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Perspectives of leisure operators and tourists on the environmental impacts of coastal tourism activities: a case study of Mauritius

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Abstract
Mauritius is a popular destination for tourists who visit the island for the sun, sea and sand in addition to tourism activities. Although the consumption of tourism activities brings various benefits to the island, there have been concerns over the adverse impacts of such activities on the marine and coastal environment, such as loss of biodiversity and disturbances caused to marine plants and animals. In order to reduce the impacts of these activities on the environment, actions from both the providers and consumers of such activities, notably leisure operators and tourists, are necessary. This paper investigates and presents findings on the perspectives of leisure operators and tourists on the environmental impacts of coastal recreational tourism activities, through answering four research questions. Following a survey conducted within the island, findings revealed a significant negative overall linear relationship between tourism activities and the negative impacts on the environment. The survey provided a means to rank the tourism activities in terms of the harms caused to the environment along with the significance of their adverse impacts. In addition, for engaging leisure operators and tourists towards sustainably minimizing the environmental impacts of tourism-related activities, a framework has been proposed within this paper.

Keywords Tourism activities · Environmental impacts · Perception · PDCA cycle · KIE framework

1 Introduction

Tourism has been regarded as a major and rapidly developing economic industry around the world and within this industry, coastal tourism is considered as one of the quickest growing areas (Nara et al. 2014). It has recently been predicted that international arrivals

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are expected to boom annually by 4.3% to reach 1.8 billion by 2030 (UNWTO 2016) and coastal areas remain attractive tourist destinations for millions of visitors who prefer to take advantage of the sea air, sun, water, seafood, beaches and scenic views. The decision to travel to a destination is influenced by several factors, where an important one includes recreational tourism activities. According to Hall et al. (2017), tourism activity here refers to "any endeavour such as experience, game, sport and hobby undertaken beyond someone's usual environment for a particular duration and that the principal motive behind travelling is not to generate any income from the place visited". Key coastal recreational activities consumed by tourists at their destination include snorkeling, cruising and fishing, among others (Ramdas and Mohamed 2014).

A popular international tourist destination known for its recreational activities, in addition to the sun, sea and sand, is Mauritius. This island is located within the Indian Ocean and approximately 2400 km away from the south-east coast of the African continent. Mauritius has a population of 1.27 million people and as a remote island, white sandy beaches of more than 150 km are present around the island. The lagoons are guarded from the open sea by the surrounding coral reefs, which also represent one of the largest reefs around the world. As such, Mauritius inherits the physical assets of small islands having nice sandy beaches, tropical weather, coral reefs and a variety of fish species that provide a break from contemporary life (Salim and Mohd Tahir 2012). During the previous three decades, the island has transformed into a middle-income diversified economy where a key player of this economic growth is the tourism sector. Direct flights to various countries helped to boost tourist arrival during the same period, where, in 2018, almost 1.4 million tourists visited the island (Statistics Mauritius 2019). Although tourism is an essential economic pillar of Mauritius, the island also has a fragile environment and is susceptible to the adverse impacts of climate change as a small island developing state (SIDS) (Statistics Mauritius 2017; Mauritius Meteorological Services 2017).

Even though consumption of tourism-related activities has brought different positive impacts to Mauritius and its inhabitants, including rise in earned incomes, social welfare improvement and consumption of public facilities (Durbarry 2004), there have been concerns pertaining to associated impacts of such activities on the natural environment (Financial Times 2017). A growth in tourism-related activities coupled with improper management can destroy the environmental attributes which a visitor came to experience, including beach, coral reefs, fisheries, water and vegetation (Farid et al. 2013). For instance, recreational activities on the rocky shores can disturb and damage natural habitats of marine plants and animals (Mendez et al. 2017). Similarly, visitors often leave their debris along the beach attracting animals and bacteria causing unpleasant coastal surroundings (Silva and Ghilardi-Lopes 2012), while also posing problems to marine animals through tangling and ingestion (Beeharry et al. 2017). Likewise, conducting activities such as snorkeling and scuba diving in improper or uncontrolled manners can lead to major damage of the coral reefs (Barker and Roberts 2004).

Taking cognizance of the adverse influences of recreational tourism activities on the coastal and marine environment of Mauritius, actions from both the providers and consumers of such activities are necessary. From a psychological perspective, investigating the perceptions of target groups has been regarded among the key measures towards a sustainable approach (Beeharry et al. 2017; Hartley et al. 2015). However, limited work has been done towards understanding and assessing the perception of key stakeholders within Mauritius, especially leisure operators as providers and tourists as consumers of tourism-related activities. As such, the purpose of this paper is to assess the perceptions of leisure operators and tourists on the environmental impacts of coastal tourism-related

activities within Mauritius, towards proposing a framework to better engage both coastal user groups to minimize environmental impacts of such activities. Findings of this study are expected to be beneficial to organizations in Mauritius, policy makers, and researchers towards helping to comprehend the perspectives of coastal users on the environmental impacts of coastal tourism activities in order to devise sustainable solutions for addressing the problem investigated in this paper.

The paper is structured as follows: in the next section, literature is reviewed on the environmental impacts of costal tourism-related recreational activities. Then, in the third section, the research framework is presented, where the research questions answered as part of this study and the methodology used to answer these questions are discussed. In the fourth section, the results are presented prior to presenting a reflective framework about how to engage leisure operators and tourists towards sustainably minimizing the environmental impacts of tourism-related activities.

2 Review of the environmental impacts of coastal tourism-related recreational activities

As a simple classification, coastal recreational tourism activities can either be performed on the beach or within the sea and undertakings from both categories have associated environmental impacts. The key environmental impacts of both classes of activities that are popular within Mauritius are discussed as follows.

2.1 Sea or marine-based activities and associated environmental impacts

A significant number of tourists make the sea as their destination for consuming recreational activities such as swimming and snorkeling, cruising and yachting, among others. However, different studies showed associated negative environmental impacts of each recreational activity described as follows:

2.1.1 Swimming and snorkeling

Swimming and snorkeling have been considered among the most innocuous pastimes of sea visitors and both activities have been recognized to enhance tourists' interest, confidence, sense of accomplishment and level of satisfaction thereby making them feel relaxed (Roman et al. 2007). However, these undertakings were also found to have different negative impacts on the marine environment. Firstly, installation of shark netting around popular swimming beaches can decrease the number of dolphins and turtles in the region (Davenport and Davenport 2006). Similarly, snorkeling was found to cause mechanical stress on corals and to negatively impact reefs while even impairing the reproductive output of corals as well as causing coral mortality in many instances (Webler and Jakubowski 2016). In addition, this activity was also found to cause eutrophication and when performing such activities, swimmers have tendency to litter, which has its own impacts on the environment (Dokulil 2014; Beeharry et al. 2017).

2.1.2 Scuba diving

Scuba diving has been recognized among the rapidly growing pastimes and to cater for this demand of tourists, approximately one million new recreational divers being trained every year around the world (Tynyakov et al. 2017). This growth could be attributed to an increase in accessibility of the reefs in many countries while leisure operators have been improving their facilities to encourage people to learn and to practice this activity. Even in Mauritius, this has become a popular activity during recent years. However, scuba divers negatively impact and disturb the marine environment in different ways (Camp and Fraser 2012). For instance, in case spear guns are used during this activity for recreation fishing and collection of crabs, lobster and octopus, considerable damage to marine habitats can be made (Terrón-Sigler et al. 2016). Furthermore, ecological disturbance can be caused by divers due to fish feeding, which attract predators to consequently reduce the population of smaller fishes within the region, thus reducing biodiversity (Giglio et al. 2019). Additionally, interaction with marine animals can adversely cause physical damage to coral reefs, which are slow to regenerate (Valentine et al. 2004).

2.1.3 Cruises

From a psychological perspective, water environment was found to exert a strong positive influence upon well-being of human beings (McVeigh et al. 2017) and recently, leisure cruising has experienced rapid expansion around the world (De Cantis et al. 2016). Even in Mauritius, cruising is being further developed where 50 vessel calls are expected to arrive to Mauritius by 2021 (Fakun 2018). This growth undoubtedly has its ecological problems. From an environment perspective, cruise ships discharging oil, hazardous wastes and pollutants can adversely affect marine plants and animals (Hall et al. 2017). Furthermore, it has been estimated that each passenger on such ships produce approximately 3.5 kg of garbage and solid waste per day that further adds to the landfills, as it is illegal for dumping in sea (Davenport and Davenport 2006). Moreover, it has previously been reported that such ships discharge around 1 million litres of sewage per week of voyage (EPA 2008). Additionally, these ships contribute to the emissions of greenhouse gases as these vessels principally rely on nonrenewable sources of energy (Coelho et al. 2015).

2.1.4 Pleasure trip vessels and yachting

During recent years, there has been an increase in the use of yachts, pleasure trip vessels and catamaran cruises in Mauritius. Whilst coastal visitors enjoy activities on pleasure trip vessels and admire the aquatic species, yachting has grown into a popular activity involving the use of sailing boats with a keel design that enable a balanced movement based on its mass. Yachting plays an important role in tourists' activities whereby generating more income to the benefit of the general economy, while also creating jobs for the public. However, yachting also has its adverse environmental impacts through water pollution from wastewater and solid waste disposal into the sea (Tosun 2001). Additionally, the use of such vessels was found to change current systems while altering the sand supply to natural beaches (Davenport and Davenport 2006). Also, such coastal structures are held at marinas, estuaries or fishing ports that provide the optimum environment for formation and the eventual diffusion of fouling macro-algae and animals (Floerl et al. 2004). Moreover, it has

been highlighted in a previous study that such types of vessels are involved in the proliferation of alien seaweed through the anchors of such structures, whereby also causing the spread of invasive mussels (Minchin et al. 2006). Furthermore, these moving vessels were reported to cause visual and acoustic disturbance for birds and cetaceans such as dolphins (Van Parijs and Corkeron 2001).

2.1.5 Recreational fishing

Different types of fishing activities are undertaken by tourists where a common one is recreational fishing, which involves catching and releasing fishes caught. Fishing was found to potentially have long-term effects on the aquatic ecosystems as the marine environment tends to face anthropogenic stresses such as pollution, change or loss in exotic habitats, eutrophication and the invasion of exotic species (Wyles et al. 2014). Additionally, littering within the sea in the form of fishing nets, gear and lines was reported as a significant hazard though entanglement and ingestion amongst marine animals, thereby causing damage and death risks (Beeharry et al. 2017). Moreover, waste monofilament fishing lines were also found to damage corals causing up to 80% mortality (Yoshikawa and Asoh 2004; Sweet et al. 2019).

2.1.6 Coastal or shore based activities and associated environmental impacts

Similar to sea or marine-based activities, the coastal environment has various recreational uses for tourists in Mauritius, including walks, sunbathing and crabbing, amongst others. These coastal or shore-based activities, in addition to associated adverse environmental impacts are elaborated as follows:

2.1.7 Tourist walks

Although walking over rocky or sandy areas along the coastal zone is a common activity undertaken by tourists, curiosity drive these visitors to informally explore and exploit food or fishing resources. Often, visitors create their own tracks when exploring regions and while so doing, they unconsciously or consciously crush important plants and animals. Due to their significance, different studies investigated the impacts of trampling on the environment (Mason et al. 2015; Barros and Pickering 2015), although beyond the context of Mauritius. Even strolling within the rocky intertidal was found to cause considerable reduction of foliose algae and the number of barnacles (Brosnan and Crumrine 1994). Moreover, trampling due to tourist walk over rocky or sandy zones showed to adversely impact crushable algae and sessile animals like mussels (Wyles et al. 2014). Similarly, trampling was found to cause serious direct damage to corals that occur within tropical rocky shores (Sarmento and Santos 2012).

2.1.8 Sunbathing

While sunbathing or tanning of the skin remain a popular activity that tourists undertake while on the beach, this group of visitors often leave debris (Yi and Kannan 2016). This consequently decreases the biodiversity of sandy shore dramatically (Sheavly and Register 2007). Furthermore, rigorous usage of sandy beaches for activities such as sunbathing was

found to lead towards lower concentration of organic matter as compared to non-touristic beaches (Gheskiere et al. 2005).

2.1.9 Extreme sports

Extreme sports such as flying parafoil kites also have their impacts on the environment. These large kites have a surface area of approximately 5–8 m^2 and need to be flown at a height of around 30 m on beaches similar to kite buggying. When these kites hit the water, loud noises are produced causing acoustic disturbance. These kite related activities were also found to interfere with the feeding trips of birds to their nests in the dunes, thereby disturbing the coastal areas where birds feed (Smith 2004).

2.1.10 Crabbing

Crabbing relates to fishing or catching crabs, which are usually found in saltwater including tidal water, bays and inlets or can also be found near underwater structures. In recent years, crabbing has emerged as a leisure activity where time is spent along the beach to catch crabs with family and friends. This leisure activity has its adverse environmental impacts where a study in the past showed that in the extensive rocky shores near Swansea (UK), at least 3000 rocks were overturned on a daily basis during low tide periods (Liddiard et al. 1989). Moreover, 90% of such rocks were turned many times where rocks are rarely replaced in their original position. Consequently, crabs are removed from their native area while also unsettling the habitats of other creatures (Wyles et al. 2014). These anthropogenic activities have associated negative impacts on the prevailing food webs.

As such, both categories of recreational activities, notably marine and coastal activities have associated adverse consequences on the environment. The key impacts identified above are summarized in Table 1.

2.1.11 Reducing the environmental impacts of tourism-related activities

In order to address the environmental impacts from both categories of tourism-related activities, different actions and mechanisms could be implemented by key stakeholders including international regulatory bodies, government and coastal visitors, amongst others. These key mechanisms include:

2.1.12 Awareness improvement

Since lack of knowledge has been identified as the main reason behind the risks of tourism activities on the natural environment (Kaiser and Fuhrer 2003), educating the target groups is considered as a key measure. In other words, it is vital to educate coastal users on the threats occurring due to tourism activities in addition to mechanisms that could be employed to reduce associated environmental impacts during consumption of such activities. For this, signposts could be placed on coastal areas to convey key messages towards improving environmental behaviour. Furthermore, sensitization campaigns or outreach educational programmes could be conducted while also targeting coastal users (Eastman et al. 2013; Nolan et al. 2009) since the more these users learn about related aspects, the more the group can share acquired knowledge to inspire consumers of tourism activities. Additionally, awareness improvement can be

Table 1 Key environmental impacts of marine and coastal recreational activities

Type of activity	Recreational activity	Key environmental impacts
Sea/marine-based activity	Swimming and snorkeling	Natural habitat disturbance and loss of biodiversity
		Eutrophication
		Consequences of marine litter
	Scuba diving	Damage of corals and coral reefs
		Natural habitat disturbance and loss of biodiversity
	Cruising	Sea water pollution and associated effects
		Consequences of marine litter
		Natural habitat disturbance and loss of biodiversity
		Damage of corals and coral reefs
	Pleasure trip vessels and yachting	Sea water pollution and associated effects
		Consequences of marine litter
		Natural habitat disturbance and loss of biodiversity Damage of corals and coral reefs
	Recreational fishing	Natural habitat disturbance and loss of biodiversity Damage of corals and coral reefs
		Eutrophication
Coastal/shore activity	Tourist walks	Natural habitat disturbance and loss of biodiversity
		Beach erosion
		Effects of debris
	Sunbathing	Natural habitat disturbance and loss of biodiversity
		Effects of debris
	Extreme sports	Effects of air and noise pollution
		Natural habitat disturbance and loss of biodiversity
	Crabbing	Natural habitat disturbance and loss of biodiversity
		Effects of debris

assisted through the use of technology, which has been a key driver to enhance the way information is made available and presented to people, thereby promoting knowledge acquisition (Bekaroo et al. 2016). In this endeavour, a plethora of websites and blogs, mobile applications, online media (newspapers, television, radio and social media) could be utilized. In addition, more innovative technologies such as augmented reality (AR) and virtual reality (VR) could be promoted to educate on the environmental impacts of tourism activities as these technologies have showed to better engage users while improving learning (Guttentag 2010; Han et al. 2013).

2.1.13 Implementing mechanisms to directly reduce impacts

Different mechanisms could also be implemented to directly address the harms caused by tourism activities on the environment. For addressing damage of corals and coral reefs, coral farming could be considered (Soong and Chen 2003). This involves cultivation of corals before transplantation to areas with the purpose of restocking damaged or devastated reefs and is currently being conducted in Mauritius (UNDP 2018). On the other hand, to prevent the effects of marine litter, distance to trash bins could be reassessed and reduced by placing bins at regular intervals since distance to bins is deemed as an essential factor for littering behaviour (Schultz et al. 2013). Also, sensor or camera-based litter monitoring and tracking mechanisms could be implemented within the coasts (Kako et al. 2012). Another solution to reduce littering behaviour is the polluter pay principle which involves paying an extra fee when purchasing products that equate environmental damages (Jang et al. 2014). To diminish effects pertaining to sea water pollution, use of eco-friendly products could be promoted on ships, while also implementing mechanisms to prevent people from throwing litter (Johnson 2002; Beeharry et al. 2017). As mechanisms for reducing natural habitat disturbance, the ocean can be explored without interfering with the wildlife species through protected areas. Also, selective fishing could be considered in order to select species and sizes when catching fishes and crabs, among others (Garcia et al. 2012). Avoiding juveniles has been argued to allow these marine animals to reproduce at least once before being harvested (Condie et al. 2014). Furthermore, seasonal ban could be adopted as conservation measure to allow fish and crab population to regenerate (Vivekanandan et al. 2010). Moreover, proper monitoring techniques could be employed to monitor maximum sustainable yield and daily allowable catch (Heredia-Delgadillo et al. 2018). Finally, eutrophication could be reduced by promoting the use of eco-friendly products that do not contain phosphates (Xin et al. 2010).

In terms of measures to reduce impacts of tourism-related activities on the coastal environment, predefined tracks could be established within coastal regions, while also preventing visitors to walk beyond tracks in order to prevent adverse environmental effects of trampling. Also, effects of uncomfortable smell and disturbance caused by solid wastes could be reduced by using techniques to prevent marine littering as discussed in the previous paragraph. Finally, the effects of air and noise pollution due to traffic and visitor congestion could be addressed by restricting number of visitors and people consuming activities. For example, number of visitors fishing and crabbing within an area could be controlled to prevent congestion.

2.1.14 Implementation of regulatory measures, policies and legislations

Rules tend to govern how people act in ways appropriate to situations (Lemaire 2017) and the implementation of rules, in the form of regulatory measures, policies and legislations have been considered as enablers of sustainable actions (Bekaroo et al. 2016). These are effectively developed through consultation between different entities including government, researchers and policy makers and were identified as a key driver to promote environmentally sustainable tourism (Juvan and Dolnicar 2017). Additionally, enforcement of rules also provides means to take further actions in case of violations. Moreover, their implementation were also highlighted as a key driver to improve personal engagement and drive knowledge acquisition amongst individuals (Golik and Gertner 1992) where for

example, there is lesser chance for people to litter in areas with enforced policies against littering. Similarly, countries which implemented laws on seasonal ban are more likely to promote growth of marine animals and plants before the next catch period (Vivekanandan et al. 2010). As such, the government can identify endangered species such as corals, aquatic animals and native plants to eventually promote enforcement programs and strict legislations to protect these species.

3 The research framework

In order to reduce the impacts of tourism activities via implementation of mechanisms discussed in the previous section, actions from both the providers and consumers of such activities are necessary (McKercher 1993). For this, it becomes essential to study their perspectives as investigating this psychological factor has been regarded among the key measures towards a sustainable approach (Beeharry et al. 2017). Fundamentally, perception has been defined as "a set of internal sensational cognitive processes of the brain at the subconscious cognitive function layers that detects, relates, interprets and searches internal cognitive information in the mind" (Wang 2009). Analysing data coming from perceptions are particularly useful for scenario building and policy formulation (Petrosillo et al. 2007). This is also because, from a psychological viewpoint, individuals who perceive a positive outcome are expected to evaluate an aspect differently as compared to an individual who perceives it in a negative manner (Andereck et al. 2005). However, limited research has been undertaken in order to investigate the perspectives of leisure operators as providers and tourists as consumers of tourism-related activities. Consequently, different research questions remained unanswered pertaining to the context of Mauritius. As such, in this section, the tourism profile of Mauritius is further described, before presenting the research questions investigated as well as the approach utilized in order to answer the formulated questions.

3.1 Tourism profile of mauritius

In terms of history, Mauritius was first colonized by the Dutch in 1598, then by the French in 1715, before being taken over by the British in 1810. While being a British colony, the economy of Mauritius was centred on sugar, which accounted for approximately 35% of the Gross Domestic Product (GDP) and represented 97% of exports (Durbarry 2004). The island gained independence in the year 1968, and due to its history, the island has diverse ethnic mix and the key spoken languages include Creole, English and French, among other languages. However, after gaining independence in 1968, there were limited prospects for economic development while focusing on sugar production and exportation and the island had to diversify its economic activities. A key sector that was developed was tourism, which at present is an essential pillar of the economy of Mauritius. This sector accounts for 8% of GDP in addition to around 10% of total employment within the island. The island slowly increased its tourist arrivals from around 74,000 in 1975 to almost 1.4 million in 2018 (Statistics Mauritius 2019). The success of the growth of this sector could be attributed to various factors, including incentives provided to develop the sector, performance of subsectors involved, as well as its inheritance from assets of small islands notably fine beaches that are popular for safe swimming facilities. During the development phase of this sector, various recreational tourism activities have been developed (as discussed in the

previous section) for tourists and that various tour and leisure operators facilitate the process via which tourists undertake these activities. As at 2018, 652 tour operators are registered and are operating to provide various services to tourists (Tourism Authority 2018).

3.2 Research questions

From reviewed literature, different questions remain unanswered pertaining to the perceptions of leisure operators and tourists on the environmental impacts of coastal tourism-related activities. For this study, tourists are considered as "foreign persons admitted under tourist visas (if required) for purposes of leisure, recreation, holiday, visits to friends or relatives, health or medical treatment, or religious pilgrimage" (OECD 2017). This group of users must also spend at least a night within an accommodation in the receiving country whilst their stay duration not exceeding 1 year. On the other hand, leisure operators are considered as individuals who work in a profession that relate to providing services and activities to tourists. As an example, leisure operators can be self-employed or working in a company or tour operator that provide activities such as snorkeling, speed boat excursions, scuba-diving to customers who can be tourists or even inhabitants.

These research questions investigated as part of this study are listed in Table 2. Firstly, limited insights are available from literature on how both coastal user groups perceive the relationship between coastal tourism activities and the environment, and this is studied through RQ1. This question is important to investigate so as to understand appropriate measures that could be taken by different stakeholders in order to enhance awareness on activities that are perceived to have limited consequences on the environment. Furthermore, with limited information available on how these coastal user groups perceive the impacts of tourism-based activities on both the marine and terrestrial environment reviewed, it becomes difficult to assess where further efforts are needed. This is investigated through RQ2. In addition, RQ3 investigates how tourists and leisure operators perceive implementation of measures towards minimizing environmental impacts of tourism-related activities. Obtaining perspectives on such measures could help determine effectiveness so that same could be better applied towards reducing environmental impacts. Finally, RQ4 delves into an approach could be adopted in order to engage coastal user groups so as to sustainably minimize environmental impacts of tourism-related activities.

By finding answers to the research questions listed in Table 2, this paper targets two contributions to the literature. Firstly, by investigating RQ1–RQ3, this paper provides insightful information on the perceptions of tourists and leisure operators on the relationship between tourism activities and the environment in addition to measures towards

Table 2 Research Questions

ID	Research question
RQ1	To what extent do coastal-based recreational tourism activities cause harm to the environment?
RQ2	To what extent are the adverse environmental impacts of the recreational tourism activities significant?
RQ3	How effective is the implementation of each measure towards minimizing environmental impacts of tourism-related activities?
RQ4	What approach could be adopted in order to engage coastal user groups to sustainably minimize environmental impacts of tourism-related activities?

minimizing environmental impacts of such activities. Secondly, through RQ4, an approach is proposed in order to engage leisure operators and tourists towards sustainably minimizing the environmental impacts of tourism-related activities.

3.3 Methodology

A survey was conducted in the island of Mauritius in order to answer the RQ1-RQ4. As data collection instrument, a questionnaire was prepared, consisting of 35 questions to be answered utilizing a Likert-5 scale that indicates the degree of agreement/disagreement. In the sane scale, 1 represented strongly disagree and 5 meant strongly agree. The target groups were tourists from international destinations and leisure operators, respectively, and as selection strategy, the non-probabilistic sampling technique of convenience was adopted. Prior to conducting the survey, a pilot study was performed with 25 participants in order to assess the correctness of the questionnaire. Feedback obtained from the pilot phase helped to finalize the questionnaire before the data collection process.

After the pilot phase, the survey was conducted during 6 weeks at various leisure operators across Mauritius in order to target both categories of users at the single point. This included La Case Nautique Mahebourg, Hobie Kayak Mauritius, Manu Fishing Guide, Mauritius Ant-Poaching, Arise Mauritius, Sea Kayaking Mauritius and Mautiyak Kayak Fishing Mauritius. As recruitment method, participants were individually approached and an introduction to the research subject was provided before seeking informed consent to be involved in the study. Following approval, the participant was briefed on the questionnaire before providing enough time and assistance to complete the document. When submitting the filled-in document, thorough check was performed to ensure necessary fields were correctly filled-in and whether the questionnaire was valid. When conducting the survey, the major challenge faced was related to obtaining consent for participants to take part in the study and linguistic barriers. Since the questionnaire was in English language, it was challenging to obtain the participation of tourists speaking other international languages. Additionally, since the data were collected during office hours, the busy schedule of leisure operators led to a delay in the process. Overall, a total of 306 participants including 171 leisure operators and 135 tourists were participated in the survey.

4 Results

As demographic details of the participants, 101 respondents (59.1%) from the leisure operator group were male and 70 were female (40.9%). As for tourists, 58 were male (43.0%) and 77 were female (57.0%). During the survey, there was participation of tourists from different countries, notably, 59 from France (43.7%), 36 from China (26.7%), 10 from Germany (7.4%), 6 from U.K. (4.4%) and 24 from different other countries (17.8%). The age distribution for both groups is depicted in Fig. 1.

The survey revealed that tourists have different reasons for performing any tourism activity and based on the same Likert-5 scale utilized, findings are summarized in Table 3.

Findings showed that the most common reason was for fun, where the group mentioned the intention to make most of their holiday while also taking a break from daily routines. This also aligns with previous studies which stated that tourists usually performed leisure activities for self-enjoyment, to come about with new and thrilling experiences and is a way to escapism (Venkatesh 2008; Williams and Buswell 2003). An important number

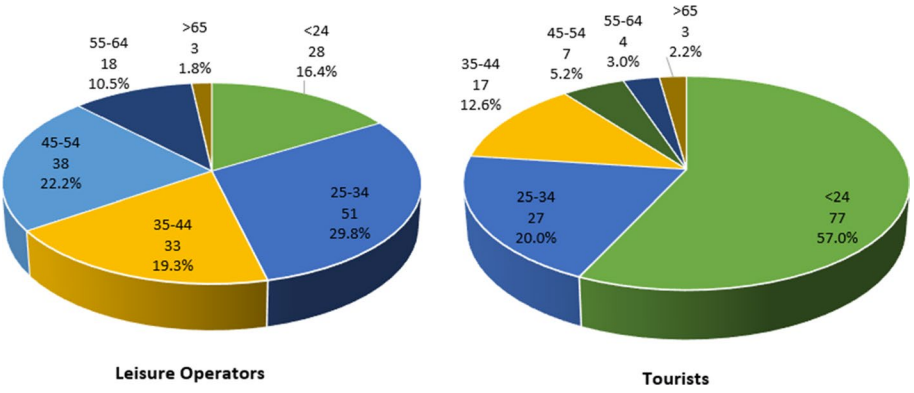

Fig. 1 Age distribution of participants

Table 3 Personal reason for consuming tourism activities

Reason	Mean	SD
Health benefits	4.09	0.868
For relaxation	4.04	0.668
For fun	4.46	0.667
To have new experiences	3.72	0.895
Overall mean	4.07	

Table 4 Significance of marine-based activities

Activity	Leisure operators		Tourists	
	Mean	SD	Mean	SD
Swimming and snorkeling	3.43	1.346	2.83	1.284
Scuba diving	3.99	1.302	3.04	1.206
Yachting and pleasure trip vessels	4.18	1.025	3.53	1.136
Cruises	4.22	0.961	3.60	1.114
Recreational fishing	3.46	1.275	3.27	0.983
Overall mean	3.86		3.25	

of tourists also claimed to perform such activities for health benefits. Such benefits tend to be higher for exploration activities rather than activities such as sunbathing or walking according to a previous study (White et al. 2010). Among the reasons, the least common ones were relaxation and for new experiences. The results are further discussed as follows towards answering RQ1-RQ4.

4.1 Extent to which tourism activities cause harm to the environment

In order to answer RQ1, perceptions of both groups of participants were sought on the extent to which both sea-based and terrestrial-based leisure activities reviewed earlier cause harm to the environment. Results showed that among the sea-based activities, fuel driven ones, namely yachting, pleasure trip vessels and cruising were perceived by both tourists and leisure operators to cause the highest harms to the environment, as summarized in Table 4. This result also positively highlights that both groups recognized that such vessels lead to pollution at sea (waste, water pollution and GHG emissions). Among both fuel driven activities, cruises were perceived to more negatively impact the environment than yachts and pleasure trip vessels, mainly because of the distance factor. On the other hand, swimming and snorkeling were identified as the activity having the least adverse environmental impact within the list. According to the participants, this was because this activity utilizes lesser equipment as compared to scuba diving. For the same activity, 31.6% leisure operators and 57.0% tourists disagreed or strongly disagreed that snorkeling has some negative impacts on the environment although the literature showed that this activity causes mechanical stress on corals, amongst other impacts (Webler and Jakubowski 2016). Overall, the order of significance of the different sea-based activities were aligned between both coastal user groups at both ends but slightly varied in between as shown in Table 4. Furthermore, leisure operators were able to better perceive the environmental harms of marine-based activities as compared to tourists with an overall mean of 3.86 for the former and 3.25 for the latter. This could be attributed to different reasons including improved awareness of the leisure operators as knowledge is primarily linked to perception (Hartley et al. 2015). Another reason could be the experience related to coastal aspects and time spent at sea by the leisure operators.

On the other hand, terrestrial-based activities investigated included tourist walks, sunbathing, extreme-sports and crabbing, as reviewed earlier. Unlike the perceptions of marine-based activities, a major difference in terms of ranking of the environmental harms of terrestrial-based activities was noted between the two participating groups. For leisure operators, tourist walk was perceived to be the most harmful recreational activity to the environment. The perceptions of this group also aligns with previous studies (McDonnell 1981; Andersen 1995) and this was principally because while exploring the coastal regions, tourists often create their own tracks thereby potentially crushing important medicinal and native plants (Hansen et al. 2002). After tourist walk, sunbathing was considered to be harmful to the environment mainly because when performing this activity, visitors disturb plants and marine organisms, and have the tendency to leave behind debris on the beach. At the other end, extreme sports were regarded to be least significant to the environment after crabbing according to leisure operators. For tourists, crabbing was perceived as most harmful activity to the environment whilst leisure operators perceived this activity among the least significant ones. According to the same group, this was principally because of the disturbance caused by this activity because of moving rocks. The second most harmful activity as per the same group was walking across the shores and an important group was unaware of the impacts of this activity on the environment thereby impacting the mean score. On the other end, sunbathing was found to be least significant to the environment according to tourists, even though the significance of this activity was higher according to leisure operators. Overall, for this group of activities as well, leisure operators were more environmentally conscious with a higher overall mean score as compared to tourists. Results pertaining to the significance of terrestrial-based activities are depicted in Table 5.

Table 5 Significance of terrestrial-based activities

Activity	Leisure operators		Tourists	
	Mean	SD	Mean	SD
Tourists walks	4.12	1.118	3.19	1.198
Sunbathing	3.82	1.336	2.72	1.176
Extreme sports	3.61	1.312	3.11	1.111
Crabbing	3.66	1.233	3.53	0.991
Overall mean	3.80		3.14	

Overall, findings revealed that that both coastal user groups perceived that different types of tourism activities are harmful to the environment in some ways (RQ1) as most of the mean scores as in Tables 4 and 5 were above 3. According to a previous study, fishing and crabbing were considered as the most harmful tourism activity being performed along the coastal and marine environment (Wyles et al. 2014). This is particularly because these activities involve removing the organisms from their natural habitat while also disturbing the environment. However, in this study cruising was perceived to have the most negative impact on the marine environment according to the participants. This variance may be due to a difference in the type of country or island, the type of beaches and the time the data has been collected (Priskin 2003). On the other hand, sunbathing was found as activity causing the least harms on the environment in the same study by Wyles et al. (2014) and in this study, the activity having the least perceived impact was swimming and snorkeling. Furthermore, marine-related activities were perceived to be more harmful than terrestrial based undertakings due to the higher mean values. As such, it could be highlighted that in different regions or countries, there is apprehension on the perceived negative impacts of tourism activities (Priskin 2003; Wyles et al. 2014). Furthermore, the overall mean score pertaining to the environmental harms for both categories of tourism activities also meant that further efforts are needed to improve awareness for both groups on how these activities impact the coastal environment.

4.2 Significance of the adverse environmental impacts of tourism activities

As discussed earlier, investigating perceptions on the environmental impacts from tourism-related activities is important in order to help policy-makers take decisions and direct

Table 6 Environmental impacts from sea-based activities

Impact	Leisure Operators		Tourists	
	Mean	SD	Mean	SD
Damage of corals and coral reefs	4.31	3.198	3.61	0.855
Sea water pollution and associated effects	4.22	1.111	4.07	0.780
Consequences of marine litter	3.87	1.360	3.78	0.871
Natural habitat disturbance and loss of biodiversity	4.48	1.426	4.10	1.010
Effects of eutrophication	3.72	1.469	3.95	0.809
Overall mean	4.12		3.90	

Table 7 Environmental impacts from terrestrial-based activities

Impact	Leisure Operators		Tourists	
	Mean	SD	Mean	SD
Natural habitat disturbance and loss of biodiversity	4.24	1.283	3.10	1.071
Beach erosion	3.99	1.295	3.61	1.110
Effects of debris	4.08	1.181	3.87	0.988
Effects of air and noise pollution	3.73	3.258	3.64	1.054
Overall mean	4.01		3.56	

potential actions. For this, the significance of the adverse environmental impacts of tourism activities on the marine and terrestrial environments were investigated based on information compiled in Table 1. Results following the survey are compiled in Tables 6 and 7, respectively, towards answering RQ2. For the environmental impacts of tourism activities on the marine environment, there was consensus on natural habitat disturbance and loss of biodiversity as the most significant marine environmental impacts of recreational tourism activities between both groups with an average score of 4.29. However, for the remaining impacts, there have been mixed perceptions. For leisure operators, damage of corals and coral reefs was perceived as the second most significant impact and this was potentially due to the media which often raises awareness on the threats facing coral reefs around Mauritius (Africa News 2016). On the other hand, consequences of marine litter were perceived as the second least impact where 22.8% of leisure operators disagreed or strongly disagreed about this impact. This group of leisure operators failed to realize the significance of marine debris, which is known to have various environmental impacts including water contamination, entanglement and ingestion of wildlife and wearing of seabed (Beeharry et al. 2017). The least perceived impact was related to the effects of fertilizers on the marine environment where 27.5% of this group of participants disagreed or strongly disagreed with this impact. In other words, this group of leisure operators found it challenging to relate eutrophication with the tourism activities such as swimming, snorkeling and recreational fishing (Dokulil 2014). For tourists, effects of sea water pollution were perceived as the most significant impact after natural habitat disturbance. Most tourists were able to understand the source and effects of water pollution principally caused by boats and yachts. Furthermore, unlike leisure operators, tourists were better able to perceive the effects of marine litter on the marine environment. This could be because of different reasons including awareness and better access to marine activities than leisure operators. Finally, damage of corals and coral reefs was perceived as having the least significant impact. This was potentially due to the unfamiliarity of this group of coastal users with the coastal or marine environment of Mauritius.

Results on the significance of the environmental impacts of tourism activities on the terrestrial are provided in Table 7. For leisure operators, the highest perceived impact on the terrestrial environment was natural habitat disturbance and loss of biodiversity. As discussed earlier, this group of users perceived that important plants are crushed while tourists explore coastal regions. In terms of frequency of occurrence, this group of users reported to witness moderately trampled crushed plants on a regular basis. Furthermore, it was also revealed that the frequency and intensity of trampling varied across regions where the lowest frequency was reported to be within areas already having defined tracks established by governing bodies. After trampling, uncomfortable smell and disturbance caused by debris

were perceived as important impacts of tourism-related activities. Accumulation of litter containing hazardous substances is known to impact both plants and animals in coastal regions (Poeta et al. 2014). According to the same group of participants, the volume of litter is highest during the summer season and local festivals during which more people visit the coastal regions. Then, beach erosion perceived as the next significant impact. A small group of 7.0% of leisure operators was also able to relate beach erosion to trampling as this activity renders the coastline fragile (Lemauviel and Rozé 2003). Finally, air and noise pollution due to traffic and visitor congestion was perceived as having the least significant impact. This is particularly because recently, the Government of Mauritius has taken the initiative to restrict vehicle access to beaches thereby reducing the effects of traffic. Moreover, heavy visitor congestion is only during some specific periods rather than a whole year, thus diminishing its associated impacts. For tourists, the most important environmental impact of tourism-related activities was perceived to be the effects of uncomfortable smell and disturbance caused by debris followed by the effects of air and noise pollution due to traffic and visitor congestion and beach erosion. However, the least significant impact was regarded as loss of biodiversity and natural habitat disturbance, even though previous studies highlighted this impact as one of the prevailing issues (McDonnell 1981; Andersen 1995). This could be influenced by the motives, interests and expectations of this group while being on holidays as these factors have been regarded to influence perceptions. As such, this least perceived impact becomes an important limitation that needs to be addressed because it is believed that tourists who are aware and knowledgeable about the environmental issues have more responsible behaviours towards the environment (Ku and Chen 2013).

Overall, the environmental impacts from sea-based activities were perceived to be higher than that from terrestrial-based activities. This could be due to sensitization campaigns from different types of media within Mauritius during recent years that have focused on such impacts (Africa News 2016).

4.3 Effectiveness of measures to minimize environmental impacts of tourism activities

Although the identification of perceived impacts, both positive and negative, is essential, it is also important to study and apply appropriate mechanisms to minimize the adverse impacts. As such, this study investigated the perceptions about how environmental impacts from tourism-related activities could be minimized (RQ3) and key mechanisms included awareness improvement, implementation of regulatory measures, policies and legislations,

Table 8 Minimization of environmental impacts

Measure	Leisure operators		Tourists	
	Mean	SD	Mean	SD
Awareness improvement	3.35	1.469	3.24	1.499
Implementation of regulatory measures, policies and legislations	3.40	1.505	4.33	0.954
Implementing mechanisms to directly reduce impacts	3.06	1.574	4.22	0.952
Overall mean	3.27		3.86	

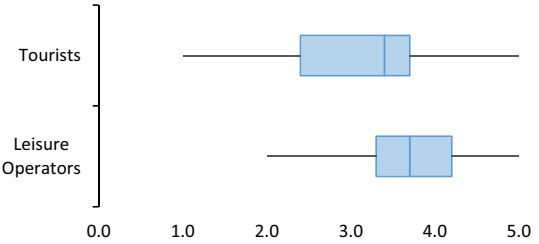

Fig. 2 Extent to which tourism activities cause harm to the environment

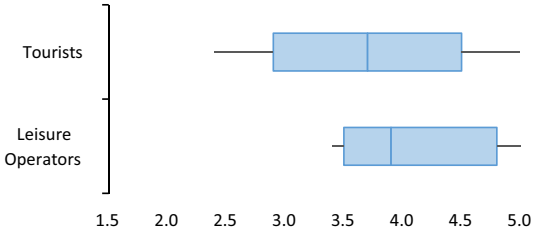

Fig. 3 Significance of the adverse environmental impacts of tourism activities

and implementing mechanisms to directly reduce impacts as discussed earlier. Results are given in Table 8, also highlighting differing overall perceptions between the two user groups, although most participants strongly agreed that the implementation of a combination of measures is necessary.

Leisure operators perceived the implementation of mechanisms to directly reduce impacts as the least effective action. This was because the group perceived that it is the responsibility of regulatory bodies to implement such actions and these stakeholders are slow to react in developing countries due to lack of resources and skills. Furthermore, an important group of leisure operators perceived awareness improvement as the most important measure towards diminishing environmental impacts from tourism-related activities. 55.6% of leisure operators agreed or strongly agreed with this measure, because perception of an individual is shaped or distorted by different factors including awareness (Rayon-Viña et al. 2019). For the same group, implementation of regulatory measures, policies and legislations was perceived as the most significant action that could reduce environmental impacts of tourism-related activities, similar to tourists. There was a wide consensus that these factors have been recognized to promote environmentally sustainable behaviour while also ensuring compliance (Bekaroo et al. 2016). However, tourists perceived awareness improvement as the least effective measure. According to the group, the most common reason was that various mechanisms already exist that promote awareness on eco-friendly behaviour including websites, mobile applications and media; but environmental issues persist.

4.4 General discussions

While investigating RQ1–RQ3, varying perspectives related on the significance of recreational tourism activities and their adverse impacts on the environment were noted. This could be because of parameters that impact group perceptions including entitativity and group properties (Beeharry et al. 2017). Furthermore, the perception of groups is impacted by certain essential qualities of individuals forming the group (Yzerbyt et al. 2004). Other

factors causing this difference include awareness, attitude, interests, expectations of the participants in addition to novelty of the aspect on which perceptions are being sought (Robbins and Judge 2001). Also, leisure operators were expected to be more knowledgeable on the relationship between tourism activities carried out along shorelines and the environment than tourists who were from an international destination and this was confirmed from findings in this study. This finding is illustrated in Figs. 2 and 3 which represent the box and whisker diagrams showing perspectives of coastal user groups studied on the significance of recreational activities as well as their adverse impacts on the environment, respectively.

In terms of perceptions on the extent to which tourism activities cause harm to the environment, it can be seen from Fig. 2 that the mean response of tourists was closer to 3 that is neither disagree nor agree. As for response distribution, more responses were closer to 2 where the group disagreed that some of the leisure activities do cause harm to the environment. On the other hand, for leisure operators, it could be seen that the mean response was closer 4 where the group mostly agreed that leisure activities do cause harm to the environment.

As for the perceptions on the environmental impacts of leisure activities, it could be observed in Fig. 3 that the mean values for both user groups were closer to 4. This also highlights that both user groups somewhat agreed that leisure activities do have some negative impacts on the environment where leisure operators being the more conscious group. This hypothesis is confirmed using Pearson Correlation coefficient on the collected data where a significant negative overall linear relationship between tourism activities and the negative impacts on the environment was found with computed value -0.242. Since this relationship was found to be negative, it could also be deduced that the more tourism activities are being performed across the island, the more the negative impacts will be apparent.

As it becomes important to mitigate these impacts, results of the survey also shed light on key differences in perceptions that could be addressed by different stakeholders involved in promoting environmentally sustainable behaviour including policy makers and regulatory bodies. Firstly, tourists need to be better enlightened on the harms of some activities on the environment including tourist walks or exploration as well as associated impacts, especially trampling. This could also be helped by leisure operators when providing guidance on how to consume activities of interest by tourist. Similarly, although leisure operators were more concerned and aware on the environmental impacts of key activities than tourists, the group had difficulties to realize the consequences of marine litter on the marine environment as well as beach erosion and effects of air and noise pollution from terrestrial-based activities. As such, these findings imply that there is a need for more efforts at both levels to improve engagement in reducing environmental impacts of tourism activities. In order to address this issue, the framework in the next section is discussed as potential solution.

5 Engaging tourists and leisure operators in reducing environmental impacts of tourism activities: a reflective framework

In order to sustainably reduce environmental impacts from coastal and marine tourism recreational activities, a set of measures are needed from both stakeholders, notably leisure operators and tourists. In this endeavour, a framework could better engage and guide these stakeholders towards reducing environmental impacts (RQ4), although no such framework

presently exists that focuses directly on both leisure operators and tourists. Taking cognizance of this gap, an integrated framework founded on the Plan-Do-Check-Act (PDCA) and Knowledge-Implementation-Effect (KIE) cycles (Bekaroo et al. 2016) could be adopted as continuous efforts are required towards minimizing the environmental impacts of coastal tourism-related activities. As part of the proposed framework, the PDCA cycle has been chosen due to its popularity in the context of sustainability-related frameworks (Bateman and David 2002). Furthermore, the utilization of the PDCA was also recognized to promote understanding and acceptance by the targeted audience (Sokovic et al. 2010). Similarly, as highlighted in this study, awareness of tourists need improvement on aspects regarding environmental impacts of tourism-related activities and for this, the KIE cycle becomes relevant. The KIE cycle is based on a popular educational design model to promote learning on sustainability related aspects (Goodyear 2005). Based on the PDCA and KIE cycles, the proposed framework aimed at engaging leisure operators and tourists towards reducing environmental impacts of coastal tourism-related activities is given in Fig. 4. This framework was also designed in order to enhance the communication gap between leisure operators and tourists to promote understanding on measures towards reducing environmental impacts of tourism-related activities.

The proposed framework in Fig. 4 is built into two parts, namely Leisure Operators and Tourists and within each part, an iterative process associated to the stakeholder is present. The iterative process within each part also shows that reducing environmental impacts of tourism-related activities is a continuous process to be followed by the involved parties where effective collaboration is needed. The Leisure Operator section of the framework has two rings, notably the inner and outer ring. The inner ring represents the key factors that influence environmental behaviour, and these include awareness, regulations and technology as identified as part of the results of this study and from reviewed the literature. Among these, both coastal user groups perceived the implementation of regulatory measures as the most important measure towards reducing the environmental impacts of tourism-related activities, as these factors promote environmentally sustainable behaviour while also ensuring compliance. The outer ring represents the process that leisure operators should implement in order to reduce environmental impacts and is based on the PDCA cycle, with the following steps:

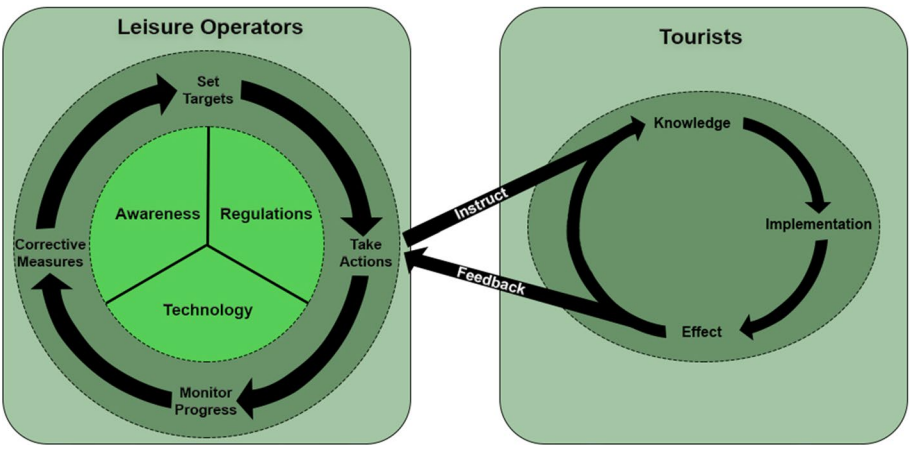

Fig. 4 Proposed framework

- *Set objectives* In this step, leisure operators should set objectives to be accomplished during a particular time frame. These objectives could be based on considerations such as areas that require urgent attention regarding environmental impact reduction, number or category of tourists to be sensitized, region to be focused upon, among others. The objectives to be established could also be influenced by external institutions including the government, higher education institutions or even nongovernmental organizations within annual reports.
- *Take actions* During this step, leisure operators are expected to take appropriate actions towards fulfilling the objectives defined in the previous stage. Examples of possible actions at this stage include sensitizing tourists on the loss of biodiversity due to trampling, installation of relevant educational and environmental tools (e.g. marine litter tracking tool) on the mobile device of tourists, among others.
- *Monitor progress* While undertaking actions towards achieving defined objectives, leisure operators should keep track of progress and that any deviations should be reported early. This also implies that proper indicators are needed for each objective so as to effectively assess progress made.
- *Corrective measures* In case of any deviations identified as part of the previous stage, corrective actions should be taken to get back on track towards fulfilling the set of objectives. Also, during this stage, actions could be taken to ensure everything have been properly documented, to ensure lessons learnt and experiences gained could be archived for use in later stages.

Between both parts of the framework, there is a feedback loop present in order to improve sharing of information between both stakeholders. Firstly, leisure operators are expected to instruct tourists about existing regulations, practices and technologies available to reduce environmental impacts of tourism activities. The information gathered is expected to improve knowledge of tourists, who can then implement these during tourism activities performed to eventually assess them, based on the KIE cycle. Then tourists need to communicate the outcome of the actions taken to the leisure operators through the second part of the feedback loop so that leisure operators. This can also be facilitated by technology where for instance a mobile application can be used for tourists to report environmental issues and performance. The information provided by the tourists could also be used as input to the monitoring phase of the PDCA-based cycle so that leisure operators can assess performance against objectives set.

In order to implement the proposed framework, it becomes the major responsibility for leisure operators to make appropriate changes. These changes could also be regulated by the government and regulatory bodies to establish environmental legislations that enforce sustainability reporting involving leisure operators (Guix et al. 2018). To initiate the implementation of the framework, leisure operators could assign or appoint sustainability champions within the organisation. Employee(s) recruited or appointed as sustainability champions have the responsibility to actively guide and lead the implementation of sustainable measures within the establishment (Spira et al. 2013). Furthermore, these champions are also responsible to empower tour operators by facilitating the learning process about techniques for reducing environmental impacts of tourism-related activities in addition to existing and regulations and technologies. Another important responsibility of the sustainability champion would be to regularly prepare sustainability performance reports to eventually disseminate to the organisation as well as regulatory bodies. Lastly, the proposed framework could also be adapted in order to

more specifically meet the needs of different leisure operators towards eventually guiding reduction of environmental impacts of tourism activities.

6 Conclusions

Whilst the tourism industry is a key pillar of the economy of Mauritius, there have been concerns over the environmental impacts of recreational tourism activities. In relation to such concerns, the perspectives of leisure operators and tourists on the environmental impacts of coastal tourism-related activities within Mauritius were assessed in this paper in order to propose a framework to better engage both coastal user groups to minimize environmental impacts of such activities. In achieving the purpose of this paper, two contributions to the literature were aimed at. Firstly, perspectives of both coastal user groups on the relationship between tourism activities and the environment were studied through a survey involving 171 leisure operators and 135 tourists within the island. Findings revealed a significant negative overall linear relationship between tourism activities and the negative impacts on the environment. Although marine and terrestrial activities were both perceived to have some harms to the environment, there were varied perceptions in terms of how harmful each activity was. As such, the order of significance perceived for all aspects investigated varied between both groups and even though leisure operators were able to better perceive the environmental impacts of tourism-related activities than tourists. However, further efforts are needed at both levels to improve engagement in reducing environmental impacts of tourism activities. To address this issue, an approach is proposed in order to engage leisure operators and tourists towards sustainably minimizing the environmental impacts of tourism-related activities, as second contribution of this paper. The proposed framework is based on the PDCA cycle for leisure operators and the KIE cycle for tourists, while also consisting of a feedback loop for sharing information between both parties. In order to implement the proposed framework, some changes are needed at the operational level of leisure operators, although these changes could be better investigated as future works. Moreover, perceptions of the impacts of coastal tourism-related activities on the environment of other relevant stakeholders (e.g. industry practitioners, researchers, local associations) can be studied in order to obtain further valuable insights in this area towards complementing the framework proposed in this paper. As such, findings from this study could be utilized by policy makers and researchers to better plan and design solutions towards minimizing associated environmental impacts of coastal tourism-related activities.

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