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Perception of Citizens Regarding Marine Litter Impacts: Collaborative Methodologies in Island Fishing Communities of Cape Verde

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Abstract: Marine litter has been considered one of the most serious global challenges, requiring urgent action by governmental bodies, especially in African Small Island Developing States (SIDS), where resources and research are limited. In addition to this, waste management and environmental education and ocean literacy programs in schools are scarce, with islands suffering more seriously from these problems. Despite the amount of literature regarding causes and impacts of marine litter, there is still not enough research conducted concerning the public perceptions on both the problem and the potential solutions. This is even more noticeable in African developing countries, where resources and research are scarce. Perception plays a key role for ecosystem management and conservation policies. This study intends to explore the perceptions of local island fishing communities in Cape Verde regarding marine litter, in order to contribute for an improvement of marine ecosystem management and development of conservation policies. To achieve that, two participatory sessions were conducted in two communities in the island of Santiago—Porto Mosquito and Porto Gouveia—where brainstorming and active listening were used to create shared and authentic spaces for dialogue between the members of the community. Results show that the population of both communities were very aware of the marine litter problem. They were able to identify the lack of a proper waste management system in the island and the inappropriate behaviours of the population as the main causes of this problem. Equipment damages and the presence of plastic inside the fish were the most relevant impacts identified by the participants. These findings reinforce previous research on the importance of public engagement and environmental education to contribute to the conservation of marine ecosystems and to build a strong collaborative ocean governance.

Keywords: marine litter; island communities; small islands; ocean literacy; public engagement; Cape Verde; Africa

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1. Introduction

Marine litter has been considered one of the biggest and most complex global environmental challenges, attracting growing attention and concern from a range of individuals, including researchers, media and political bodies [1,2]. The United Nations Conference on Sustainable Development in 2012, also known as Rio+20, gave it particular attention and addressed this issue in the resolution adopted by the General Assembly, stating "*We note with concern that the health of oceans and marine biodiversity are negatively affected by marine pollution, including marine debris, especially plastic, persistent organic pollutants, heavy metals and nitrogen-based compounds, from a number of marine and land-based sources, including*

shipping and land run-of" [3]. Following this, the Leaders' Declaration at the G7 summit in 2015, also stated the consequences of marine litter, in particular plastic litter, to marine and coastal ecosystems and human health, acknowledging this as a global challenge [4].

Marine litter is commonly defined as "*any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment*" [1,5,6], and consists of, mainly, items originated by human activities that were deliberately or not discarded into the sea, rivers and the coastline (e.g., beaches). In fact, litter can also be brought to the marine environment indirectly through rivers, sewage, stormwater or winds [6–9]. According to OSPAR [10], the most common material types found in marine litter are plastic, sanitary waste, glass, metal, paper and rubber, however, it is evident that plastic items are the most abundant type of marine debris [8,11–13] accounting for around 80% of the total marine debris [8,14]. Plastic is, in fact, a problematic component of marine litter, not only due to its abundance, but also because of its resistance, longevity and the fact that large pieces of plastic can break down into smaller and smaller pieces, eventually becoming individual polymer molecules—microplastics [1,15–18]. Moreover, plastic production has increased over the last decades and, in 2018, the global production of plastic almost reached 360 million tonnes, producing more than 360 billion euros of revenues just in Europe [19]. Due to its multifunctional properties and competitive prices, plastic became an extremely versatile product, used for food packaging, medicine tools, electronics, automotive design, among others [20], and, because of that, the amount of plastics entering the ocean per year is still unknown [12], even though it is increasing in some locations [15].

According to [7], the spatial distribution and amount of marine litter in the ocean depend on numerous factors, including its origin/source, ocean currents, wind patterns and physiographic characteristics [15]. The main source of marine litter is, in fact, terrestrial (around 80%), including tourism, industrial and recreational areas, terrestrial runoffs, river discharges, wastewater effluents, sewage treatment plants and pipes and into sea-based sources. Sea-land sources account the remaining 20% of the total amount and include commercial and recreational shipping, aquaculture and fishing [21–23]. Because of that, marine debris is found near densely populated regions, like the Mediterranean Sea [7,21], for example, but also in remote places far away from obvious sources [6]. Although most of the marine litter is found at the coastline, it is estimated that this only accounts for 15% of all marine debris found. The other 15% can be found mixed at different levels in the water column, and the remaining 70% can be found at the bottom of the sea, and remains there, particularly on accumulation bottoms [6,14].

The continuous input and accumulation of waste, especially plastic-based litter, in the marine environment has severe impacts for marine wildlife, economic activities and services and human health [8,24,25]. The main threats to marine life are related with entanglement in debris, particularly synthetic ropes used for fishing, and ingestion of microplastic particles [8,20,26,27], that animals confuse for food. Where the first can lead to death from injury, drowning, or starvation caused by general debilitation and altered hunting or foraging behaviour, the latter can lead to death by starvation, due to the inability of animals to digest or pass the plastic, experiencing a false sense of satiety [8,17,20,28]. Apart from that, the transportation and dispersion of invasive species in the marine environment is another impact of marine litter, that have major consequences for marine ecosystems [8,12], since they impact native populations and colonize new habitats [26]. The accumulation of marine litter in the ocean may also cause physical damage to ecosystems, affecting some species habitats and, consequently, marine biodiversity [8]. Besides the direct environmental damage to marine wildlife, plastic pollution can also cause enormous social and economic impacts [20,29]. As marine and coastal ecosystems have great importance for economy, through industries such as fisheries, tourism and recreational activities, for example, the presence of debris in the ocean can lower those returns [20,30]. For example, the presence of litter in the marine environment affects negatively its aesthetics and decreases recreational opportunities, which can contribute to a loss of tourists, damage

of leisure infrastructure and equipment and damage the local image of certain hotels, resulting in economic losses of millions [17,31]. Other economic costs include the costs regarding beach cleaning, damages caused in shipping, control and eradication of invasive species, damage of vessels and equipment of some marine industries and loss of fish stock, for example [14,24,27,31]. In addition to that, marine litter can cause several injuries to humans and the ingestion of microplastics by marine species can impact the fishing industries in the future and its accumulation in the food chain can pose a serious threat to the food safety and generate serious health implications to human health [29,32,33].

Despite the amount of literature regarding causes and impacts of marine litter, there is still not enough research conducted concerning the public perceptions on both the problem and the potential solutions [1,34]. This is even more noticeable in African developing countries, where resources and research are scarce, as well as ocean literacy programs. Nonetheless, understanding society perceptions and interactions with the marine environment is essential for the ecosystem management approach and conservation policies [34,35]. For these reasons, this paper aims to address the research gap mentioned previously and explores the views and perceptions of local coastal communities in the island of Santiago, Cape Verde, regarding marine litter, as well as understanding the behaviours, the impacts and responses from the general population regarding this issue. For that, two public participatory sessions were conducted in two local communities of the island, which are described in the methods section, as well as the results and findings from those sessions. The discussion section of the paper considers some key issues related to public perception on marine litter and the conclusion, after a set of final considerations, identifies relevant aspects that should be considered for future research.

2. Case Study

Cape Verde is a volcanic archipelago of ten small islands in the middle of the Atlantic, distanced from the West African mainland by 570 km (Figure 1). With an area of 4033 km^2 [36] and a population of approximately 550,000 inhabitants [37], Cape Verde is considered a small island developing state (SIDS) facing several challenges other SIDS face, including sustainability ones. In spite of that, Cape Verde has been recognized by the international community, in recent years, as one of the most successful countries in Africa regarding political, economic and social performance [29,38–40].

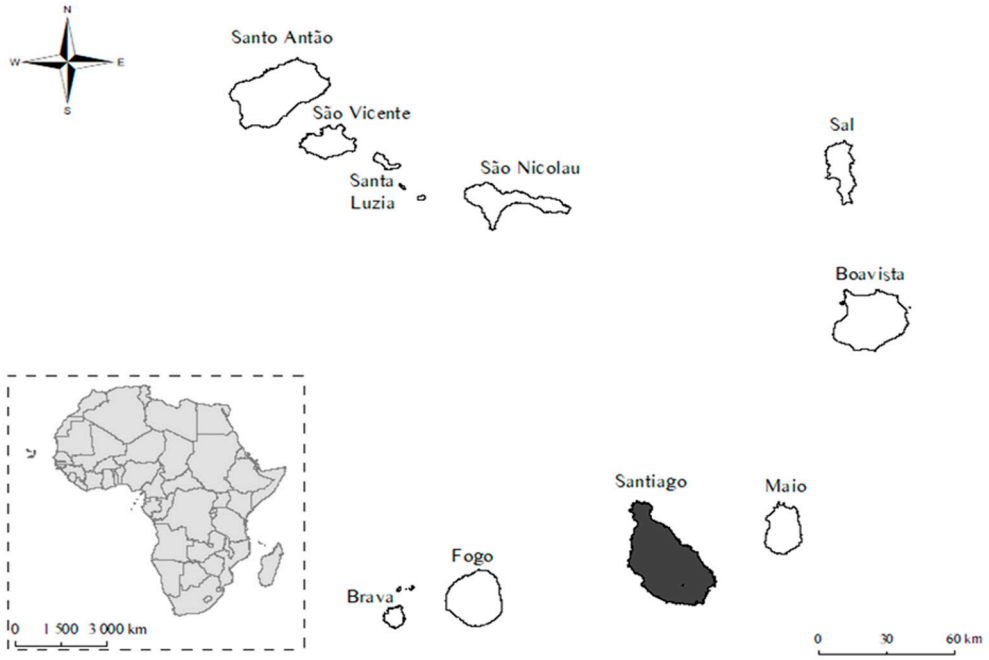

Figure 1. Cape Verde archipelago with its ten islands (Data from: Humanitarian Data Exchange).

Regardless of the progress and the government commitment to improve the living standards of the country, Cape Verde continues to struggle with macroeconomic and environmental problems arising from its insularity and archipelago configuration, fast demographic growth and insufficient self-production of goods [38,40,41]. Due to that, Cape Verde imports substantial amounts of goods, generating excessive quantities of waste—like plastic [42]—that fail to have adequate treatment, due the lack of technology, infrastructures and public knowledge. In this way, the waste generated is usually placed in a landfill or in inappropriate allocations (e.g., the ground, valleys, etc.), which increases the probability of being washed into the ocean (Figure A1).

This study was conducted in two local coastal communities in the island of Santiago, the biggest and the most populated island of the whole archipelago [43]—Porto Mosquito and Porto Gouveia (Figure 2).

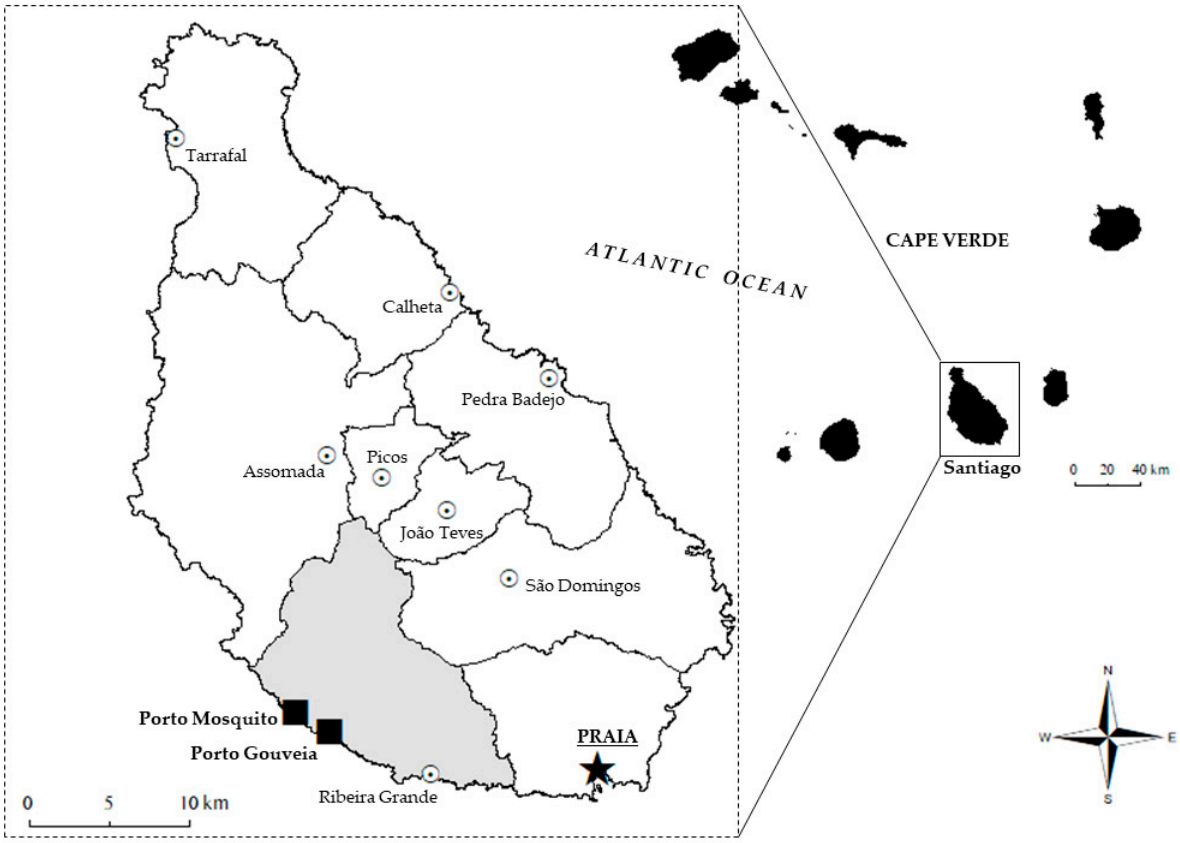

Figure 2. Porto Mosquito and Porto Gouveia (Data from: Humanitarian Data Exchange).

Both communities are located in the municipality of Ribeira Grande de Santiago, with an area of 164 km^2 and a population of 8520 inhabitants, where the average age is around 28 years old, and the percentage of women is 50.7% to 49.3% of men. When it comes to education level, according to INE | IMC [44] 77.9% of the total population of the municipality with more than 15 years old is instructed (defined as people aged 15 and over who can read and write at least one simple ticket in the language they know). However, the percentage of men instructed compared to women in the same age group, is higher, being 84.5% and 71.7%, respectively. The level of instruction tends to be even higher in younger individuals, however still almost 13% of the population over 15 years of age has never attended school.

Both communities—Porto Mosquito and Porto Gouveia—are fishing communities, and the main economic activities of both communities are related to fishing and the sale of fish, and sand extraction for construction for women. The dependence of these two

communities on coastal resources and their isolation from other communities, makes them the ideal communities to carry out our research.

Porto Mosquito is a small community located in the south of the Santiago island, about 20 km of the countries' capital, Praia. According to the last Census of Cape Verde, this community counted 819 inhabitants in 2010 (367 males and 452 females). However, the probability this number has increased in the last decade is very high. Still based on the 2010 Census, from those, 40% had less than 15 years old, almost 55% were between 15–64 years old and only 5% were older than 65 years. Porto Gouveia the other community, located at 15 km from the capital (Praia) with a population of 534 inhabitants (260 men and 274 women). Even though the percentage of the population with less than 15 years old, between 15 and 64 years old and older than 65 years old is similar to Porto Mosquito (39%, 56% and 5%, respectively), the percentage of working people in Porto Gouveia is higher than in Porto Mosquito (31% to 26%, respectively).

3. Materials and Methods

Marine litter is a serious problem with several impacts on coastal communities, especially the ones that directly depend on marine resources for income [31]. So, the purpose of this research is to understand the perceptions about marine litter of two local coastal communities in Cape Verde. Specifically, it focuses on coastal residents' values, behaviours, level of awareness and knowledge regarding this topic. To build understanding on this, the authors opted for a qualitative methodological action-research approach supported by public participation processes and community engagement methods. The reason behind the selection of this approach is due to the fact qualitative research captures multiple versions of multiple realities and the gathered narratives can illuminate how informants use language to convey particular meanings and experiences that shape those realities [45].

Public participation can be defined as the active involvement of groups of people affiliated by geographic proximity, special interests or similar situations, in accomplished common matters and affairs affecting the well-being of them [46,47]. The experience and contributions of citizens can contribute to the improvement of decision making processes and, in some cases, to the changing of the whole planning process [48], since they are the main potential victims and benefactors of proposed planning measures and, therefore, the best judges of those actions [49]. Public participation helps to promote active involvement, exchange, and empowerment of the community, to build trust and commitment among the citizens and to create connections in the knowledge-power and management constitution [50,51].

The process of public participation conducted in this research consisted in five procedures based on the "*Stakeholder Engagement Manual – The practitioner's handbook on stakeholder engagement*" developed by Accountability, the United Nations Environment Program (UNEP), and Stakeholder Research Associates [52], and the methodology presented by [50]. As it is shown in Figure 3, the five procedures are problem identification, stakeholder selection, consultation and involvement, capacity building and evaluation and reporting.

3.1. Problem Identification

The problem identification is an important step to any conflict resolution or decision-making process. Individuals, organizations, and institutions have to jointly identify and define an existing problem, including defining its root cause, to fully understand it. This is done collectively by the ones living or working on that problem. Only with a proper problem identification it is possible to find the right answers and the appropriate tools to fix it. The main questions to be answered in this first step are what issues need to be addressed, who should be involved to solve it, and what has to be achieved by the public participatory process.

The issues to be addressed in this specific research were the marine litter impacts on low income coastal communities in developing countries. The objective of the participatory process set up consisted in understanding the population perception towards this problem,

promote a build-up of a common understanding of the issues to be addressed within that problem and provide them with tools to find solutions to deal with those problems.

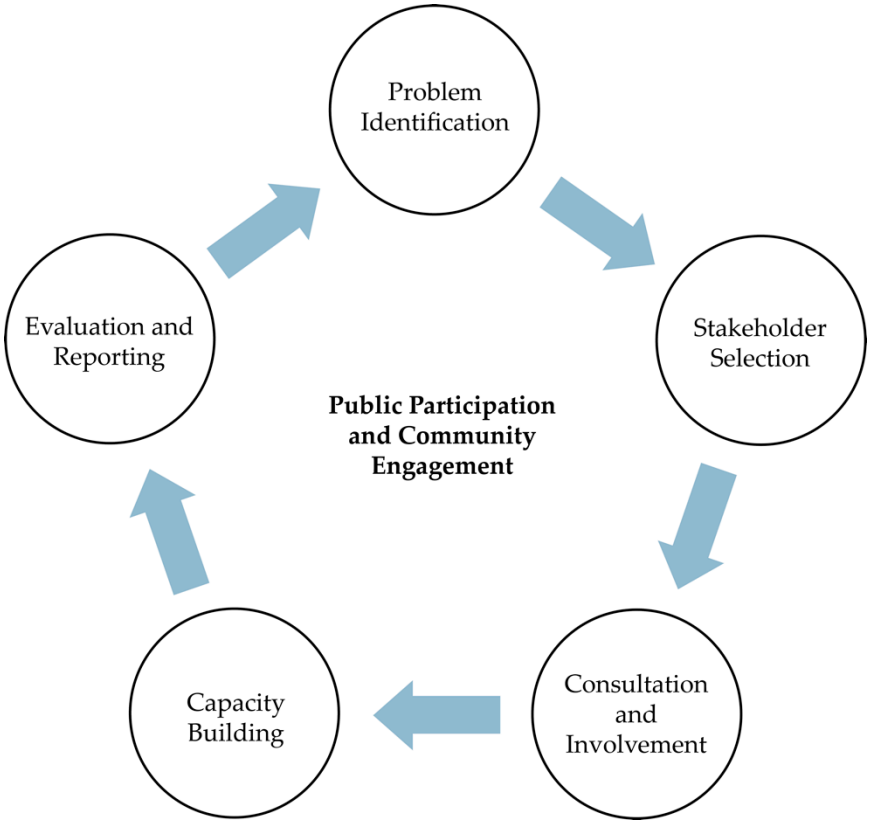

Figure 3. Public Participation and Community Engagement Methodology (Based on Krick et al., 2005 [51]).

3.2. Stakeholder Selection

The second procedure involved a systematic identification, selection and characterization of the different stakeholders that were to be involved in the process. Two similar coastal communities were selected—Porto Gouveia and Porto Mosquito. To start and operationalize the process, it was necessary to visit both communities, to build a better knowledge of the situation in loco.

To facilitate and promote the engagement of people to participate in the participatory sessions planned, these visits were done at different hours and different days. This allowed the team to build a connection with the local communities. Simultaneously, due to lack of technology devices by the community, flyers (Figure A2) were distributed to the population and posted in strategical places with a lot of influx of citizens (e.g., primary school, local grocery store, etc.), to reach a more diverse crowd. Additionally, some people with major influence in the community were invited to spread to word about the process (e.g., the schoolteacher), to encourage more people to attend the sessions.

3.3. Consultation and Involvement

The aim of this part of the public participation process is to develop and implement engagement processes with the community and the main focus of the consultation and involvement process is to get stakeholders perception and to find contributions and solutions about the problem that is under discussion [50,52]. The range of engagement can differ from basic meetings and phone calls with simple information, to more innovative methodologies such as advisory panels or multi-stakeholder forums, which allows a real co-construction with stakeholders [52].

In both sessions conducted in this study, non-formal and active participatory methods were used in order to create shared and authentic spaces for genuine dialogue [53] between the members of the community [54–56], namely brainstorming and active listening (Figures A3 and A4). With these methods, the participants are the centre of the sessions, which allows everyone to interact and share their knowledge and experience over the years [57]. With these methods, it is possible to create new knowledge and to gather different perspectives of a common topic which, in this case, is marine litter.

The first method of the consultation and involvement phase was a brainstorm where all the participants were invited to express their thoughts regarding marine litter in the absence of judgment from the other participants. All the ideas emerged were collected and systematized by the facilitator. The second method consisted in active listening, where the facilitator would ask specific questions regarding marine litter, namely, the causes, the consequences and what could be done to solve this problem. The answers would, again, be collected by the facilitator.

3.4. Capacity Building

Capacity building is the process in which individuals acquire, improve and retain knowledge, tools, skills and new competencies, in order to strengthen and maintain their capabilities to achieve their own development over time [58–60]. In public participatory processes, capacity building can help the community to strengthen and sustain knowledge regarding a specific topic, giving them the tools to deal with it and to find solutions for a problem.

In both conducted sessions, after the population perceptions were gathered in the consultation and involvement and active listening methods, some scientific information about marine litter was presented (Figures A5 and A6). Here, people were taught about what marine litter was, the main causes, impacts around the globe and what could be done to prevent this problem. In addition, some training regarding this issue was provided, which allowed the construction of a common vision between the participants in which they set some objectives and joint actions to tackle the marine litter in their communities.

3.5. Evaluation and Reporting

After every public participatory session, it is important to ask for and give feedback to all participants, in order to create opportunities to update the group. Besides that, based on the answers and the discussion, it is possible to evaluate the method and adjust it, so it can be improved for future activities/policies [50].

4. Results

The results are presented in two different sections. In Section 4.1, the information presented regards the citizens who participated in both public participation sessions. The data presented includes the gender, the age group and the occupation of all participants. Section 4.2 registers the overall perceptions, awareness and concerns of the citizens regarding marine litter, namely the causes, the type of materials found and its impacts as well as some solutions proposed by the community.

4.1. Participants Characterization

As presented in Figure 4, most of the participants in the public participatory sessions were women—61% against 39% of men. Considering the population numbers presented in Case Study section, these are not surprising results, since, both communities have a predominance of the female gender, although the percentage of women in the sessions is higher compared with the ones revealed by the official statistics that report 55.2% and 51.3% of women respectively in PM and PG.

Regarding the age of the participants, 36% of the participants were no older than 19 years old, most of them being students. The percentage of people between the age range of 20 and 39 years old was 39% and 22% of people belonged to the age range of 40

to 59 years old. Only 3% of people in both sessions were older than 60 years old, as it is shown in Figure 5.

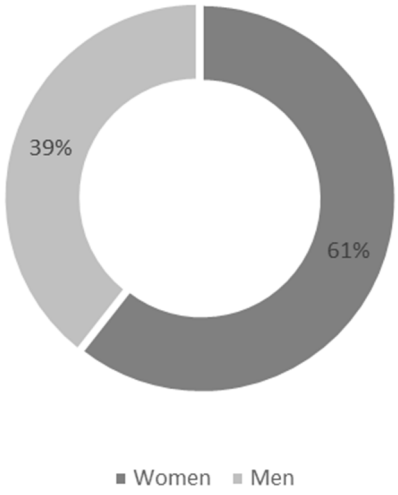

Figure 4. Participants in the group sessions by gender.

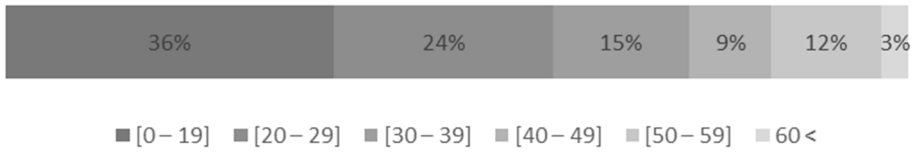

Figure 5. Participants in the group sessions by age group.

The average age of the group was 29 years old and women who attended the sessions were, in average, older than men. The average age of women was 34 years old, against the average of 21 years old for men.

Concerning their occupation, the main activities of the population are related to the sea. Most of the men worked as fisherman or fish sellers, as opposed to women, who worked at the beach as sand collectors. As the sample included a lot of young people, it was expected there would be a lot of students among the participants, and, as shown in figure below, indeed 27% of the total participants reported being students. This, however, is inconclusive as to whether they had other activities besides that one. Some 3% of the participants were cooks, an activity carried out only by women, and 9% were unemployed, as shown in Figure 6.

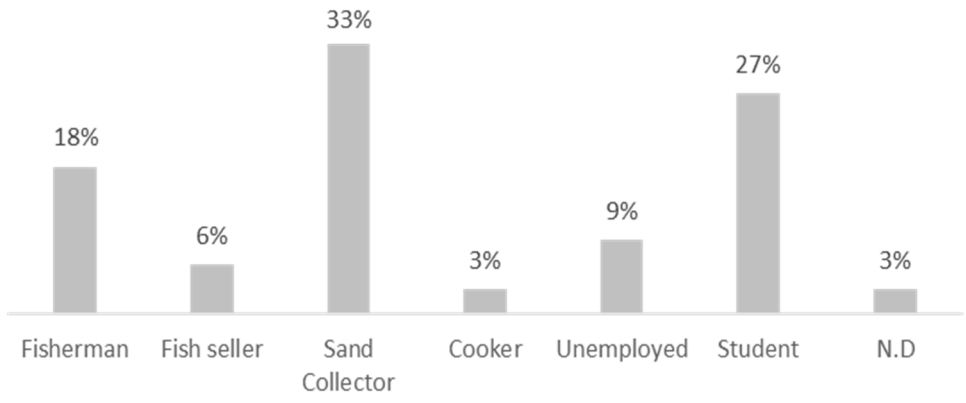

Figure 6. Participants in the group sessions by occupation.

4.2. Participants Views about Marine Litter

Since the participants of the public participatory sessions were from two coastal communities, citizens were quite familiar with the marine litter topic. They were able to correctly identify some causes and main impacts on their lives, as well as propose some solutions to address this issue.

Regarding the causes, the population identified the lack of a proper waste management system on the island as the main cause of marine litter. Apart from that, they also acknowledged some inappropriate behaviours of the population regarding trash disposal, as well as an absence of information about this topic. As for the impacts, almost every fishman mentioned damages to the equipment due to marine litter debris and some of them even noticed plastic pieces inside some fish species. The women, as sand collectors, referred the reduce of productivity in their activities due to the abundance of marine debris at the local beaches. Plastic was identified by the participants as the most common material found in the ocean and at the beaches.

Although the participants were concerned about the causes and the impacts of marine litter, they were also able to identify some solutions to deal with this problem. Some of the suggestions include the improvement of the waste management system, as well as the existence of more educational activities in schools.

More information about the views of the population regarding marine litter can be found in Table 1.

Table 1. Participants perceptions regarding marine litter.

Topic	Problem	Perceptions
Causes	Waste Management	The community identified the lack of proper waste management as one of the biggest problems in the island. The lack of trash bins makes people to dispose trash in the hills, which will end up in the sea when it rains
	Origin of Litter	People were fast to refer that it is now allowed to throw litter to the ocean, so the main part of marine litter comes from land
	Population Literacy	The population admitted that there was not enough information regarding this topic, which explains the lack awareness about marine litter. The community also stated that even when there are trash bins in the street, people usually do not put their residues in the correct place and, the majority, end up on the streets
Waste found	Plastic	In both communities, the population could easily identify plastic (water and oil bottles) as the main component of marine debris. Apart from that, some citizens also stated that clothes and shoes were also common to be found in the beaches
Impacts	Equipment Damage	Some fishermen stated that, sometimes, the fishnets that are abandoned in the sea, can wrap around the boat propeller, which can damage it, resulting in money losses to repair it. This also makes impossible for fishmen and fish sellers to work, which, for some families, is the main source of income
	Wildlife at risk	Some participants claimed to have seen some marine species stuck in trash in the ocean and, some of them, even claimed to have found pieces of plastic inside some fish species
	Sand Collection	The sand collectors referred that the trash can complicate their job, because some areas are so full of litter, that they must clean it first, so they can collect the sand. This, of course, affects their productivity resulting in losses of income
Solutions	Waste management	The community is aware of the problems regarding waste management and stated that more trash bins in the street and a more efficient trash collection could help prevent the amount of litter that end up in the ocean. Some citizens also pointed out that some materials could be reused as much as possible and recycled to reduce the amount of waste produced
	Educational Campaigns	The population also stated that some campaigns about this topic should be done with the involvement of the community, in order to bring awareness about marine litter. Some of the activities suggested were beach cleaning campaigns and training sessions to the professors of local schools

5. Discussion

The current research illustrates that the participants of both sessions hold a positive attitude towards marine ecosystems and showed high awareness of the marine litter issue, especially in their communities. The population was able to identify the causes of marine litter, as well as some impacts and solutions, which shows increased level of awareness concerning this topic, as what happens in other places around the globe, demonstrated by previous works [20,34,35]. Although most of the participants were from low income families with a low educational level, they were fast to recognize the pressures (causes), state (waste found), impacts and to propose solutions (responses) regarding marine litter (Table 1). Coastal communities depend on the oceans for livelihoods, for food security and wellbeing [30], and, for that reason, both communities in this study were conscious about this problem and were able to identify the importance of marine environments, due to the benefits they receive from them in a personal, socio-cultural and economic point of view

Looking at the distribution of the participants, most of them are females (61%) and students (27%), which may indicate that more knowledgeable people and women are more likely to be concerned about environmental issues. Although this cannot be fully confirmed by this research, is coherent with previous studies in other regions of the globe [34,61–63]. In fact, according to Gissi et al. [64], women play a crucial role regarding marine conservation and ocean governance, including the study of marine litter. Women are recognized as key actors in the adoption of ethical principles that can contribute to individual behavioural changes, attitudes and actions towards sustainability in fisheries and in marine ecosystems [64].

When it comes to the causes of marine litter, the lack of waste management in the island was pointed out as one of the main reasons to marine litter, similar to a study conducted in Amvrakikos Wetlands National Park, Greece [25]. The population mentioned the insufficient number of trash bins in both communities, as well as the inefficient transport system of solid waste, stating that the waste is not collected as regularly as should be. In fact, some of these problems are coherent with the studies of Tavares et al., and Zsigraiová et al. [65,66], where both authors claim that the existing waste management on the island of Santiago is characterised by insufficient collection, which causes enormous pressures regarding marine litter. Even though there are some small returnable containers and some high-capacity containers spread all over the municipalities, according to the authors, the waste collection from the large containers is only done twice a week or even sporadically, depending on the place, means of transportation or even other logistic reasons. In opposite of Praia, where the roads and streets are robust, comparable to some developed countries, the same does not apply to the rest of the island, particularly in rural, more peripheral areas that are more isolated. Due to the geomorphology of the island (a mountainous island), some communities are not so easily accessible by truck, which may compromise the waste collection. Other reason that may have an influence on the weak waste collection is the still fragile economic performance of the country, which may contribute to the lack of proper equipment (e.g., waste trucks) to guarantee an efficient waste transportation.

Despite the participants acknowledgement about not being possible to throw trash in the ocean, there is still a lot of marine litter found in the coastline of both communities, some of local origin, some brought by the sea. Because of that, the population was fast to identify the source of the trash being from mainland, similar to findings in other studies [11]. Even though each municipality is responsible for the waste collection of its territory, there is no specific waste treatment for the trash generated and all the waste produced in the island, that is collected, ends up in a landfill near Praia, the capital city. Unfortunately, some of the trash produced by the population is thrown on the streets, as also stated by the participants. These behaviours, combined with the inexistence of a proper waste treatment, are a result of poor environmental and ocean literacy programs among the population, as well as inadequate environmental policies in the country. Although an Environmental Education Plan was developed in 2014 for a 8 year period (2014–2022),

there is still a lack of environmental education actions in schools and a disregard of the population involvement in the development of environmental governance strategies [67], that contribute for the neglect of the population regarding environmental issues. Only with a serious development and improvement of environmental educational programs it is possible to change the population behaviours at a long term, regarding not only marine litter, but also other current and important environmental issues.

As previously mentioned, the deficient trash collection and treatment is an important issue and one of the causes of the marine litter in the ocean and coastal areas. This problem is even more aggravated if we consider that Cape Verde is an insular country that imports most of its products, including food [38–40]. As it is known, most of the food consumed nowadays comes in packages, including plastic ones, not only to guarantee its quality and its durability, but also to assure a more convenience transportation and usage by the consumer, contributing for the growing global production of plastic, which reached 359 million tonnes in 2018 [19]. In fact, according to Babayemi et al. [42], Cape Verde imported around 6000 tonnes of plastic per year, during the period of 1997 and 2017, resulting in expenses of more than 339 million dollars, and these numbers are expected to rise in the future. Besides the impact plastic importation has for Cape Verde economy, the inexistence of selective waste collection causes plastic to be one of the main materials found not only in the trash bins, but also in the streets, beaches and the ocean, as stated by the populations in the focus group sessions. In both communities, the population could easily identify plastic bottles and packages of food and other domestic products, as part as marine debris.

Even though there was no study conducted regarding the exact money losses caused by the equipment damage of fishermen, both communities identify this as being a serious problem caused by marine litter that directly impacts them and their families. Considering that in the United Kingdom alone, the economic cost of equipment damages in fisheries is estimated at more than 11 million euros per year [30], and, in Asia-Pacific region, tourism, fishing and shipping industries are estimated to be impacted by 1.3 billion dollars per year [24], so, it is no surprise that both coastal communities in this research have big economic impacts in their fishery activities. In reality, more than 70% of Cape Verde's GDP is assured by services, however there is still a substantial part of the economy that is based on the primary sector and fish and fisheries are Cape Verde's main exports [43,67]. For that reason, Cape Verde economy is extremely vulnerable due to its high dependency on foreign aid and remittances, as well as the instability of its agricultural production [38], as previously mentioned, and a decreasing of fisheries, impact directly its economy and the life of the ones that depend on it for income, as was mentioned by the locals.

According to the results shown in Table 1, there are several variables associated with the marine litter identified by the population, which can be found in Figure 7. In this causal loop diagram, it is possible to identify, in a summarized way, the causal relationships among the variables and its polarity: a plus (+) implies a change in the variable in the same direction and a minus (–) implies a change in the opposite direction [68,69].

As the causal loop diagram shows, ocean literacy and environmental education and awareness constitute important leverage points with direct impact on marine litter, on a positive or negative way. In fact, this leverage point has a negative retroactive relationship with marine litter, which means that if ocean literacy increases in a certain community, the protection of marine environments will increase as well in the long term, which includes the reduction of marine litter [70,71]. In this way, it is important to understand, alongside the coastal communities, whose income depend on coastal resources, their perception regarding the theme of marine litter, in order to develop a diagnosis on the literacy level of these communities and to propose programs to increase environmental education and awareness in the community. The community's perception regarding marine waste, will also contribute for the development of strategies that aim to improve the existing waste management and treatment systems at a national level.

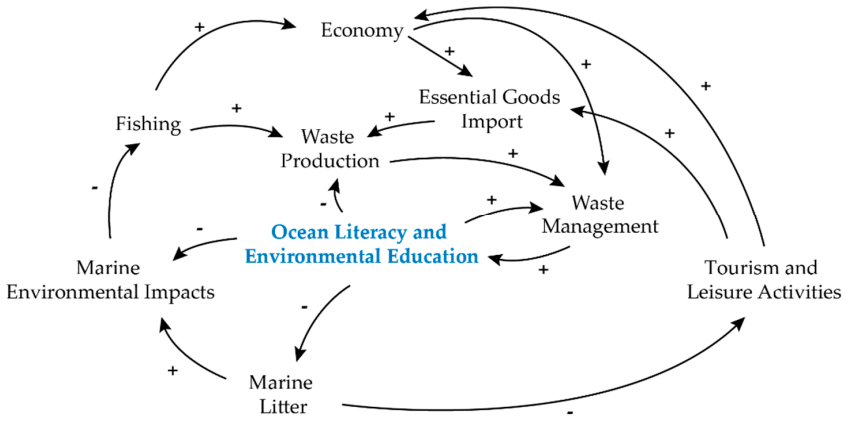

Figure 7. Simplified casual loop diagram of marine litter in fishing island coastal communities in Cape Verde.

While no formal survey was conducted in this study, the methodological approach of this research was important to establish a relationship among researchers and the community members and build understanding on the issue at stake—population perception on marine litter. The findings are significant for the debate on how to engage local coastal communities and the population in general with the sea and marine environments, since they provide a wide range of services to the population. Additionally, by engaging the community, it is expected that individual behaviours regarding marine litter and environmental protection can change within both communities, in order to improve the local marine environment. The lack of awareness of these issues may mean that the community disconnect with the engagement attempt. However, further successful ocean literacy strategies and programs and environmental education and awareness campaigns must be developed for and with the population, in order to engage individuals in the intended response of reducing marine litter in the sea.

6. Conclusions

Many coastal communities in developing countries depend of the marine resources for their income. They depend of the fisheries and on the recreational activities provided by the sea and recognize the importance of marine ecosystems for their wellbeing. However, despite the critical importance of marine environments, the growing impacts caused by humans, namely climate change, overfishing and marine pollution, which include marine litter, are compromising the protection of the oceans and coastal ecosystems of the planet. Due to the cross-border nature of marine litter, the management of this issue requires interventions at all levels (local, national and global) and different approaches (technical and educational) to mitigate threats.

As an outcome from this study, is it now possible to conclude that island fishing communities of developing countries are fully aware of the environmental problems surrounding them, including the presence of marine litter in coastal and marine ecosystems. It is also noticeable that, despite the language barriers and the lack of literacy of the population (many people did not know how to write and read), these specific coastal communities were extremely concerned regarding marine litter and were able to acknowledge the importance of environmental educational programs and actions to tackle this serious issue. However, the results also show the concerns population had regarding limited ocean literacy programs, which did not allowed the community to engage in the ecosystem's protection.

As the research was conducted, another important finding was that women and students have proven to have a key role for addressing successfully marine litter and environment conservation and are more willing to adopt individual behavioural changes, attitudes and actions towards sustainability and to contribute to the conservation of marine

ecosystems. Therefore, its inclusion in future strategies and policies to address these issues should be thoughtfully considered, in order to improve environmental protection of marine ecosystems and to reduce marine litter in these countries.

Although Cape Verde has been seen as an example by the international community as a peaceful, social conscious and economic growing nation, its environmental programs need urgent attention. As a small island developing state (SIDS), Cape Verde is extremely vulnerable to environmental problems, due to its incapacity of self-sustain and hight dependency of other nations to maintain its economy. The dissemination of knowledge about the ocean and marine environment is extremely important and schools are the main institution responsible to teach and pass on knowledge to people in these communities. For that reason, improving community engagement, developing awareness campaigns and ocean literacy programs, as well as inclusive ocean and coastal management policies is the only way to assure that marine litter is reduced in the ocean and marine environments and to guarantee the protection and conservation of marine biodiversity and respective habitats.

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Appendix A

Figure A1. Waste found at the beach (photo by the authors, September 2019).

Figure A2. Example of poster for publicizing the sessions, posted in public places in both communities prior the participatory sessions.

Figure A3. Active listening and brainstorming in the participatory session in Porto Gouveia. (photos by the authors, September 2019).

Figure A4. Active listening and brainstorming in the participatory session in Porto Mosquito. (photos by the authors, September 2019).

Figure A5. Capacity building regarding marine litter in the participatory session in Porto Gouveia. (photos by the authors, September 2019).

Figure A6. Capacity building regarding marine litter in the participatory session in Porto Gouveia (photos by the authors, September 2019).

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