are given the opportunity to test alternatives to SUP items, at no cost. Plastic straws and cups were identified as two highly used SUP items within the islands’ hospitality industry, with alternative products essentially non-existent within the daily operations of the businesses. Furthermore, little was known to the business of reusable solutions. Therefore interested businesses were given the option to 1) test the use of metal straws as a replacement for single-use straws, and 2) participate in a pilot deposit-refund cup system called “the Corfu Cup”, which enabled customers to use, return, and reuse a non-plastic cup, at any participating business; with a small deposit fee, instead of having to bring their own cup or using a plastic cup.

Those transition experiments, as part of a wider sustainability transition (Caniglia et al., 2017), aim at accelerating awareness, acceptance and adoption of alternative business models not yet introduced in the island. Within a framework of academia-societal collaboration, the experiments help diffuse the innovation with limited investment and risk from the business side; while identifying the success factors, the potential limitations in the context of the island, and the potential for replication.

### 3.4. Developing the roadmap

The starting point of the roadmap development is the identification of the goal(s) to be achieved. These goals are captured in a long term “vision” (by 2050) which the local stakeholders commonly developed and agreed upon during a participatory workshop. The roadmap itself is composed of a set of actions co-designed by the local community, to be implemented in the short, mid, and long term. This portfolio of actions, ranging from regulatory instruments, market-based instruments, voluntary agreements, or informative actions, is meant to represent the best mix of policy instruments to support the sustainable transition towards decreased consumption of SUP items on the islands, and the associated plastic waste produced.

The ideation workshops support the development of innovative ideas from local stakeholders adapted to the community’s needs and the specific characteristics of the local environment. The possible solutions to be implemented are not limited to the best practices identified during the knowledge background phase (Step 1), which were used as examples to trigger the imagination of what could be done and adapted locally. During the workshops with each stakeholder group (local businesses, civil society, and associations),

solutions targeting local businesses and consumers are identified and prioritized within a short-, mid-, and long-term period. A final round of discussions with the municipality supported the consolidation of the roadmap and align the actions with the municipality’s agenda, priorities, and capacities.

### 3.5. Implementation in the case study areas

The first phase (defining the problem and background knowledge) was conducted in each island, providing a good overview of the challenges at stake related to SUP in small Mediterranean islands while the stakeholder engagement and experiments phase as well as the roadmap development were implemented only in Corfu island.

From the municipalities’ perspective, interest in dealing with the plastic crisis varied greatly, depending on multiple local factors (political, environmental, societal, and economic). The methodology was based on close collaboration with the municipal authorities, which are seen as the leading stakeholder with the power and influence to support the required transformative change in the island. As such, priority was given to the island of Corfu as a test site to co-develop the roadmap due to the high level of interest expressed from the municipality, which can be explained by a historical local context. There, following a major waste management crisis, the local authorities were under pressure to act. As a result, tackling waste issues, including plastic, in the island was high on the agenda. Additionally, in Corfu, the research team was able to rely on an already established relationship with a local network which was mobilized to implement the stakeholder-driven participatory approach and ensure its success.

## 4. Results

### 4.1. Survey results

A total of 57 businesses (the majority were small individual Greek-owned businesses with less than 10 employees) from the hospitality industry (cafes, beach bars, restaurants, hotels) were interviewed face-to-face using closed-ended questions. They were chosen randomly throughout the various parts of the islands (by the beach, inland, in the urban centre, isolated locations), following the willingness of business representatives to answer. The interviewees also had the opportunity to comment and react on the set of questions, allowing the collection of additional elements characterizing the local social, political, economic and environmental contexts. The interviews were conducted on the three islands during September 2020, at the very end of the Greek Summer season.

Overall, respondents were aware of the extent of the plastic pollution; however only 50% could describe the impacts, while not more than a third of respondents knew about the sources of the plastic pollution as shown in (Figure 2). Regarding the EU policies tackling the issues (e.g. the EU plastic Directive which was about to enter into force at the time of the interviews), knowledge was very limited (e.g. in terms of which products were concerned by the law, which implication it will have for their business etc.).

The knowledge of existing alternatives and commitment to switching to alternatives varies greatly depending on the type of SUP items. Aside from the straws, which fall under the EU Plastic directive banning the

product, barely 60% of respondents intend to stop using SUP items in their daily business operations (Figure 3). Furthermore, the interviews showed that businesses were essentially looking at alternatives which were also single-use; reusable products were very rarely considered.

Regarding the reasons for business to adopt alternatives to SUPs in their daily operations (Figure 4), three-quarters of the business owners interviewed mentioned a sense of environmental responsibility, while legislation was the second most mentioned reason. Only 13% of respondents mentioned “consumer demand” as a reason to switch to non-SUP items, implying that the consumer demand for non-SUP items was very low, not yet being an incentive.

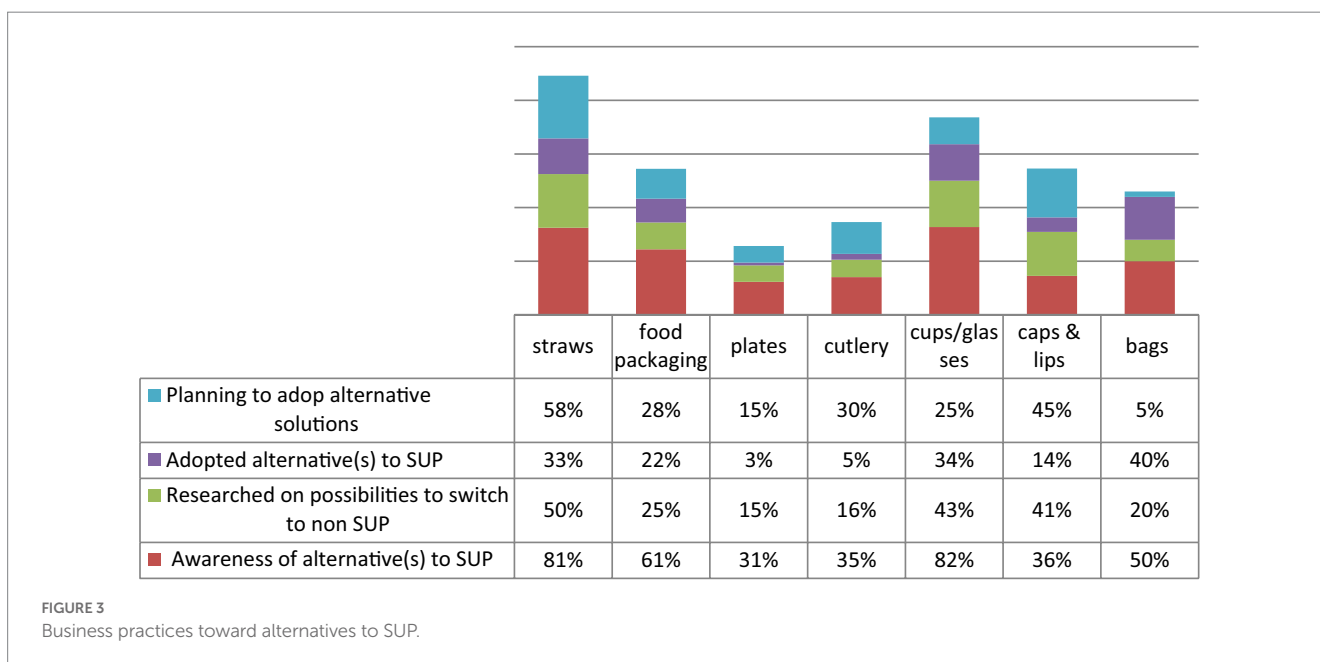
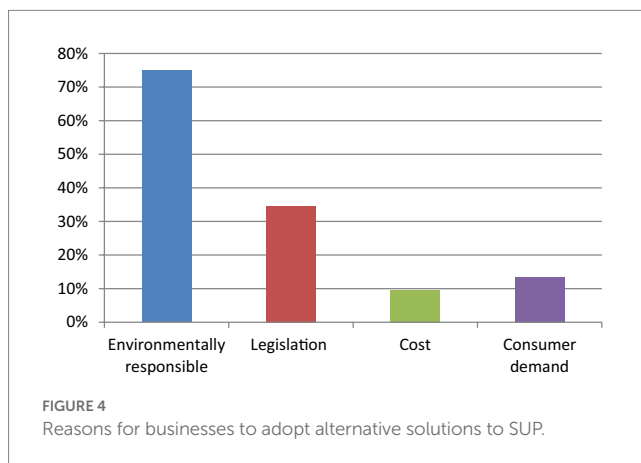
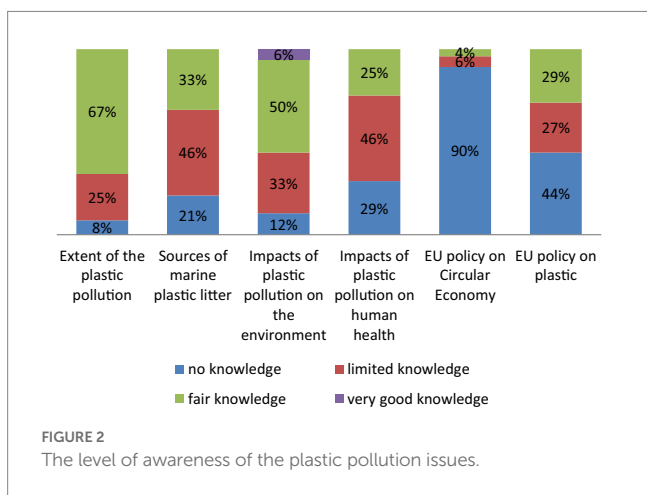
Figure 5 presents an overview of the main barriers for adopting alternatives to SUP items (i.e. other type of single use items or reusable). The cost and lack of consumer demand (as highlighted in the previous answer - Figure 4) were the most cited reasons, while access to alternative products was also raised as an issue.

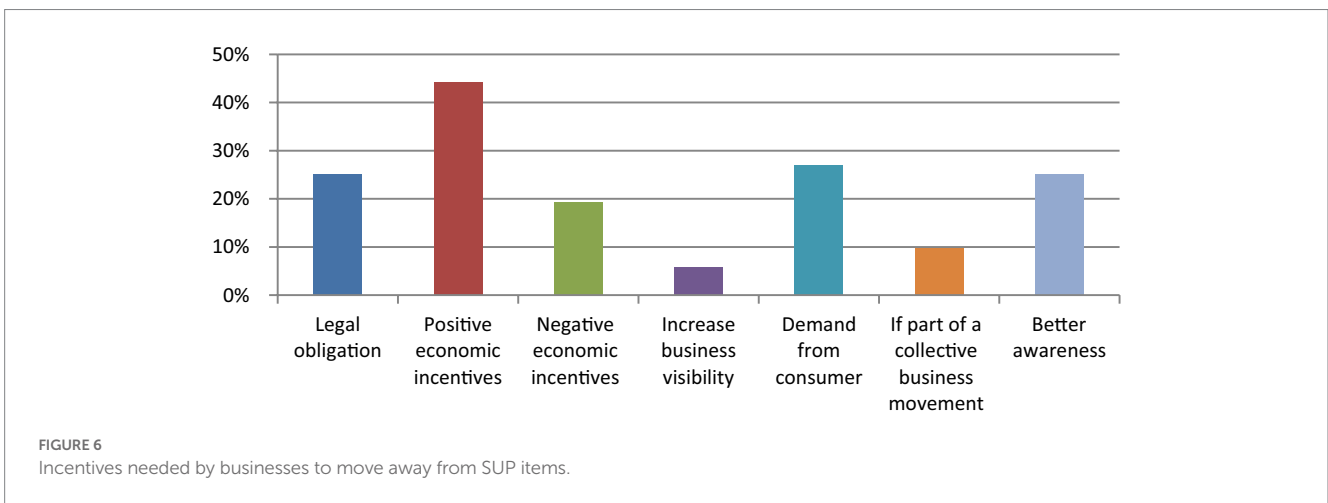
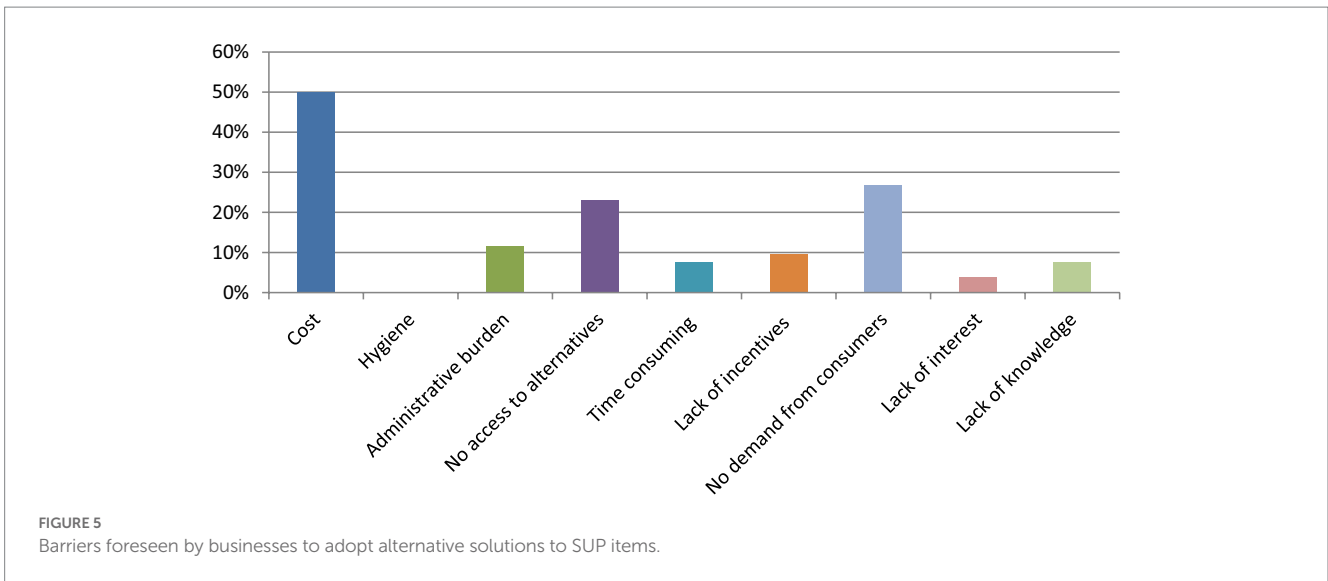
To mitigate the barriers to adopting non-SUP items, businesses ask for the implementation of positive economic incentives (e.g., subsidies and tax reduction) but also expect consumers to drive the

change by demanding alternative products to SUPs. They also consider increasing awareness and legal obligations as important incentives to move away from SUP use (Figure 6).

### 4.2. Experiments for transformation

The first experiment was the implementation of a Climathon event, a new approach to raising awareness on SUP issues. It provided a forum for citizens and local decision makers to work together to trigger system change. The event is particularly well-suited to the youth community by working in a group-setting over two full days, to collaboratively answer a specific challenge related to climate change, with the aim of developing innovative solutions. The proposed challenge as part of the experiment was “the reduction of Single-Use-Plastic items in the island”, to contribute to the wider challenge of reducing CO2 emissions in the plastic industry. A total of 35 persons (online and on-site) participated in this first edition in 2020. Since then, Climathon Corfu has successfully mobilized the local





community around challenges related to plastic and waste production, plastic and waste production.

The second experiment focused on the implementation of a pilot deposit refund cup system, “the Corfu Cup,” a system inspired by the ‘ReCup Germany’ initiative. Cafes who participated in the system gave the option to their clients to order their take away beverages in a reusable cup. The client payed 5 euro to “rent” the cup and could return it anytime at any participating cafe. The user could see on a website a map of the island which cafes were participating in the scheme and their location on the island. The pilot started with 5 cafes, 3 more joined while the experiment was running (over a period of 2 months). The use of reusable metal straws was also tested, with three participating cafes. They were given a set of metal straws of different sizes (thickness and diameter), adapted to all drinks that could be served in a café-bar (particularly suited for cocktails). Training was also provided on their proper use and maintenance. The café-bars were very positive and easily adopted the metal straws for cocktails. Only very few straws were lost, which was an initial concern from business owners. One café fully adopted the reusable alternative, deciding to end their usage of single-use straws.

The goal of the experiment was to 1) raise awareness within the business community of sustainable alternative business models and practices based on reusable items; 2) to create a basis on which a few early adopters of this innovative practices can support dissemination within the island community and wider adoption; and 3) to trigger behavioral change from the consumer side by creating new habits.

### 4.3. A roadmap to phase out SUPs

The outputs of the ideation workshops resulted in a vision to tackle the SUP issues on Corfu island, giving clear goals to be achieved by 2050 (e.g. ban of plastic bottles; use only reusable items in the hospitality industry; a circular economy based island; high incentives for low waste production), alongside a set of actions to be implemented by either the municipality, the hospitality industry or civil society (Figure 7). The roadmap is composed of a mix of policy instruments and capacity building measures (e.g. raising awareness campaign, clean-up etc.), market-based instruments (e.g. deposit-refund scheme, economic incentives to reduce and reuse etc.), voluntary agreements

### A Vision to tackle SUP issues in Corfu island

In 2050, the island of Corfu will be fully sustainable when it comes to waste management and SUP items in particular, having fully embraced the circular economy principles. There will be no more plastic bottles available on the island, the tap water will be drinkable and available for free in public places. The hospitality industry will operate with unique types of reusable items as an alternative to SUP. Hotels in particular will have totally phased out SUP items in their amenities. Inhabitants and visitors will easily be able to compost their single use items in multiple points throughout the island. Businesses are constantly looking at improving their operating systems to eliminate plastic and other non-valorized waste, fully benefiting from Circular Economy principles. The pay-as-you-throw waste management system is in full operation, incentivizing businesses and inhabitants to reduce their individual waste production.

#### Actions to kick start within 2 years time

Municipality leadership	Hospitality industry leadership	Civil society leadership	Collaborative raising awareness actions
<ul style="list-style-type: none"> <li>Translate the roadmap into local policies (V, R)</li> <li>Free potable water available in public spaces (M)</li> <li>Partnership with NGOs &amp; Academia for capacity building (V)</li> <li>Public catering tenders to include mandatory use of non-SUP materials (R)</li> </ul>	<ul style="list-style-type: none"> <li>Business to incentivize customers to use their own cup (BONUS)</li> <li>Develop a system (business models) which incentivize business to develop sustainable practices, create value, including individual monitoring for continual performance improvement (M)</li> </ul>	<ul style="list-style-type: none"> <li>Implement the Corfu Cup reuse system 2.0 (M)</li> <li>Use the Experiment's Corfu cups in cultural events (M)</li> </ul>	<ul style="list-style-type: none"> <li>Communicate and support initiatives to reduce SUP (C)</li> <li>Climathon as a community event to identify innovative ideas and develop entrepreneurship in the island ecosystem (C)</li> </ul>

#### Actions to kick start within 5 years time

<ul style="list-style-type: none"> <li>Incentivize and support businesses to reduce and reuse (M)</li> <li>Deposit/refund schemes for waste recycling (M)</li> <li>Communication campaign on waste management (I)</li> <li>Pay what you throw Reward as you reduce system (M)</li> </ul>	<ul style="list-style-type: none"> <li>Business associations to have dedicated personal for awareness campaign and training (C)</li> <li>Implement plastic free zones (V)</li> <li>Green certificate for business sustainability (V)</li> <li>Work in clusters for the businesses to access supplies at a reduced price (V)</li> <li>Yearly training for businesses on Circular Economy (C)</li> </ul>	<ul style="list-style-type: none"> <li>Cleanups campaigns used as a communication tools for SUP and CE (C)</li> </ul>	<ul style="list-style-type: none"> <li>Information campaign directed at businesses on legislation, plastic issues, existing alternatives (C)</li> <li>Beach and sea clean-up campaigns (C)</li> </ul>
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C Capacity building    M Market-based instruments  
V Voluntary Agreement    R Regulatory measures

FIGURE 7  
Corfu co-designed roadmap to phase out SUP on the island.

(e.g. partnership between municipality and NGOs, development of a business cluster etc.), and regulatory measures (e.g. public catering tenders to include mandatory use of non-SUP items).

## 5. Discussion

### 5.1. The local context of small island communities

Despite local specificities' link to a culture and history unique to each island, which influences the local habits (and to an extent the degree of local awareness related to environmental issues), the survey results (section 4.1) show that Greek islands are characterized by similar societal and technical challenges, exacerbated by a lack of resources. The respondents were generally aware of the marine plastic issues (Figure 2) however, knowledge of the extent of the environmental impact on marine biodiversity and the risks to human health posed by marine litter was limited, with very few respondents able to make the link with consumption patterns highly reliant on SUP items. It was found that cafes and beach bars can use hundreds of plastic coffee cups and thousands of plastic straws a day during the peak of the summer season.

Given the low rate of plastic recycling, most of the plastic waste produced ends up in landfills with risk of leakage in the environment. The interviews also revealed a lack of knowledge from business owners in terms of existing legislations to curb plastic use and plastic waste production in the country; e.g. the implementation of the EU Directive on Single-Use-Plastic which was set for the 1st of July 2021 (the interviews were conducted at the end of the summer season 2020). This highlighted the lack of capacity to anticipate and prepare for the effective implementation of the legislation in the following season. In the summer of 2021 and 2022, the use of banned SUP items was still observed (e.g., straws), which could be explained by the use of remaining stocks bought prior to the change in the law. Nevertheless, it brings into question not only the levels of law enforcement and compliance, but also the degree of understanding about the purpose of the law itself (i.e. reducing the harmful impacts of certain plastic products); furthermore, the willingness and capacity of the industry to adapt to the necessary change. This brings into focus the need for proper implementation and enforcement of the law on the islands, as well as the need to better inform local stakeholders through environmental awareness actions on the islands; considering that compliance with the law can be facilitated by 'higher levels of environmental awareness (Iacarella



et al., 2021), which reinforces the need for raising environmental awareness actions on the islands. Raising the levels of awareness within the community of business owners on plastic issues, the existing laws and their purposes, and the need for change is, therefore, a necessary starting point, a key action identified by the whole community, and acknowledged by the industry itself. It is translated in the Corfu roadmap (section 4.3) by a variety of capacity-building actions (information campaigns and training), specifically targeting business owners.

When it comes to the adoption of transformative alternatives to SUP items, such as reusable items, not only are they sparsely used on the islands but also on occasion perceived by consumers as too complicated or not practical when consuming multiple take away coffees a day (a common local practice); which represents a barrier for businesses. The minority of businesses which try to reduce their consumption of SUP items often cited a lack of consumer interest (perceived or real). In fact, the lack of demand from consumers has been identified by the interviewed business owners as the second main barrier to switching to non-SUP items, after the cost issue. The survey also reveals the lack of knowledge in terms of alternative solutions available and, more generally, how to run a business with limited or no single-use plastic products. In Ikaria, a remote island, the lack of access to alternatives was specifically mentioned by many respondents as a limiting factor for the transition.

## 5.2. A roadmap to phase out SUP items in coastal touristic areas

The Corfu roadmap (Figure 7) proposes a portfolio of actions mobilizing a mix of policy instruments to effectively tackle the complexity of the SUP challenges, involving multiple actors with different needs, behavioral drivers, values, and norms, which a single strategy cannot solve (Cordier and Uehara, 2019; Heidbreder et al., 2019). It is composed of market-based instruments (e.g., economic incentives and deposit-refund schemes) capacity-building actions (e.g., raising awareness campaigns; training; and marine litter clean-up), as well as various types of voluntary agreements within the business sector (e.g., working in a cluster; use of green certificates; and partnerships), particularly relevant to trigger a sustainable transformation. However, very few regulatory measures have been proposed. The transition at the local level is foreseen through a willingness to change triggered by increased awareness of the problems and the solutions, as well as economic incentives, making the change of practices and behavior economically profitable and attractive for businesses and consumers. Additionally, legislative measures are not always perceived as very effective due to the issue of law enforcement at the local level, a challenge not only present in small islands but in many member states when it comes to the European Directives implementation (Ballesterio, 2017).

The identified solutions are set to be developed within the next 2–5 years, illustrating the urgency of the problem, with a need to act now, but also the difficulties faced by stakeholders to plan long-term actions.

### 5.2.1. Raising awareness

Raising the levels of awareness of consumers and businesses on the local problems related to SUP usage, the existing solutions, and

potential business opportunities, is fundamental to trigger sustainable transformation (Giri, 2021). It has been mentioned multiple times by survey respondents (section 4.1) and identified as a high priority during the co-design workshops. The purpose of these actions will be to increase societal knowledge on the problems, the solutions, legislation (existing and forthcoming), and good practice in order to foster behavioural change. This will further draw the interest of business owners to develop sustainable strategies, and support change of consumer behavior towards sustainable products and practices (Wen et al., 2018; Chen and Cho, 2019). As illustrated in the roadmap, awareness campaigns are not the only tool to be used; proactive interventions involving businesses and civil society must complement the efforts to raise awareness. Developing tailor-made training for local business operators on circular economy practices and strategies has been identified as a trigger for change. Marine litter clean-up campaigns are also seen as an effective tool to raise environmental awareness (Kiessling et al., 2017). Finally, organizing participatory community events has proven to be an impactful tool to support the emergence of engaged local community groups in finding innovative solutions to environmental challenges. The successful experience of the Climathon in Corfu allowed the outreach of a wider community of people, including the youth, attracted by the gamification format (teams competing to provide a tailor-made solution to a local challenge faced by their island); in particular, the prospect of having a real impact if their idea is selected for further development. In Corfu, the Climathon format has proven to be an effective tool not just for raising awareness, but also to develop capacity building in system thinking and system approaches; attracting more participants every year.

### 5.2.2. The role of local public administrations

As the main public sector partner on the island, the municipality should have the necessary power and influence to lead the island in phasing out SUP items, driving the island's transition toward sustainability. However, the lack of trust in public authorities in the Greek islands in effectively managing public affairs (e.g., waste management) and their capacity to lead the necessary changes creates a risk of low engagement of citizens (Wamsler et al., 2022). This translates to a low social acceptance of the transformative change in SUP uses proposed by the municipality. Nevertheless, having the municipality at the heart of the participative approach is part of the process to build trust in the policy-society relationship. The municipality, as the public representative, therefore leads by example; by embracing sustainable practices, starting from the ban on SUP uses within the administration itself. Officially adopting the SUP-free roadmap as a territorial strategy will also send a strong signal to all partners, businesses, and citizens, reflecting positively on the municipality's commitment to a sustainable transformation. The road-map will need to be buttressed by the effective implementation of the actions identified.

Public authorities should take the lead in raising awareness of good waste management practices, to reduce, reuse, and recycle. However, communication alone won't be enough; increasing recycling rates and having an effective waste management system are also part of the transformative path. In the Corfu Island context, it is proposed to be achieved by economically incentivizing consumers and businesses to adopt good practices, with the implementation of deposit-refund schemes targeting plastic cups and bottles to improve

the recycling rate on the island and reduce leakage into the environment. The adoption of a pay-as-you-throw principle (extended producer responsibility) and reward-as-you-reduce system is also expected to trigger behavioral change in terms of the volume of waste produced, by inciting businesses and citizens to reduce and recycle. The lack of access to potable water is another factor feeding the production of plastic waste on the island. Access to drinking water (both by tap and in public spaces) is seen as another priority action for the municipality, to be able to phase out SUP items.

However, despite being in a position of natural leadership to support the transition at the local level, local authorities, particularly in the island context, face certain challenges with limited financial and human capacities due to their size and remote geographic position. Difficulty supporting waste infrastructure investment, limited personnel, and a lack of expertise are structural factors hampering the capacity of island municipalities to lead the transformative process alone. Strengthening partnerships with NGOs, academia, and research has been identified as a mitigation measure to bridge the “resource gap”, by bringing technical and financial capacities. Current local partnerships with environmental NGOs for marine litter clean-up and recycling campaigns as well as raising awareness activities have already proven to be successful.

At this stage, no formal partnership with the food and beverage industry, such as voluntary agreements, to reduce plastic waste consumption and increase recycling, had been foreseen as a priority action despite the opportunity this instrument can offer to trigger behavioral change (UNEP, 2018). Public-private partnerships should also be taken into consideration as a source of funding in the future. The ability of the private sector and local authorities to work together is still underdeveloped; following up on the roadmap engagement process by maintaining interactions between the two groups will allow the development of trust to reach the necessary level of maturity for a public-private voluntary agreement to emerge and be included in the roadmap action plan.

### 5.2.3. The role of the hospitality industry

Businesses have direct access to consumers (local citizens and tourists). They are ideally placed to drive new consumption habits by building awareness and promoting the use of alternatives to SUP products. The survey also shows that businesses are highly sensitive to consumer demand (Figure 6). A change in habits and demand from the consumer side towards more environmentally friendly products will certainly trigger a change of business models towards more sustainable practices (Mitrano and Wollehbe, 2020). The influence of the business-consumer relationship two-fold, hence the need to develop strategies combining actions targeting consumers and businesses.

In the Corfu roadmap, the role of business associations is pivotal in facilitating the integration of new practices within the daily operations of local businesses. The associations play a central role in providing access to their members in order to engage them in activities such as the provision of training on circular economy approaches, the formation of business clusters, the adoption of green certificates, setting up plastic free zones in the city, as well as developing innovative systems to incentivize business owners to adopt sustainable practices; for instance, using goal-setting and achievement-tracking devices as well as including rewards systems (OECD, 2017).

At this stage, the adoption of the proposed measures by the local hospitality businesses is still voluntary as no specific mechanism has been discussed to ensure the commitment of the island hospitality industry. It is expected that by increasing knowledge and capacity building on sustainable practices, opening potential new business opportunities, combined with incentives from the public authorities, (as well as demand-push from consumers, and policy-pull from the need to comply with legislation) will be sufficient for businesses to adhere to the proposed strategy.

The metal straw experiment and the pilot ‘Corfu cup’ system were successful in the sense that they showcased how to successfully integrate a deposit-refund system or reusable products into the daily business operations within a local context not accustomed to such approaches. A small number of local business owners are leading by example by being first adopters of alternative innovative solutions, enabling the diffusion of the innovation throughout the local business ecosystem; thereby facilitating the emergence of a new sustainable system by contributing to phase-out of unsustainable SUP products and practices (EEA, 2019).

## 5.3. Reflection on the methodology

This systemic interactive, participatory methodology using a combination of research tools adopted from the social and sustainability fields enabled a collective understanding of the problem (accounting for societal, technological, economic and political aspects). This supported, identification of tailor-made solutions for the specific context and the development of a network of actors across stakeholder groups willing to keep working collaboratively to foster the necessary transformative changes on the island is a successful outcome of the process on its own. The proposed methodology is particularly adapted to a local context, where the considerations and actions in terms of phasing out SUPs are not yet mature, and the consensus on the necessity to move away from SUP uses is yet to be achieved. In addition, the local authorities are concerned about the issue, however are not pro-active in terms of taking concrete steps towards addressing the issue. The road-mapping and co-design processes allow for the exploration of different possible actions, identification of barriers, and to reach consensus among all parties involved (business, policy, academia, civil society) on the solutions to implement. This ensures a high level of acceptability of future policy measures, while the real-world experiments provide evidence-based-impacts of sustainable transformation actions.

Islands can be seen as ideal territories for this form of the transformative process, as they are composed of small communities more easily reachable and engaged. Nevertheless, in the case of Corfu Island, it turned out to be challenging to mobilize the local community which was not yet sensitive to the issue. This highlighted the need to invest adequate time in the participatory design stage, the stakeholder network analysis, and the engagement process. Mobilizing the civil society on island communities that are not used to being actively involved in participatory processes can be difficult to achieve. Relying on an existing local network of key actors, and communicating well enough about the purpose and expected outcomes is of utmost importance; both to trigger interest and manage expectations.

The engaged participants, including municipality representatives, recognized the added value of the participatory process; taking the stakeholder engagement a step beyond simply providing information and undertaking consultation. The process improved capacity building among participants, increasing knowledge of the plastic issues on the island, existing solutions, as well as know-how to co-develop transformative strategies. It built the foundation for a civil society-policy-business network, a core group of people willing to keep the collaborative momentum alive and facilitate the future implementation of the roadmap.

The local experiments were particularly valuable for triggering behaviour change in the business sectors, providing concrete examples of alternative viable business operations.

While the roadmap development is based on a co-designed qualitative process with local stakeholders, quantifying the expected impacts of the proposed actions in time, using modeling tools (e.g., system dynamic modeling – Cordier and Uehara, 2019) will further support local policymakers in prioritizing the solutions to implement, thereby creating a robust, evidence-based action plan to phase out plastic on the island.

## 6. Conclusion

A top-down legislative approach will not be sufficient to rapidly reduce plastic marine litter on islands. A combination of policies to prevent, mitigate, and enable changes at a local level, targeting consumers and businesses, is necessary to tackle the multifaceted marine litter challenges. Raising awareness and capacity-building strategies adapted to specific social groups (business owners, consumers, and young people) is a starting block for transformative change on the islands.

At a time when the international community is coming together to negotiate a future international treaty to tackle plastic pollution, this research looked at how it can be translated into concrete actions and effective impacts in the context of small islands. The study acknowledges the need to empower local communities and the responsibility of municipalities and the hospitality industry in the fight against plastic pollution. A participatory methodology, based on system innovation and transition management approaches, was applied to co-identify the best mix of policy instruments to support the reduction and elimination of SUP items, reducing the risk of plastic marine litter. A successful strategy should actively involve public and private actors as well as civil society, combining reduce, reuse, and recycle actions targeting local businesses and consumers (island inhabitants and tourists). These actions should include awareness raising actions (information and clean-up campaigns), economic incentives (deposit-refund schemes, pay-as-you-throw, and reward as you reduce principles), develop capacity building (circular economy training for professionals and participatory community events), and partnership within the quadruple helix.

In the context of a small island, the development of transformative experiments, based on public authority-research/academia collaborations for change, have created the conditions for municipalities and small businesses to adopt sustainable

solutions; from the integration of reusable products and the replacement of SUP items, to involving civil society actors in the local policy development process by co-designing a SUP-free strategic roadmap. While it is too early to quantitatively measure the long-term impacts of the experiments and the roadmap, a follow-up study to assess the progress made on the islands in regards to tackling SUP uses is recommended. Nevertheless, the co-development of a vision and a roadmap bringing together key actors (the municipality, the hospitality sector representatives, and the civil society) who would otherwise not have worked in collaboration in such a manner, is a significant achievement in itself. In addition, the pilot experiments were successful in showcasing to local businesses how SUP alternatives can easily be integrated to current business practices and adopted by customers.

## Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

## Author contributions

AG, EA, ED, PK, LP, and XT contributed to conception and design of the study. AG and LP performed the interviews with local businesses in Syros and Ikaria islands. XT performed the interviews with local businesses in Corfu. AG, ED, and XT supported the stakeholder engagement process and roadmap development. AG wrote the first draft of the manuscript. EA, ED, PK, and LP wrote sections of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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