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

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Abstract:

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 sector contributing to marine plastic pollution therefor 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 touristic islands. The methodology was applied in small Greek islands in the Mediterranean Sea where lack of knowledge and awareness, limited financial resources and expertise, low efficiency of the waste management system were identified as the main challenges. 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 innovation (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).. A roadmap of actions, based on the Circular Economy reduce, reuse, recycle principles, including raising awareness actions, positive economic incentives, capacity building and partnership within the quadruple helix (academia, business, public authorities and civil society representatives), was co-developed, forming the basis of the municipal island free SUP strategy. The study provides 1) an innovative participatory methodology to tackle SUP issues replicable in various contexts, 2) evidences on key barriers to be overcome by the local tourism industry in small island communities to phase out SUP uses.

Key words: marine litter; participative approach; co-production, system thinking, single-use-plastic; island

1. Introduction

Over the past 20 years, an increased number of scientific publications (see in Abalansa, (2020) and Aretoulaki et al. (2020) literature review), and reports from international organisations (WWF in Alessi. et al. 2018; Ellen MacArthur Foundation, 2016; UNEP, 2016a; OECD, 2022b) have documented the rising problem of marine litter and plastic pollution in particular, a human-made environmental pollutant that have 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 in 2019 (OECD, 2022a) with alarming predictions for the next decades (leakage to be doubled by 2060, cf. OECD, 2022b) leading to a world ocean with more marine litter than fish by 2050 (Ellen MacArthur Foundation, 2016). This extensive plastic-based contamination of the

marine environment is directly linked to mass consumption and unsustainable production systems characterizing 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. Single-Use-Plastic items) in comparison to the durability of the material itself (Szeteiová et al., 2010). This pro-consumerism system is reaching its limits in regards to the environmental damages (e.g. habitat degradation; plastic contamination of the food chain; death of marine vertebrate through entanglement and ingestion) it generates (Reisser 2013; Kóhn et al. 2015; UNEP, 2016a; Delia 2021), dramatically changing the face of the Earth, creating a new era shaped by human: 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 damages irreversible. A variety of policy instruments have already been identified, from regulation (e.g. ban of plastic bags), market-based instruments (e.g. deposit-refund scheme), voluntary agreement (e.g. public-private agreement; memorandum of understanding), to raising awareness campaigns (e.g. beach clean-up), along with local examples of successful initiatives known as best practices (i.e. inventory from the BlueMed initiative in the Mediterranean region) (UNEP 2016a; UNEP 2018; Alpizar et al., 2020). However the effective implementation of those solutions with impactful 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, 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; Rodriguez 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), 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., 2019).

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 (Hoellein et al., 2015; Thiel et al.,

2013; Alessi. et al., 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 (Acoleyen et al., 2014; Jambeck et al., 2015).

In the context of the implementation of the European Commission Single-Use-Plastic Directive which banned the use of certain SUP items since 2021 (i.e. straws, stirrers, plastic cutlery), and imposes measures to reduce the consumption of other single-use-plastics (i.e. food and beverage containers) (European Commission, 2018), this study looked at mitigation measures tackling SUP littering prior to their release in the marine environment, in order to foster 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 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 with the business ecosystem, a stakeholder group less addressed in the literature (Garcia-Vazquez et al., 2021). A qualitative participatory system innovation approach was used to identify the best mix of policy instruments adapted to the specific island context, empowering local communities exploratory work 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 (Gkoltsiou et Mougiakou, 2021). The full roadmap development was implemented in one of the island, Corfu, in the Greek Ionian Sea, it provides short and mid-term actions targeting businesses, consumers and public authorities.

This research 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 to bridge the science-policy-society gap. It gives a concrete example of stakeholder engagement process based on a strong participation of public authorities and the hospitality industry in order to co-develop solutions to phase out SUP uses for marine pollution reduction, paving the way to sustainability transformation in 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 while concentrated around 7% of global microplastic, the so-called Mediterranean "plastic trap" (Suaria et al. 2016), the majority of the plastic is of land-based sources (Papadinitriu and Allinson, 2022). In the region, the tourism sector is being 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 third is coming back to the coastlines within a year), mainly due to coastal activities (Dalberg Advisors, 2019). Three main factors should be taken into consideration within the Greek island context when it comes to waste and marine litter issues. The country is characterised by structural waste management issues including low

capacity from municipalities; lack of know-how; lack of recycling infrastructures; difficulties to introduce separate collections; low public engagement towards good practices; low trust in public authorities. Greece has one of European lowest per capita volume of processing and recycling plastic waste (cf. Eurostat) while consuming coffees and other food take away and deliveries using disposable packaging like SUP on a daily basis, often ending in landfill with risks of leakages into the environment. Plastic straws, cups, bags and other packaging are common items found on beaches (Kouvara et al., 2022). Finally, the Greek islands have to deal with intense coastal tourism and recreational activities, responsible for an increase of waste by up to 26% every year (Alessi. et al., 2018). Greece received 3 times more visitors than its own population, with small islands welcoming millions of beachgoers in a few months, creating 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 in the marine environment is common. It is worth mentioning that the COVID-19 pandemic has not necessarily further increased SUP litter on the Greek coastal areas despite an increase in uses at the same period (Kouvara et al., 2022).

The study site included 3 Greek touristic islands, of different sizes and characteristics. Ikaria, a small island of 255 km² with a population of 8,312 inhabitants, part of the North Easter 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 gathers in the villages throughout the Summer. These events are sources of a very high consumption of plastic waste, not recycle, ending in landfill. The second island, Syros (83.6 km² for 21,507 inhabitants), located in the Cyclades region (South Aegean Sea) is not as touristic as its neighbouring island, Mikonos, Paros or Santorini. Nevertheless the island has very popular beach bars and restaurants as well as a high number of cafes due to its year-long resident community and the vibrant city, Ermoupoli, capital of the Cyclades region. Therefore, the consumption of SUP items and plastic waste produced is consequent. The island of Corfu (Kérkyra), 7th biggest Greek island (593km²), is a hot spot for coastal tourism activity in Greece, located in the North West part of the Ionian Sea. It comprises a population of about 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 about 9 thousand tonnes of garbage at the pick of the season with only 5 to 7% being recycled, the rest ended up in landfills, many illegal, increasing the risk of soil and water contamination. As anywhere else in Greece, a high consumption of Single-Use-Plastic (cups, straws, bags, bottles) can be observed in the local community daily routine. Beach littering and plastic leakage in the marine environment is a common feature. In Corfu, the waste management issue is even more sensitive, following a major waste management crisis in the middle of 2018 summer season, which aggravated the situation and created a feeling of distrust between citizens and the municipality.

3. Material and Method

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 of consumer habits, business models and processes. A challenge-led system mapping process was used (Matti et al., 2020) based on system

innovation and a transition management approach (Roorda et al. 2014; Loorbach, 2007; Loorbach, 2014), a participatory methodology used in the field of sustainability transition and trans-disciplinary in order to deal with persistent problems and facilitate sustainable change (van der Brugge and Rotmans, 2007). It is used to trigger processes of change that transform the way societal systems meet societal needs; Those processes of change are fundamental shifts in structures, mind-sets and practices, involving multi-actors' engagement from many different domains and scale-levels in solving problems oriented activities, co-production of knowledge and co-design of solutions in an iterative process (Geel and Schot, 2007; Roorda and Akisnete, 2013; Durose et al, 2022). The highly participatory process enables to take into consideration a diversity of perspective while managing potential actor's disagreement in the response to sustainability challenges, giving a direction for change (Smith and al. 2005). Transition Management ultimately aims at influencing the direction and pace of societal change dynamics, contributing to sustainability by creating space for new ways of organizing, doing and thinking as well as collective empowerment; eventually bringing about a desired transition (Loorbach and Rotmans, 2006). System innovation (Gaziulusoy, 2015; Schlaile et al. 2019) and system thinking theories (Bosh et al. 2007; Espinosa et al., 2008; Marshall and Farahbakhsh, 2013; Arnold et al. 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) of each part of the system, supporting policy-makers in designing innovation policies for sustainable change (Edler and Fagerberg, 2017). In the case of marine litter and SUP, the aim is to look at 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), looking at the different parts of the problem, the existing opportunities (successful existing initiatives) and the emerging solutions (e.g. social and technological innovations adapted to the local context), involving key stakeholders from the quadruple helix (academia, industry, public sector, civil society). The methodology consists of three steps (cf. figure 1 below):

(1) Building a strong knowledge background to understand the challenge and the system which include i) get a sound understanding of the local cultural, political, economic and social context ii) identify the societal, technical and financial challenges and barriers as well as enablers and opportunities, iii) compile an inventory of successful practices to the focused problem to be used as seeds for inspiration and replication solutions.

(2) A stakeholder engagement process is developed, in order to create a space for shared knowledge and understanding of the system and the challenge through the implementation of an arena for co-creation of activities, allowing knowledge exchange and identification of solutions. Here, experiments are set-up to enable the local community to explore alternatives options in terms of business models and consumerism habits, to accelerate their adoption, drawing the path to sustainability transformation (Schäpke et al., 2018).

(3) Co-design, with the municipality, of a "roadmap for change", a portfolio of actions, based on a common goal (a vision) at 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, webinar) and real-world experiments.

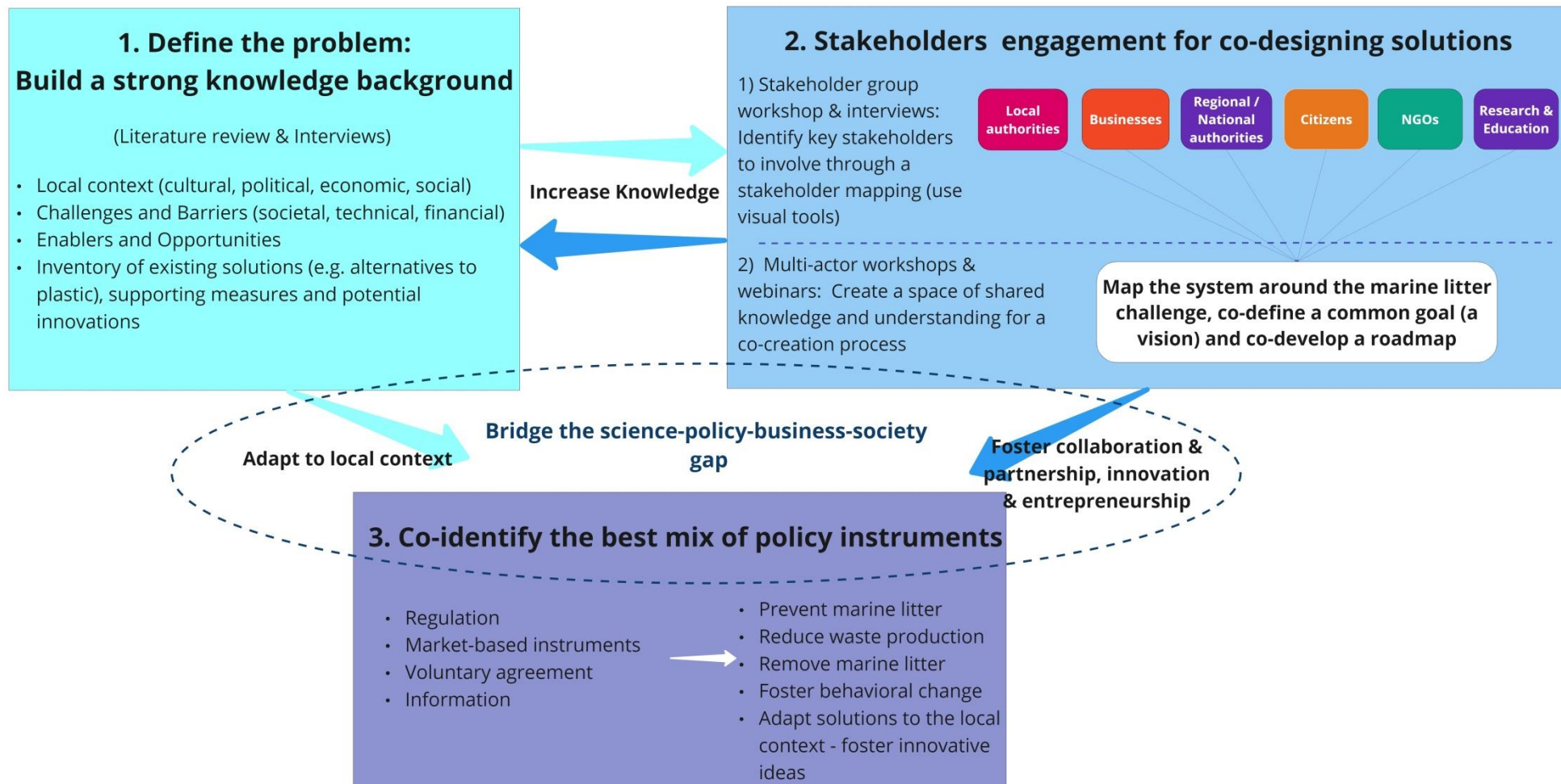


Figure 1: Participatory system-based approach

3.2. Defining the problem and background knowledge (STEP 1)

A system mapping approach (EC 2021; Matti et al., 2020) 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; 3) the local stakeholders network to engage the key actors within the community, using mapping tools (De Vicente et al., 2016).

A social survey was conducted targeting local businesses from the food and beverage industry (cafes, bars, beach bars, restaurants, hotels), in order to better understand the local business context, the level of awareness on the plastic issue, the main practices regarding the use of SUP items, the potential hurdles, barriers, and needs to transition to alternatives practices from the business perspective. Once the environmental, societal and technical challenges but also the resources gaps were identified, a literature review of existing solutions to tackle those challenges was conducted, example 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 process.

3.3. Engaging stakeholders and experiments (STEP 2)

Following the stakeholder mapping, a participatory process was implemented with the engagement of stakeholder representatives of the civil society, the hospitality industry, the local policy maker, during a series of ideation workshops.

A closer collaboration was developed with the municipality. In charge of implementing the island territorial development strategy, and responsible for the waste management system, it has the power and influence to 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, working closely with the research team leading the process, contributing and validating each step.

In parallel, local experiments were conducted within the stakeholder engagement phase, inviting stakeholders (local businesses and consumers) to test sustainable alternatives to SUP items as a means to trigger behavioural 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” were given the opportunity, over a period of 2 months, to test alternatives to SUP, at no cost. They were given the option to 1) test the use of metal straws in their daily operations instead of single-use straws, and 2) participate in a pilot deposit-refund cup system called “the Corfu Cup” which enable customers to use, return, and reuse a non-plastic cup, in any participating businesses, via a small deposit fee, instead of having to bring their own cup or using a plastic cup.

Those transition experiments, as part of the process to transition to sustainability (Camiglia et al., 2022), aim at accelerating awareness, acceptance and adoption of alternative business models not yet introduced in the island. Within a framework of academia-society collaboration, the experiments help diffuse the innovation with limited investment and risk

from the business side, identifying the success factors, the potential limitations in the island context, and the replicable potentials

3.4. Developing the roadmap (STEP 3)

The starting point of the roadmap development is the identification of the goal(s) to be achieved captured in a long term “vision” (by 2050) the local stakeholders commonly built and agreed on. The roadmap itself is composed of a set of actions co-designed by the local community, to be implemented in the short, mid to long term. This portfolio of actions, ranging from regulatory instruments, market-based instruments, voluntary agreement or informative actions, is meant to represent the best mix of policy instruments to support the transition to sustainability in relation to SUP items consumption and waste production in the context of a small island.

The ideation workshops support the development of innovative ideas from local stakeholders adapted to the community 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. Those are used as examples to trigger the imagination of what can be done and adapted locally. During the workshops with each stakeholder groups (local businesses, civil society, associations), solutions targeting local businesses and consumers are identified and prioritize within a short, mid and long term period. A final round of discussions with the municipality is used to consolidate the roadmap and align the actions with the municipality 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 as well as the roadmap development were implemented only in Corfu island.

From the municipality perspective, interest in dealing with the plastic crisis varied greatly, depending on multiple local factors (political, environmental, societal, and economic). Having a methodology based on close collaboration with the municipal authorities, seeing as the key stakeholder with the power and influence to support the required transformative change in the island, priority was given to the island of Corfu as a test site to co-develop the roadmap due to the high interest expressed from the municipality, the result of a specific local context. There, following a major waste management crisis in 2018, the local authorities are under pressure to act. As a result, reducing waste production including plastic in the island is 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 participate approach and ensure its success.

4. Results

4.1. Survey results

A total of 57 businesses (the majority were small individual Greek-own businesses with less than 10 employees) from the hospitality industry (cafes, beach bars, restaurants, hotels)

were interviewed face-to-face using closed-ended questions, chosen randomly throughout the islands (by the beach, inland, in the urban centre), based on their willingness to answer. The interviewees also had the opportunity to comment and react, allowing the collection of additional elements characterizing the local social, political, economic and environmental context. The interviews were conducted in the 3 islands during September 2020, at the very end of the Greek summer season.

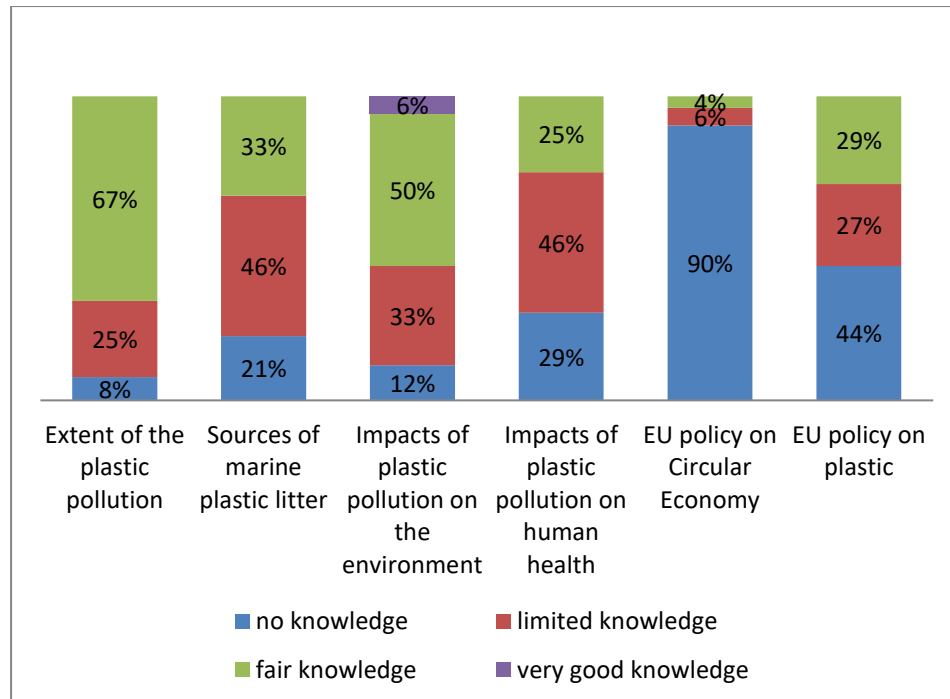


Figure 2: Level of awareness of the plastic pollution issues

Overall respondents are aware of the extent of the plastic pollution, however only 50% could describe the impacts, barely a third of respondents know about the sources of the plastic pollution. Regarding the EU policies tackling the issues, which concern directly the businesses (e.g. the EU plastic Directive), knowledge was very limited (figure 2).

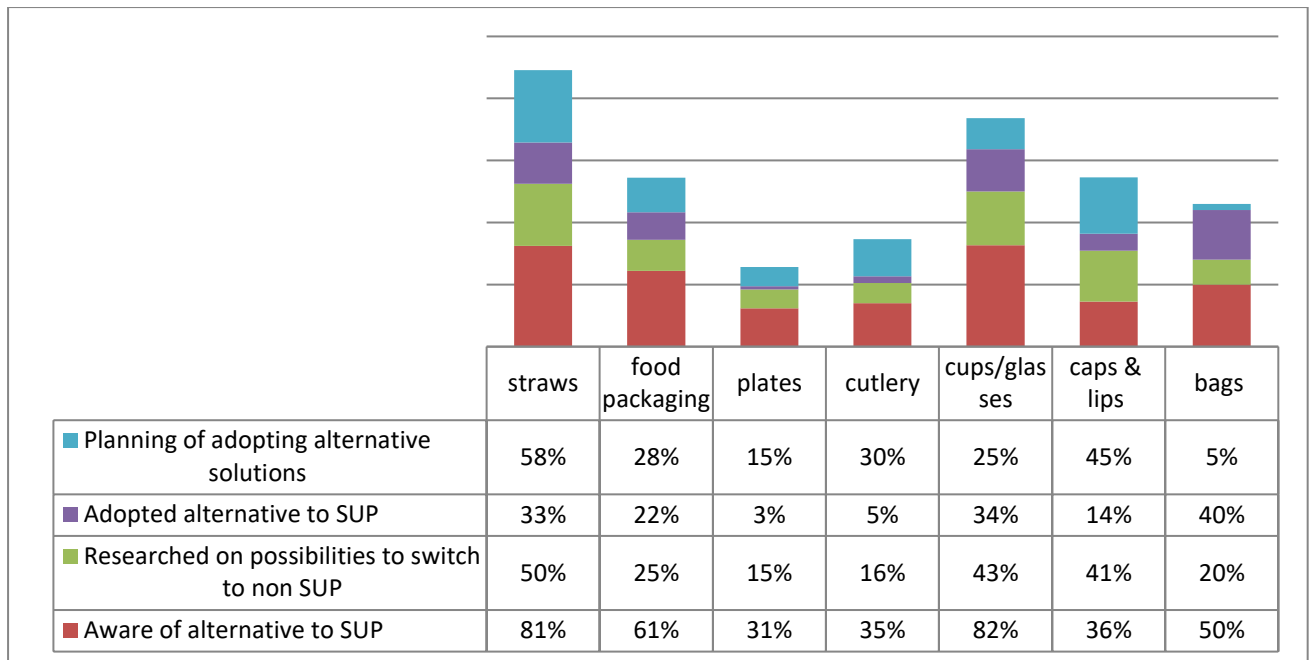


Figure 3: Businesses practices towards alternatives to SUP

The knowledge of existing alternatives and commitment to switch to alternatives varies greatly depending on the type of SUP items. Putting aside the straws, which fall under the EU Plastic directive banning the product, overall barely 60% of respondents intend to stop using SUP items in their daily business operations (figure 3).

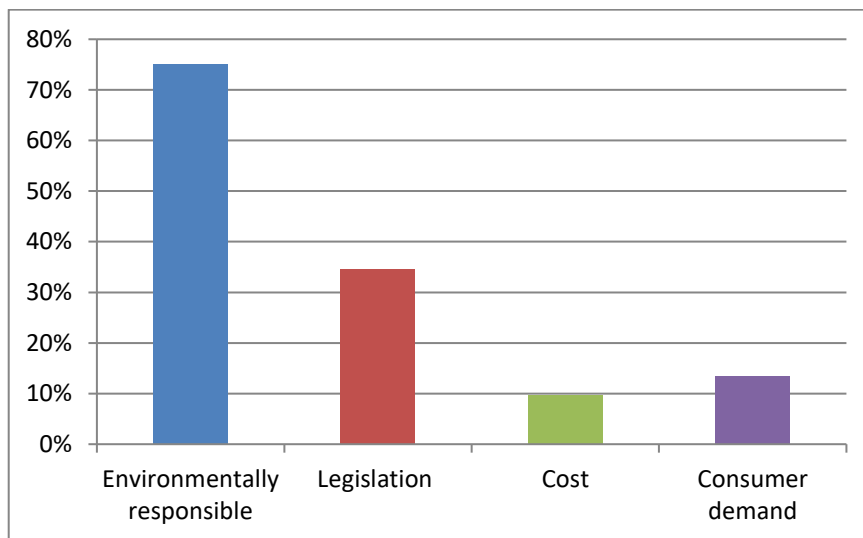


Figure 4: Reasons for businesses to adopt alternative solutions to SUP

Analysis the reasons for business to adopt alternatives to SUP in their daily operations (figure 4), three-quarter of business owners interviewed mentioned a sense of environmental responsibility, legislation is the second most mentioned reason. Only 13% of

respondents mentioned “consumer demand” as a reason to switch to non-SUP items.

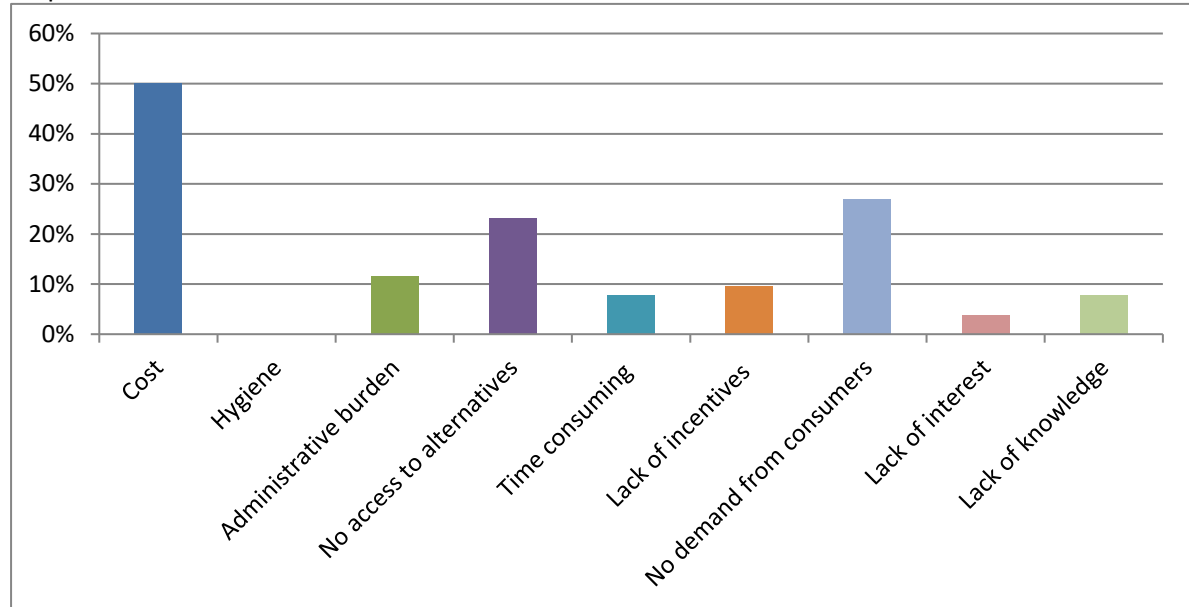


Figure 5: Barriers foreseen by businesses to adopt alternatives solution to SUP

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 are the most cited reason, access to alternative products is also an issue raised.

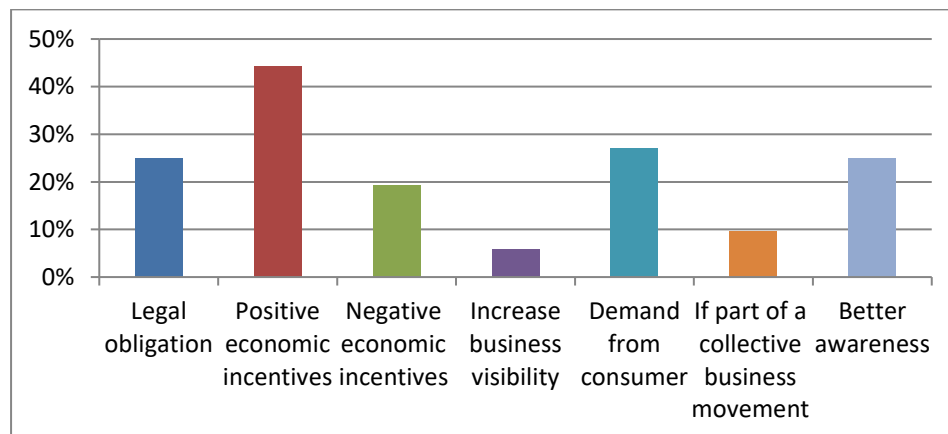


Figure 6: Incentives needed by businesses to move away from SUP items

To mitigate the barriers for adopting non-SUP items, businesses ask for the implementation of positive economic incentives (e.g. subsidies, tax reduction), but also expect consumers to drive the change by demanding alternative products to SUP, which will also be triggered by increase awareness and legal obligations (figure 6).

4.2. Experiments for transformation

The first experiment was the implementation of a Climathon event, as a new approach to raise awareness on the SUP issues, providing fora for citizens and local decision makers to work together to trigger system change. The event suits particularly well the youth community by working in a group-setting during two full days to collaboratively answer a specific challenge related to Climate change, with the aim to develop innovative solutions. The proposed challenge, as part of the experiment, was “the reduction of Single-Use-Plastic

items in the island” knowing that plastic items directly contributes to Climate change due to emission of CO2 throughout the life cycle of the products. 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.

The second experiment focused on the implementation of a pilot deposit refund cup system, “the Corfu Cup”, a system inspired by the ReCup Germany. Cafes who participated in the system gave the option to their clients to order their take away coffee or other beverage in a reusable cup. The client pays 5 euro to “rent” the cup and can return it anytime at any cafe that is participating. The user can see on a website a map of the island with cafes that participate and their location on the map. The pilot started with 5 cafes, 3 more joined while the experiment was already running within a period of 2 months. Cafes also experiment the use of reusable metal straws.

The goal of the experiment was, on one side to raise awareness of businesses on sustainable alternative business model and practice based on non- SUP items, on the other side to trigger behavioural change from the consumer side.

4.3. A roadmap to phase out SUPs

The outputs of the ideations workshop resulted in a vision tackling the SUP issue in the Corfu island, giving clear goals to be achieved by 2050 (ban of plastic bottle; use of reusable item only in the hospitality industry; a circular economy based island; high incentives for low waste production), along a set of actions to be implemented by either the municipality, the hospitality industry, the civil society (figure 7). The roadmap is composed of a mix of policy instruments including capacity building (raising awareness campaign; clean-up ...) Market-based instruments (deposit-refund scheme; economic incentives to reduce and reuse ...), voluntary agreement (partnership between municipality and NGOs; development of business cluster ...), and regulatory measures (public catering tenders to include mandatory use of non-SUP items).

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 embrace the circular economy principles. There will be no more plastic bottle available in the island, the tap water will be drinkable and available for free in public places. The hospitality industry will operate with a unique type of reusable items as an alternative to SUP. Hotels in particular will have totally phase 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



Figure 7: Corfu co-designed roadmap to phase out SUP in the island

5. Discussion

5.1. Local context of small island communities

Despite local specificities link to a culture and history unique to each island which influence the local habits and, to a certain point, the degree of local awareness related to environmental issues, the surveys' results (section 4.1) show that Greek islands are characterized by similar societal and technical challenges combined with resource gaps. The respondents were generally aware of the marine plastic issues (figure 2) however the knowledge of the extent of the environmental impacts on the marine biodiversity and the risks to human health posed by marine litter were quite vague while very few respondents were able to make the link with the current consumption patterns highly relying on single-use-plastic items. Cafes and beach bars can use hundreds of plastic coffee cups and thousands of plastic straws a day during the pic of a summer season, given the low plastic recycling rate, most of the plastic waste 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 curve plastic uses and plastic waste production in the country as the implementation of the EU Directive on Single-Use-Plastic was set for the 1st of July 2021 (the interviews were conducted at the end of the summer season 2020), which then highlighted the lack of capacity to anticipate and be prepared for the effective implementation of the law next season. In summer 2021 and 2022, the use of banned SUP items could still be observed (e.g. straws), which could be explained by the use of remaining

stocks bought prior to the law. Nevertheless it still questions the level of law enforcement, and compliance, but also the degree of understanding of the purpose of the law itself (i.e. reduce the harmful impacts of certain plastic products), and furthermore the willingness and capacity to adapt to a necessary change. It highlights the need for proper implementation and enforcement of the law on the islands, but also the need to better inform, considering that compliance with the law can be facilitated by higher environmental awareness (Iacarella et al. 2021), which reinforces the need for raising environmental awareness actions in the islands. Raising awareness of business owners on the 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 in the islands but also not always positively perceived by consumers, seen as too complicated, not practical when taking multiple coffees take away a day (a common local practice), which represent a barrier for businesses. Businesses which try to reduce their consumption of single-use-plastic items, while being a minority, often mentioned a lack of consumer interest (perceived or real). In fact, the lack of demand from consumer has been identified by the interviewed business owners as the second main barrier to switch to non-single-use-plastic items (figure 5), 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 reduced to no single-use plastic products. In Ikaria, a remote island, the non-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 which involve multiple actors with different needs, behavioural drivers, values and norms, which a single strategy cannot solve (Heidbreder et al., 2019; Cordier and Uehara, 2019). It is composed of market-based instruments (e.g.: economic incentives; deposit-refund schemes), capacity building actions (e.g. raising awareness campaigns; training; marine litter clean-up) but also various types of voluntary agreements within the business sector (e.g. working in cluster; use of green certificates; partnerships), particularly relevant to trigger a sustainable transformation. However very few regulatory measures have been proposed, the transition at local level is foreseen through a willingness to change triggered by an increased awareness of the problems and the solutions, as well as economic incentives, making the change of practices and behaviour economically profitable and attractive for the businesses and the consumers. Additionally, legislative measures are not always perceived as very effective due to the issue of law enforcement at local level, a challenge not only present in small islands, but in many member states when it comes to European Directives implementation (Ballesteros, 2017).

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

5.2.1. Raising awareness

Raising awareness of consumers and businesses on the local problems related to SUP but also about the existing solutions and business opportunities which can be created, is fundamental to trigger sustainable transformation (Giri, 2021). It has been mentioned multiple times by survey respondents and identified as a high priority during the co-designed workshops. The purpose is to better inform to increase societal knowledge on the problems, the solutions, the existing and future legislations, and the good practices in order to foster behavioural change, attract interest of business owners in developing sustainable strategies, influence consumer choices towards sustainable products and practices (Chen and Cho, 2019; Wen et al., 2018). As illustrated in the roadmap, informing is not the only channel to be used, pro-active interventions involving businesses and the civil society must complement the raising awareness package of actions. Developing tailors-made trainings for local business operators on circular economy practices and strategies has been identified as a trigger for change (xx). Marine litter clean-up campaigns are also seen as an effective tool to raise environmental awareness (Kiessling et al., 2017). Finally, organising participatory community events has proven to be an impactful tool to support the emergence of engaged local community groups in finding innovative solutions to an environmental challenge. 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 are competing in providing a tailor-made solution to a local challenge their island is facing) and the prospect to have a real impact if their idea is selected for further development. The Climathon format has proven to be an effective tool in Corfu for awareness raising but also to develop capacity building in system thinking and systemic approaches, attracting more participants every year.

5.2.2. The role of local public administrations

As the main policy maker in the island, the municipality should have the necessary power and influence to lead the island in phasing out SUP items, driving the island transition towards sustainability. However the lack of trust in public authorities in the Greek islands in effectively managing public affairs (e.g. waste management) and capacity to lead the necessary changes creates a risk of low engagement of citizens (Wasmsler et al., 2022) and low social acceptance of the transformative change in SUP uses proposed by the municipality. Having the municipality at the heart of the participative approach is part of the process to develop trust in the policy-society relationship. The municipality, as the public representative, is due to lead by example by embracing sustainable practices, starting from the ban of 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 commitment to transformation. It will have to be followed by an effective implementation of the actions identifies.

Public authorities should take the lead in raising awareness on good waste management practices, to reduce, reuse and recycle. However, communication alone won't be enough; increasing recycling rate 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 in adopting good practices, with the implementation of deposit-refund schemes targeting plastic cups and bottles to improve the

recycling rate in the island and reduce leakage in the environment. The adoption of a “pay-as-you-through” principle (extended producer responsibility), “reward-as-you-reduce” system, is also expected to trigger behaviour change in terms of volume of waste produced, inciting businesses and citizens to reduce and recycle. The lack of access to potable water is another factor feeding the production of plastic waste in the island. Access to drinking water on tap but also in public space 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 leader to support the transition at 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. Difficulties to support waste infrastructure investments, limited personnel and a lack of expertise are structural factors hampering the capacity of island municipalities to lead alone the transformative process. Strengthening partnerships with NGOs, academia and research, have been identified as a mitigation measure able to fill in the gap by adding technical and financial capacities. Current local partnerships with environmental NGOs for marine litter clean-up and recycling campaign 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 behavioural change (UNEP, 2018). Public-private partnerships should be also 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 at its premise; following up the roadmap engagement process by keeping interactions alive between those two groups on the topic will allow the development of trust to reach the necessary level for 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 showed that businesses are highly sensitive to consumer demand (figure 6). A change of habits and demand from the consumer side for environmentally friendly products will trigger a change of business models towards more sustainable practices (Mitrano and Wollehbe, 2022). The influence business-consumer works in two-folds, thus the needs to develop strategies combining actions targeting consumers and businesses.

In the Corfu roadmap, the role of the business associations is pivotal in facilitating the integration of new practices within the businesses daily operations by providing training on circular economy approaches, support the formation of business clusters, the adoption of green certificates, the setting-up of plastic free zones in the city as well as developing innovative systems to incentivize business owners in adopting sustainable practices using goal setting and achievement tracking device including a reward system (OECD, 2017).

At this stage, the adoption of those 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 increasing knowledge and capacity building

in sustainability practices, opening potential new business opportunities, combined with incentives from the public authorities, demand from consumers, and the need to comply with the laws will be sufficient for businesses to adhere to the proposed strategy.

The Corfu cup was a successful experiment in that sense, as it showcased how to successfully integrate a deposit-refund system into the daily business operations in a local context not accustomed to it. A small number of local business owners led by example by being first adopters of an alternative innovative solution, enabling the diffusion of the innovation throughout the local business ecosystem, facilitating the emergence of a new sustainable system by contributing to the phase out of unsustainable practices (EEA, 2019).

5.3. Reflexion on the methodology

This systemic interactive, participatory methodology using a combination of research tools borrowed in the social and sustainability fields enabled a collective understanding of the problem in its societal, technologic, economic and political aspects, the identification of tailor-made solutions for the specific context, and the development of a network of actors across stakeholders groups willing to keep working collaboratively to foster the necessary transformative changes in the island which is a successful outcome of the process on its own. The proposed methodology is particularly adapted to a local context where the reflexion in terms of phasing out SUP is not yet mature, the consensus on the necessity to move away from SUP uses is yet to be achieved, the local authorities are concerned about the issue but are not pro-active. The road-mapping co-designed process allows to explore different possible actions, identify barriers, and reach consensus with all parties involved (business, policy, academia, civil society) on the solutions to implement, ensuring 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 transformative process, being composed of small communities more easily reachable and engaged. Nevertheless, in the case of Corfu island, it turned out to be challenging to mobilise the local community not yet sensitive to the issue, pointing out the need to allocate enough time in the participatory design stage, the stakeholder network analysis, and the engagement process. Mobilizing the civil society in island communities not used to be 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, to trigger interest and manage expectations, is of utmost importance.

The engaged participants, including municipality representatives, recognized the added value of the participative process, going beyond the stage of simple information and consultation. It improved capacity building among participants, increasing knowledge on the plastic issues in 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 change of behaviour in the business sectors, bringing concrete examples of alternative viable business operations.

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 modelling tool (e.g. system dynamic modelling – Cordier and Uehara, 2019) will further support local policy makers in prioritizing the solutions to implement, creating a robust, evidence-based action plan to phase out plastic in the island.

Conclusion

A top-down legislative approach won't be sufficient to rapidly reduce plastic marine litter in islands. A combination of policies able to prevent, mitigate and enable changes at 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, young) is a starting block for transformative change in the islands.

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

In the context of a small island, the development of transformative experiments, based on public-research collaborations for change, have created the conditions for public authorities and small businesses to adopt sustainability solutions, from the integration of reusable products to replace SUP items to involving the civil society in the local policy development process by co-designing a free SUP strategic roadmap.

It is too early to quantitatively measure the impacts of the experiments; it is recommended to have a follow up study to assess the progress made in the island in regards to tackling SUP uses. Nevertheless the co-development of a vision and a roadmap, bringing the municipality, the hospitality sector representatives, the civil society together is a significant achievement on its own while the pilot experiments were successful in showing to local businesses how alternatives can easily be integrated to current business models and adopted by customers.

References

Abalansa, S., El Mahrab, B., Vondolia, G. K., Icely, J., & Newton, A. (2020). The marine plastic litter issue: A social-economic analysis. *Sustainability (Switzerland)*, 12(20), 1–27. <https://doi.org/10.3390/su12208677>

van Acoleyen M., Laureysens I., Lambert S., Raport L., Van Sluis C., Kater B., van Onselen E., Veiga J., Ferreira M., (2014), Marine Litter study to support the establishment of an initial quantitative headline reduction target - SFRA0025, ARCADIS, EUCC, 315 p.

Alessi. et al., 2018. "Out of the plastic trap: saving the Mediterranean from plastic pollution". WWF Mediterranean Marine Initiative, Rome, Italy. 28 pp.

Alpizar F., Carlsson F., Lanza G., B. Carney, Daniels R.C., Jaime M., Ho T., Nie Z., Salazar C., Tibesigwa B., Wahdera S.,(2020), A framework for selecting and designing policies to reduce marine plastic pollution in developing countries, *Environ. Sci. Pol.*, 109, pp. 25-35, [10.1016/j.envsci.2020.04.007](https://doi.org/10.1016/j.envsci.2020.04.007)

Aretoulaki E., Ponis S., Plakas G., Agalianos K., (2020), A systematic meta-review analysis of review papers in the marine plastic pollution literature, *Marine Pollution Bulletin*, Vol. 161, Part A, 111690, ISSN 0025-326X, <https://doi.org/10.1016/j.marpolbul.2020.111690>

Arnold, R. D., & Wade, J. P. (2015). A definition of systems thinking: A systems approach. *Procedia Computer Science*, 44(C), 669–678. <https://doi.org/10.1016/j.procs.2015.03.050>

Bilestaro M., (2017), Monitoring the implementation of EU law: tools and challenges, European Parliament, Directorate-General for internal policies, Policy Department for Citizens' Rights and Constitutional Affairs, Petitions study, doi: 10.2861/49370

Barnes, D. K. A. (2005). Remote Islands reveal rapid rise of Southern Hemisphere, sea debris. *The Scientific World Journal*, 5, 915–921.

Bergmann M., Gutow L., Klages M., (2015), Marine Anthropogenic litter, Springer International Publishing, 447 p., DOI 10.1007/978-3-319-16510-3

Boto I., and Biasca R., (2012), Small Island Economies: from Vulnerabilities to Opportunities, Briefing no.27, CTA Brussels, 34 p. <https://brusselsbriefings.files.wordpress.com/2012/06/reader-br-27-small-island-economies-vulnerabilities-and-opportunities.pdf>

Brugge, R.v.d., Rotmans, J. Towards transition management of European water resources. *Water Resour Manage* 21, 249–267 (2007). <https://doi.org/10.1007/s11269-006-9052-0>

Bodh O.J.H., King C.A., Herbohn J.L., Russell I.W., Smith C.S.,(2007), Systems thinking for natural resource management, *Syst. Res.* 24, 217-232, DOI: 10.1002/sres.818

Caniglia, G., Sch€apke, N., Luederitz, C., Gralla1, F., Abson, D.J., Lang, D.L., von Wehrden, H., in this issue. Real world experiments as means for transformation in sustainability science. What can we learn from other fields and their history? *J. Clean. Prod*

Cabezas-Rabadán, C., Rodilla, M., Pardo-Pascual, J. E., & Herrera-Racionero, P. (2019). Assessing users' expectations and perceptions on different beach types and the need for diverse management frameworks along the Western Mediterranean. *Land Use Policy*, 81(October 2018), 219–231. <https://doi.org/10.1016/j.landusepol.2018.10.027>

Chatziparaskeva, G., Papamichael, I., & Zorpas, A. A. (2022). Microplastics in the coastal environment of Mediterranean and the impact on sustainability level. *Sustainable Chemistry and Pharmacy*, 29, 100768. <https://doi.org/10.1016/J.SCP.2022.100768>

Chen W. Y., Cho F. H. T., (2019), Environmental information disclosure and societal preferences for urban river restoration: Latent class modelling of a discrete-choice experiment, *Journal of Cleaner Production*, Vol. 231, 2019, pp. 1294-1306, ISSN 0959-6526, <https://doi.org/10.1016/j.jclepro.2019.05.307>.

Cordier M. , Uehara T., (2019), How much innovation is needed to protect the ocean from plastic contamination? *Sci. Total Environ.*, 670 pp. 789-799, [10.1016/j.scitotenv.2019.03.258](https://doi.org/10.1016/j.scitotenv.2019.03.258)

Dalberg Advisors (2019), “Stop the Flood of Plastic: How Mediterranean countries can save their sea”, WWF Mediterranean Marine Initiative, https://wwfeu.awsassets.panda.org/downloads/wwfmimi_stop_the_flood_of_plastic_mediterranean.pdf

Delia P., (2021), Protecting the Marine Environment From Land-based Activities, IISD Earth Negotiation Bulletin, Brief 9 <https://www.iisd.org/system/files/2021-01/still-one-earth-GPA.pdf>

De Vicente Lopez, J., Matti, C., (2016), Visual toolbox for system innovation. A resource book for practitioners to map, analyse and facilitate sustainability transitions, Transitions Hub Series Climate-KIC, Brussels 2016. ISBN 978-2-9601874-1-0

Durose, C., Perry, B., & Richardson, L. (2022). Is co-production a ‘good’ concept? Three responses. *Futures*, 142. <https://doi.org/10.1016/J.FUTURES.2022.102999>

Dalberg Advisors, WWF Mediterranean Marine Initiative, 2019 “Stop the Flood of Plastic: How Mediterranean countries can save their sea”

Eastman, L.B.; Núñez, P.; Crettier, B.; Thiel, M. (2013), Identification of self-reported user behavior, education level, and preferences to reduce littering on beaches—A survey from the SE Pacific. *Ocean Coast. Manag.*, 78, 18–24.

Eckelman M.J. , Ashton W. , Arakaki Y. , Hanaki K. , Nagashima S. , Malone-Lee L.C. (2014) Island waste management systems: statistics, challenges, and opportunities for applied industrial ecology *J. Ind. Ecol.*, 18 (2), pp. 306-317

Edler, J.; Fagerberg, J., (2017) Innovation policy: What, why, and how. *Oxf. Rev. Econ. Policy*, 33, 2–23.

Ellen MacArthur Foundation, (2016), The New Plastics Economy – Rethinking the Future of Plastics. Ellen MacArthur Foundation and McKinsey & Company, Davos.

Espinosa, A., Harnden, R., Walker, J., 2008. A complexity approach to sustainability e Stafford Beer revisited. *Eur. J. Oper. Res.* 187 (2), 636e651.

European Commission, (2018), A European Strategy for Plastics in a Circular Economy.

European Commission, (2021), Supporting sustainability transitions under the European green deal with cohesion policy Toolkit for national and regional decision-makers

EEA (2019), Sustainability transitions: policy and practice, Copenhagen.

Fuldauer, L. I., Ives, M. C., Adshead, D., Thacker, S., & Hall, J. W. (2019). Participatory planning of the future of waste management in small island developing states to deliver on the Sustainable Development Goals. *Journal of Cleaner Production*, 223, 147–162. <https://doi.org/10.1016/J.JCLEPRO.2019.02.269>

Galgani, F., Hanke, G., Maes, T., (2015). Global distribution, composition and abundance of marine litter. In: Bergmann, M., Gutow, L., Klages, M. (Eds.), *Marine Anthropogenic Litter*. Springer, Berlin.

Galgani F. et al., (2014), In: CIESM 2014. Marine litter in the Mediterranean and Black Seas. CIESM Workshop Monograph n° 46 [F. Briand, ed.], 180 p., CIESM Publisher, Monaco.

Galloway T.S. (2015) Micro- and Nano-plastics and Human Health. In: Bergmann M., Gutow L., Klages M. (eds) *Marine Anthropogenic Litter*. Springer, Cham. https://doi.org/10.1007/978-3-319-16510-3_13

Garcia-Vazquez, E., Garcia-Ael, C., & Topa, G. (2021). On the way to reduce marine microplastics pollution. Research landscape of psychosocial drivers. *Science of The Total Environment*, 799, 149384. <https://doi.org/10.1016/J.SCITOTENV.2021.149384>

Geels, F. W., & Schot, J. (2007). Typology of sociotechnical transition pathways. *Research Policy*, 36, 399–417. <https://doi.org/10.1016/j.respol.2007.01.003>

Giri, 2021, (2021)Water quality prospective in twenty first century: status of water quality in major river basins, contemporary strategies and impediments: a review, *Environ. Pollut.*, 271 (2021), Article 116332, 10.1016/j.envpol.2020.116332

Gkoltsiou A., Mouggiakou E., (2021) The use of Islandscape character assessment and participatory spatial SWOT analysis to the strategic planning and sustainable development of small islands. The case of Gavdos, *Land Use Policy*, Vol. 103,105277, ISSN 0264-8377, <https://doi.org/10.1016/j.landusepol.2021.105277>.

Heidbreder L.M. , Bablok I. , Drews S. , Menzel C. , (2019), Tackling the plastic problem: a review on perceptions, behaviors, and interventions, *Sci. Total Environ.*, 668, pp. 1077-1093, [10.1016/j.scitotenv.2019.02.437](https://doi.org/10.1016/j.scitotenv.2019.02.437)

Hoellein, T.J.; Westhoven, M.; Lyandres, O.; Cross, J. (2015,) Abundance and environmental drivers of anthropogenic litter on 5 Lake Michigan beaches: A study facilitated by citizen science data collection. *J. Great Lakes Res.* 41, 78–86.

Idil Gaziulusoy, A. (2015). A critical review of approaches available for design and innovation teams through the perspective of sustainability science and system innovation theories. *Journal of Cleaner Production*, 107, 366–377. <https://doi.org/10.1016/j.jclepro.2015.01.012>

Iacarella J. C., Clyde G., Bergseth B. J., Ban N. C., (2021),A synthesis of the prevalence and drivers of non-compliance in marine protected areas,Biological Conservation, Vol. 255, 108992, ISSN 0006-3207, <https://doi.org/10.1016/j.biocon.2021.108992>.

Jambeck, J.R., Andrady, A., Geyer, R., Narayan, R., Perryman, M., Siegler, T., Wilcox, C., Lavender Law, K. , (2015). Plastic waste inputs from land into the ocean, *Science*, 347, p. 768-771.

Kiessling, T., Salas, S., Mutafoğlu, K., Thiel, M., 2017. Who cares about dirty beaches? Evaluating environmental awareness and action on coastal litter in Chile. *Ocean and Coastal Management* 137, 82–95. <https://doi.org/10.1016/j.ocecoaman.2016.11.029>.

Kouvara, K., Papatheodorou, G., Kosmopoulou, A., Giovos, I., Charitou, A., Filippides, A., Kaberi, H., Kalaitzi, L., Kyrkitsos, F., Koundouri, P., Triantafyllou, C., Gletsos, M., Fakiris, E., & Geraga, M. (2022). COVID-19-related litter pollution on Greek beaches and nearshore shallow water environments. *Marine Pollution Bulletin*, 185(PA), 114250. <https://doi.org/10.1016/j.marpolbul.2022.114250>
Kühn, S., Bravo Rebolledo, E.L., van Franeker, J.A., 2015. Deleterious effects of litter on marine life. In: Bergmann, M., Gutow, L., Klages, M. (Eds.), *Marine Anthropogenic Litter*. Springer International Publishing, Cham, pp. 75–116. 10.1007/978-3-319-16510-3_4

Lachmann, F., Almroth, B. C., Baumann, H., Broström, G., Corvellec, H., Gipperth, L., Hasselov, M., Karlsson, T., & Nilsson, P. (2017). *Marine plastic litter on Small Island Developing States (SIDS): Impacts and measures*. Swedish Institute for the Marine Environment, University of Gothenburg.

Lebreton, L.C.M.; Van Der Zwet, J.; Damsteeg, J.W.; Slat, B.; Andrady, A.; Reisser, J. (2017)River plastic emissions to the world’s oceans. *Nat. Commun.*, 8, 15611.

Loorbach, Derk A. and Jan Rotmans. (2006). “Managing transitions for sustainable development.”

[Loorbach, D.A., 2007. Transition Management: New Mode of Governance for Sustainable Development. North 193. https://doi.org/10.3141/2013-09.](https://doi.org/10.3141/2013-09)

Loorbach, D., (2014)Transition management in the urban context: guidance manual. DRIFT, Erasmus University Rotterdam, Rotterdam,

Marshall, R.E., Farahbakhsh, K., (2013). Systems approaches to integrated solid waste management in developing countries. *Waste Manag.* 33, 988e1003. <https://doi.org/10.1016/j.wasman.2012.12.023>

Matti, C., Martín Corvillo, JM, Vivas Lalinde, I., Juan Agulló, B., Stamate, E., Avella, G., and Bauer A., (2020), Challenge-led system mapping. A knowledge management approach. Transitions Hub series. EIT Climate-KIC, Brussels ISBN 978-2-9601874-3-4, <https://drive.google.com/file/d/1oWI5xb8i6Mve-AbxXYOmnL59Qn8mYXZv/view>

Monteiro R. C.P., Ivar do Sul Juliana A., Costa Monica F., (2018), Plastic pollution in islands of the Atlantic Ocean, *Environmental Pollution*, Volume 238, pp. 103-110, ISSN 0269-7491, <https://doi.org/10.1016/j.envpol.2018.01.096>

Nevens, F., Frantzeskaki, N., Gorissen, L., Loorbach, D., (2013). Urban Transition Labs: co-creating transformative action for sustainable cities. *J. Clean. Prod.* 50, 111e122. <http://dx.doi.org/10.1016/j.jclepro.2012.12.001>.

Newman S., Watkins E., Farmer A., Brink P., Schweitzer JP. (2015) The Economics of Marine Litter. In: Bergmann M., Gutow L., Klages M. (eds) *Marine Anthropogenic Litter*. Springer, Cham. https://doi.org/10.1007/978-3-319-16510-3_14

Miedzinski, M., McDowall, W., Fahnestock, J., Rataj, O., & Papachristos, G. (2022). Paving the pathways towards sustainable future? A critical assessment of STI policy roadmaps as policy instruments for sustainability transitions. *Futures*, 142. <https://doi.org/10.1016/J.FUTURES.2022.103015>

Mitrano D.M. , Wollehben W., (2020), Microplastic regulation should be more precise to incentivize both innovation and environmental safety, *Nat. Commun.*, 11 p. 5324, 10.1038/s41467-020-19069-1

OECD, (2017), Tackling environmental problems with the help of behavioural insights, <https://doi.org/10.1787/9789264273887-en>

OECD (2022a), *Global Plastics Outlook: Economic Drivers, Environmental Impacts and Policy Options*, OECD Publishing, Paris, <https://doi.org/10.1787/de747aef-en>

OECD (2022b), *Global Plastics Outlook: Policy Scenarios to 2060*, OECD Publishing, Paris, <https://doi.org/10.1787/aa1edf33-en>

Papadimitriou, M., Allinson, G., (2022). Microplastics in the Mediterranean marine environment: a combined bibliometric and systematic analysis to identify current trends and challenges. *Micropl.&Nanopl.* 2, 8 <https://doi.org/10.1186/s43591-022-00026-2>

Schäpke, N., Stelzer, F., Caniglia, G., Bergmann, M., Wanner, M., Singer-Brodowski, M., Loorbach, D., Olsson, P., Baedeker, C., & Lang, D. J. (2018). Jointly experimenting for transformation?: Shaping real-world laboratories by comparing them. *GAIA - Ecological Perspectives for Science and Society*, 27, 85–96. <https://doi.org/10.14512/gaia.27.s1.16>

Rangel-Buitrago N., Williams A., Costa M.F., De Jong V., (2020), Curbing the inexorable rising in marine litter: An overview, *Ocean and Coastal Management* 188 (2020) 105133

Reisser J, Shaw J, Wilcox C, Hardesty BD, Proietti M, Thums M, et al. (2013) Marine Plastic Pollution in Waters around Australia: Characteristics, Concentrations, and Pathways. *PLoS ONE* 8(11): e80466. <https://doi.org/10.1371/journal.pone.0080466>

- Rodríguez, Y., Ressurreição, A., & Pham, C. K. (2020). Socio-economic impacts of marine litter for remote oceanic islands: The case of the Azores. *Marine Pollution Bulletin*, 160, 111631. doi:10.1016/j.marpolbul.2020.111631
- Roorda, C. & Akinsete, E. (2013). *MUSIC Aberdeen, "Mini Guide to Transition Management"* Rotterdam: Dutch Research Institute For Transitions
- Roorda, C., Wittmayer, J., Henneman, P., Steenbergen, F. van, Frantzeskaki, N., Loorbach, D., (2014) *Transition management in the urban context: guidance manual*. DRIFT, Erasmus University Rotterdam, Rotterdam,.
- Raudsepp-Hearne, C., Peterson, G D, Bennett, E M, Biggs, R, Norström, A V, Pereira, L, Vervoort, J, Iwaniec, D M, Mcphearson, T, Olsson, P, Hichert, T, Falardeau, M, & Aceituno, A Jiménez. (2020). *Seeds of good anthropocenes: developing sustainability scenarios for Northern Europe*. 15, 605–617. <https://doi.org/10.1007/s11625-019-00714-8>
- Schlaile, M.P., Urmetzer, S. (2019). Transitions to Sustainable Development. In: Leal Filho, W., Azul, A., Brandli, L., Özuyar, P., Wall, T. (eds) *Decent Work and Economic Growth*. Encyclopedia of the UN Sustainable Development Goals. Springer, Cham. https://doi.org/10.1007/978-3-319-71058-7_52-1
- Sharma, S., Sharma, V., & Chatterjee, S. (2021). Microplastics in the Mediterranean Sea: Sources, Pollution Intensity, Sea Health, and Regulatory Policies . In *Frontiers in Marine Science* (Vol. 8). <https://www.frontiersin.org/articles/10.3389/fmars.2021.634934>
- Smith, A., Stirling, A., & Berkhout, F. (2005). The governance of sustainable socio-technical transitions. *Research Policy*, 34, 1491–1510. <https://doi.org/10.1016/j.respol.2005.07.005>
- Suaria G. et al. (2016). The Mediterranean Plastic Soup: synthetic polymers in Mediterranean surface waters. *Sci. Rep.*, 6, 37551.
- Szeteiová, K. *Automotive Materials Plastics in Automotive Markets Today*. Engineering 2010, 27–33. Available online: https://www.mtf.stuba.sk/buxus/docs/internetovy_casopis/2010/3/szeteiova.pdf (accessed on 8 October 2020).
- Thiel, M.; Hinojosa, I.A.; Miranda, L.; Pantoja, J.F.; Rivadeneira, M.M.; Vásquez, N. , (2013) *Anthropogenic marine debris in the coastal environment: A multi-year comparison between coastal waters and local shores*. *Mar. Pollut. Bull.*, 71, 307–316.
- Tyedmers, E., Malik, A., Fry, J., Geschke, A., Yousefzadeh, M., & Lenzen, M. (2020). Sustainable development opportunities in small island nations: A case study of the Cook Islands. *Journal of Cleaner Production*, 277. <https://doi.org/10.1016/J.JCLEPRO.2020.123045>
- UNEP (2016a). *Marine plastic debris and microplastics – Global lessons and research to inspire action and guide policy change*. United Nations Environment Programme, Nairobi.
- UNEP(2016b) *Regional Oceans Governance*, Available online: <https://www.unenvironment.org/resources/report/regional-oceans-governance> (accessed on 1 July 2020)

UNEP (2018). SINGLE-USE PLASTICS: A Roadmap for Sustainability (Rev. ed., pp. vi; 6).

UNEP, (2019), Sustainable Coastal Tourism – an Integrated Planning Management Approach. United Nations Environment Programme, Milan.

Voytenko, Y., McCormick, K., Evans, J., Schliwa, G., (2015) Urban living labs for sustainability and low carbon cities in Europe: towards a research agenda. *J. Clean. Prod.* 1e10. <http://dx.doi.org/10.1016/j.jclepro.2015.08.053>.

Wamsler C., Mundaca L., Osberg G., (2022), Rethinking political agency: The role of individuals' engagement, perceptions and trust in transitioning to a low-carbon transport system, *Journal of Cleaner Production*, Vol. 360, 132197,ISSN 0959-6526, <https://doi.org/10.1016/j.jclepro.2022.132197>

Watkins, E.; Brink, P.; Withana, S.; Mutafoglu, K.; Schweitzer, J.-P.; Russi, D.; Kettunen, M. Marine litter: Socio-Economic Study: Scoping Report; Institute for European Environmental Policy: London, UK; Brussels, Belgium, 2015; Available online: <https://www.bundesregierung.de/resource/blob/974430/436888/a8d13ddc42b36d8d71048b3ee39dcfc0/2015-06-01-marine-litter-data.pdf?download=1> pdf (accessed on 18 September 2022).

Wilson, S.P., Verlis, K.M., (2017), The ugly face of tourism: marine debris pollution linked to visitation in the southern Great Barrier Reef, Australia. *Mar. Pollut. Bull.* 117 (1), 239–246.

Wen W., Zhou P., Zhang F., (2018), Carbon emissions abatement: Emissions trading vs consumer awareness, *Energy Economics*, Vol. 76, pp. 34-47, ISSN 0140-9883, <https://doi.org/10.1016/j.eneco.2018.09.019>.

Zalasiewicz, J., Waters, C. N., Ivar do Sul, J. A., Corcoran, P. L., Barnosky, A. D., Cearreta, A., ... Yonah, Y. (2016). The geological cycle of plastics and their use as a stratigraphic indicator of the Anthropocene. *Anthropocene*, 13, 4–17. doi:10.1016/j.ancene.2016.01.002