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Exploring sustainability practices in an aquarium

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ABSTRACT
Over the years, aquariums have experienced criticism because they are viewed as exploitative and captive hubs for marine wildlife. Drawing from the Theory of Planned Behaviour, this study was conducted to explore sustainability practices in an aquarium. The study used a qualitative exploratory cross-sectional research design, and semi-structured interviews were conducted with 19 Two Oceans Aquarium employees. The findings showed sustainability practices, such as recycling, the use of solar energy, and turtle rehabilitation. The barriers to implementing sustainability practices were a lack of alternatives, staff apathy, and a lack of interest. The influence of sustainable practices on marine wildlife was found to include marine conservation and collaboration with relevant stakeholders in environmental projects. Communication with visitors was achieved through social marketing, social networking, and interactive signage. This study recommends the use of interactive signage, social networking, and social marketing by aquariums to communicate with visitors. Education and awareness are recommended to reinforce sustainable practices.

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Introduction

Environmental degradation and biodiversity loss have largely been attributed to tourism activities (Han, 2021; Rhyne et al., 2014). This has prompted a change in consumption patterns with increasing demand for environmentally friendly products and services in the tourism industry (Han, 2021). As a snowball effect, tourism service providers have transitioned to offering environmentally friendly products as well as incorporating sustainability practices in their service offerings (Han, 2021). Sustainability refers to the practice by which current human actions enable the continuity and productivity of ecosystems for the benefit of future generations (Rhyne et al., 2014). Therefore, this study seeks to explore sustainability practices implemented in aquariums.

Aquariums are artificial marine environments specifically designed for housing and displaying marine wildlife (Rhyne et al., 2014). Since their initial inception in 1826, aquariums have gained worldwide popularity, attracting more than 600 million visitors (Hall & Warmorts, 2008). They have seen significant growth over the years and are relevant tourism franchises (Hall & Warmorts, 2008). Members of the World Association of Zoos and Aquariums (WAZA) worldwide collectively welcome more than 700 million visitors (World Association of Zoos and Aquariums (WAZA),), 2021). However, like any tourism product, there is a risk of overconsumption and exploitation, which makes it imperative to explore sustainability practices implemented by aquariums.

Uncommonly known, aquariums serve a purpose beyond providing leisure and pleasure for visitors, and they also play an important role as centres for conservation education (Gill & Warrington, 2017). Mann-Lang et al. (2023) highlighted that aquariums are instrumental in forging sustainability and conservation in societies by implementing a model to help people appreciate what they perceive to be special in their communities. On the other hand, other studies have focused on the behaviour of visitors after exposure to marine ecotourism in aquariums (Mann et al., 2017) and explored the knowledge of visitors on marine

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conservation and ecotourism (Mann-Lang et al., 2023). Further, additional research has been conducted on visitors' perceptions of sustainability in aquariums and how these perceptions ultimately influence future behaviour (Mann et al., 2017; Mann-Lang et al., 2023). However, not all aquariums engage and implement sustainability practices (Gill & Warrington, 2017), and presently, no research has been carried out at the Two Oceans Aquarium (TOA) to explore the sustainability practices they are implementing. This presents a practical and knowledge gap in the literature and as such, this study seeks to address those gaps by exploring employees' perceptions of the sustainability practices in an aquarium. TOA is one of the biggest aquariums in South Africa and highly rated in Africa. The aquarium is dedicated to advancing marine wildlife conservation. The study was informed by the Theory of Planned Behaviour which is used in understanding pro-environmental behaviour in humans (Klöckner, 2013) thus making it a relevant theory in exploring and understanding the factors influencing the behaviour of the informants of this study.

Literature review

Sustainability and sustainability practices

Huang et al. (2022) stated that sustainability in tourism comprises three branches: environmental, sociocultural, and economic sustainability. Aquariums as tourism centres are no exception to the concept of sustainability. Sustainability practices refer to the policies that organisations implement to fulfill the three branches of sustainability (Font et al., 2016). For example, environmental sustainability may involve waste recycling, sociocultural sustainability may focus on local community development, and economic sustainability may focus on the employment of people from local communities (Font et al., 2016). Hall and Warmorts (2008) argued that public aquariums have gained immense popularity, are visible entities of marine trade, and are responsible for conserving and educating their patrons on the sustainability of marine species. Therefore, sustainable consumer behaviour encompasses aspects and actions such as responsible consumption (whereby an individual ensures the responsible use of natural resources), improvement of their quality of life, and ultimately does not cause harm to the environment while doing it (Han, 2021). Sustainability practices in the tourism industry, as established by the Global Tourism Sustainable Tourism Council (GTSC), include sustainable management, conservation of resources, reduction of pollution and biodiversity, landscapes, and ecosystem conservation (Fennel &Cooper, 2020). Therefore, it is imperative for establishments to implement sustainable practices that are beneficial to the sustainability of aquarium environments.

Barriers to sustainability in aquariums

For successful tourism sustainability, there is a need for effective implementation of sustainability practices. However, barriers to sustainability exist. Visitors without sustainability knowledge have been among the barriers to the implementation of sustainability practices (Mann et al., 2017). The lack of conservation learning and action resources has been identified as a barrier to the reinforcement of pro-environmental sustainability in visitors, such as visitors not being aware of the effects of improper waste disposal (Mann et al., 2017).

Seasonality is an aspect of the tourism industry that can lead to overcrowding due to the influx of visitors in busy areas and can be detrimental to the host environment (An & Alarcon, 2020). Overcrowding of public places and facilities can potentially disrupt breeding behaviour and, in some cases, induce stress that can ultimately cause the death of animals (Ballantyne, Packer, & Hughes, 2009). An and Alarcon (2020) further expressed that barriers to sustainability can emanate as negative results of tourism activities, such as disruption of local people's lives, increased price of property ownership, safety concerns, environmental damage, increased waste, and exhaustion of resources. All of these factors have a cumulative effect of being barriers to sustainability.

Influence of sustainability practices in aquariums

Aquariums have traditionally been perceived as centres of captivity for marine animals sourced from the wild (Fischer et al., 2024). Choudhury (2025) postulates that tourism may be seen as a facilitator of animal oppression. In a bid to entertain, animals can bear the brunt of maltreatment through cruel training, confinement, and being made to perform unnatural tricks that can be deemed as harmful to them (Choudhury, 2025). As a result, a power imbalance between humans and animals can lead to the commodification of animals, a sense of entitlement, most often to the detriment of the animals in captivity. It is expected that sustainability in aquariums should extend beyond environmental conservation to encompass animal welfare, ethical considerations, and public education.

The justification for keeping marine animals in captivity is increasingly scrutinized (Kreger & Hutchins, 2010; Muka & Zarpentine, 2021). In this regard, aquariums should prioritise animal welfare, ethical sourcing, and conservation-driven practices over entertainment to ensure that they are truly sustainable (Kagan et al., 2018). The shift toward sanctuaries, rehabilitation, and technology-based education reflects evolving societal values and scientific understanding of marine animal needs (Hutchins et al., 2003; Townsend, 2009; Willette et al., 2023).

Due to the different concerns, many zoological institutions have evolved to embrace and incorporate sustainability efforts and minimize negative impacts in their product offerings (Fischer et al., 2024). Implementing cooperative management in aquariums can raise awareness about marine conservation management and endangered marine species (Hall & Warmorts, 2008). According to Hall and Warmorts (2008), through the formation of management bodies, aquariums take collective actions by implementing membership rules and policies that induce and expedite the education, conservation, and science of marine organisms and biodiversity. Thus, aquariums can be peer-reviewed and share information that will benefit the aquarium environment. Accreditation, such as the Association of Zoos and Aquariums (AZA) in North America, ensures that accredited institutions educate and inspire environmental education and appreciation (Gill &Warrington, 2017).

Aquariums aid sustainability in population management and the maintenance of genetic diversity (Hall & Warmorts, 2008). This is especially important in nurturing endangered marine species to prevent extinction (Hall & Warmorts, 2008). Globally, there has been a decrease in marine biodiversity (Kirkman et al., 2021), and aquariums can be a vehicle for bringing back that equilibrium and restoration of biodiversity. Marine biodiversity is important to the tourism industry as viewing displays of marine animals and their diversity is a tourism product. It is important to note that a lot of what is known about sharks and stingrays has been through observation in aquariums (Hall & Warmorts, 2008). Therefore, not only do aquariums enjoy tourism patrons, but they are also valuable educational resources.

Communication of sustainability to visitors

Ballantyne et al. (2009) suggested that wildlife tourism occurs in different settings, including animals in captivity, such as aquariums, and has the potential to influence conservation and attitudes and ultimately influence sustainable behaviour. To achieve this, there is a need for education and communication of sustainable practices among visitors. Tourism can have drastic effects on sustainability (An & Alarcon, 2020; Ballantyne et al., 2009) if there is no change in management. Therefore, to ensure the success of sustainable tourism practices, there is a need to incorporate communication, education, and awareness to ensure that visitors do not undo conservation efforts (Ballantyne et al., 2009).

Communication with visitors can occur through conservation-themed interpretations that promote pro-conservation practices while interacting with animals (Ballantyne et al., 2009). Thematic interpretation is whereby selected information conveys the main idea in this case of sustainability and could be through signage, pamphlets, and boards. Evidence suggests that visitors' education can foster voluntary compliance and adherence to sustainable practices and regulations (Ballantyne et al., 2009). As much as communication with visitors is important in fostering immediate sustainability, imparted education and awareness also contribute to conservation education that visitors take with them and possibly utilise when they visit other environments.

Theoretical framework

Klöckner (2013) argues that individual behavioural characteristics can influence several aspects of sustainability; therefore, understanding behavioural determinants is important, as it influences behavioural choices and decisions. In the context of aquariums, it is imperative to understand what employees think about sustainability practices, as this will influence their choices and the decisions they make when implementing them.

One theory that can explain the implementation of sustainability practices in aquariums is the theory of planned behaviour (TPB). TPB is a behavioural theory that proposes that people's behaviour comprises voluntary and involuntary aspects and is an important theory in studying individual behaviour in pro-environmental behaviour (Klöckner, 2013; Yazdanpanah & Forouzani, 2015). The theory was first proposed by Ajzen in 1991 as an auxiliary theory based on the theory of reasoned action (Gao et al., 2017; Yazdanpanah & Forouzani, 2015). TPB proposes that three variables influence behaviour: attitude towards behaviour, subjective norm, and perceived behaviour control (Gao et al., 2017; Klöckner, 2013).

Gao et al. (2017) postulated that the most important variable in TPB is the attitude toward behaviour. In this study, attitude towards behaviour is contextualised as the employees' attitudes towards the enforcement and implementation of sustainable practices. Understanding the attitude towards sustainability practices will also be imperative in understanding what those sustainability practices are. The more positive an individual's attitude toward sustainability, the more they lean toward implementing sustainable conduct (Gao et al., 2017; Klöckner, 2013). Consequently, this variable is instrumental in understanding personal barriers to the implementation of sustainability practices at TOA. Subjective norm is another variable that affects behavioural intention in the TPB. Individual behaviour patterns conform to the expectations and viewpoints of people important to the individual who can approve or disapprove of the intended behaviour (Gao et al., 2017; Klöckner, 2013). In this study, the subjective norm can be interpreted as conformity to the rules and regulations enforced by higher management to implement authority. Therefore, behaviour and conduct can be guided by conformity to the rules stipulated by aquarium management. Since the subjective norm variable incorporates approval and disapproval of intended behaviour (Gao et al., 2017), this variable is instrumental in understanding the motivating factors for partaking in the enforcement of sustainability practices at TOA.

The final variable in the TPB is perceived behavioural control. This element stipulates that there are some factors such as opportunity, resources, knowledge, and skills that an individual cannot control, but they have a bearing on behavioural intention (Gao et al., 2017). The more control an individual has over the elements above, the more they can exert control over their behaviour and have particular behavioural conduct (Klöckner, 2013). Thus, in this study perceived behavioural control can be interpreted as the more employees and stakeholders at TOA are knowledgeable and possess skills and resources to facilitate sustainability, the more they lean towards practising sustainability. This variable also explains barriers to sustainability from an institutional perspective.

This study also makes use of sustainability theory to incorporate economic and ecological models of sustainability. According to Jenkins and Bauman (2009), three models of sustainability are drawn from the theory of sustainability: political, economic, and ecological. However, these models are not mutually exclusive and are often interrelated. Of importance to this study are the ecological models of sustainability that focus on the sustenance of biological diversity, ecological integrity, and the overall well-being of natural living environmental elements (Jenkins & Bauman, 2009). This makes the ecological model of sustainability theory relevant to the study, as it focuses on the sustainability practices in aquariums that ultimately lead to sustainability and conservation of the marine environment. There is a further breakdown of perceptions from which the ecological models of sustainability theory can be viewed, and these are anthropocentric and ecocentric (Jenkins & Bauman, 2009). The researchers adopted the ecocentric view, as it looks at the ecological sustainability of marine environments for their intrinsic value.

Another important dimension of sustainable tourism is economic factors. According to An and Alarcon (2020), sustainable tourism realises economic benefits through economic returns. This can be achieved by creating employment and injecting money into the economy through visitors' economic activities. In aquariums, people are hired as a labour force to run the aquarium. Therefore, aquariums provide education, research, breeding, and veterinary care, generate economic activities through employment, and provide exhibits to visitors that enrich them with experiences (Hall & Warmorts, 2008).

Methodology

This study applied a qualitative exploratory cross-sectional research design within the interpretivism paradigm to explore and interpret the phenomenon of sustainability practices in aquariums in a social context (Pham, 2018). Thanh and Thanh (2015) suggested that interpretivism enables researchers to discover views through the participants taking part in the study, as it portrays reality in a socially constructed, complex, and ever-changing context (Thanh & Thanh, 2015). The research design allowed the researchers to explore sustainability practices and gather detailed insights from employees at TOA through in-depth descriptions.

Purposive sampling was used to recruit participants from among TOA employees. Participants were selected based on employee roles relevant to sustainability; therefore, not everyone had an equal chance of selection (Bhardwaj, 2019). Participants in this study were from a list of employees provided by the management team at the TOA. A maximum sample size of 20 participants was set for this study, as it was estimated that saturation would be achieved at that point. The saturation point is when there are no new opinions from the respondents (Cobern & Adams, 2020). Results from a study by Guest et al. (2020), who utilised thematic saturation, indicated that a saturation point of 95% was reached between interviews 11 and 12. Hennink and Kaiser (2022) also suggested that saturation can be reached in 9-17 interviews.

To ensure that participants understood the scope of sustainability, research information was provided to participants in a brief introduction and included information further expanding on sustainability practices in aquariums. The first part of the interview schedule contained questions on the demographic data. The second part included open-ended questions that enabled broad and varied concepts to emerge during the data collection. The questions addressed sustainability practices, barriers to sustainability, the influence of sustainability practices on the sustainability of the marine environment, and communication of sustainability measures to visitors at TOA. Some of the key questions include:

- What sustainability measures do you factor into your daily work schedule?
- What challenges have you faced in your role when implementing sustainability practices?
- How have sustainability practices being implemented at TOA affected the sustainability of the marine wildlife and environment?
- How are visitors to the aquarium taught or informed about sustainability?

The study was provided with ethical clearance/approval on 7th July 2023 by the Faculty of Economic and Management Sciences Research Ethics Committee at the University of Pretoria (Protocol No.: EMS079/23). The data were collected through semi-structured interviews. Before commencing the interviews, consent was obtained from participants to participate in the study and record the sessions using an electronic recording device. All the participants were told that their participation in the study was voluntary, how the data would be used in the research, and how their confidentiality would be maintained during and after the study. The consents were written and sent to all participants before the interviews. Face-to-face and online interviews were conducted through Google Meet, recorded, and transcribed verbatim.

The six stages of thematic analysis proposed by Braun and Clarke (2012) were utilised to analyse the transcribed data. Stage 1 involved familiarisation with the data collected from TOA employees. In stage 2, the initial codes were developed. Stage 3 allowed researchers to search for and identify the codes. In stage 4, emerging themes were reviewed by the researchers, while stage 5 allowed the researchers to define themes and give labels. The final stage was report writing, which involved the interpretation of the themes.

Findings and discussion

Participant demographic information

As illustrated in Table 1, 19 of 20 people participated in the study, representing a 95% response rate. Fifteen patients were female, and four were male. The interviewed participants represented the nine departments in which they worked for a period ranging from four months to 28 years.

Table 1. Profile of study participants.

Participant code	Gender	Employment duration	Department
1	Female	6 years	Conservation
2	Female	28 years	Sustainability
3	Male	6 years	Marketing
4	Female	15 years	Finance
5	Male	18 years	Visitor services
6	Female	8 years	Education
7	Female	2 months	Education-adult training
8	Female	2 years	Curatorial-animal health
9	Male	6 years	Conservation
10	Female	22 years	Research
11	Female	9 years	Education
12	Female	1-year	Functions
13	Female	2 years	Research and training
14	Female	4 months	Core education
15	Female	9 months	Marketing
16	Male	12 years	Functions
17	Female	26 years	Education
18	Female	3 years	Visitor services
19	Female	8 years	Education

Sustainability practices at two oceans aquarium

All 19 participants understood what sustainability encompasses and alluded to it not as a once-off event but as an ongoing process. Some of the definitions of sustainability by participants are as follows:

> Using what nature must offer for our survival without compromising the availability of resources in the future (Participant 7).

> Using resources to provide the needs of current generations without compromising the needs of future generations (Participant 13).

The different definitions portray the participants' understanding of the term sustainability; it can be surmised that it is a process and there is a reference to the future. This reverberates with the definition of sustainability provided by Rhyne et al. (2014), who defined sustainability as current actions that enable the productivity and sustenance of ecosystems for future generations. Understanding sustainability is imperative for employees at aquariums, as they are responsible for implementing sustainability practices and incorporating them into their daily work schedules.

It was evident from the interviews that several sustainability practices were being implemented at TOA, and these included: the creation of awareness, educating people on environmental sustainability, use of solar power, use of grey water, use of biodegradable, switching off lights and unused appliances, recycling, use of software to minimise paper usage through printing, using reusable containers and shopper bags, a no-balloon policy for the functions' venue, minimising single-use plastics, timers for audio and visual equipment, purchase of only green listed fish in the food department, repurpose of oil into bio fuel, use of biodegradable packaging, onsite waste sorting and treatment, use of reusable water bottles, reuse of fish from classrooms to feed penguins, use of biodegradable gloves, and use of loofah sponges for cleaning tanks. Other sustainability measures indicated by the research participants also included sourcing from sustainable suppliers, differentiated bins for different wastes, exemplary employees and ambassadors of sustainability, proper disposal of hazardous waste, use of rain tanks, turtle rescue (rehabilitation and release), wildlife monitoring, and electricity and water audits to foster responsible behaviour. From the participants' responses, it can be noted that the current sustainability practices are mainly influenced by the subjective norm variable of the TPB. There are rules and regulations governing how things are done and that significantly influence the sustainable behaviour of employees. The following major themes emerged from different sustainability practices:

Conservation education and awareness

Conservation education and awareness are featured in the responses of most participants as an important sustainability practice. This practice is implemented by creating awareness through beach clean-up campaigns, where people are educated about environmental sustainability. Education and awareness messages are also spread through training staff and patrons. This gives credence to the notion that perceived behavioural control as a variable of TPB has a bearing on behavioural conduct as suggested by Klöckner (2013). The employees were knowledgeable and thus engaged in the sustainability practice since they have the knowledge and resources to engage in such. As noted by one of the participants:

> Creating awareness through innovative programmes such as the Smart Living Outreach Programme is one of the key activities of the aquarium (Participant 7).

The use of conservation education and awareness was also alluded to by Utete et al. (2022), who suggested that education and conservation awareness are important drivers of sustainable resource management practices. At TOA, beach clean-up campaigns and education courses are offered to students on the sustainability of the marine environment. They also do 'free talks,' puppet shows, and exhibitions all geared towards sustainability.

Marine wildlife protection practices

At TOA, sustainability practices are implemented for the sole purpose of marine wildlife protection. These practices include turtle rescue (rehabilitation and release), wildlife monitoring, reuse of fish from classrooms to feed penguins, and purchase of only green-listed fish in the food department.

> We work with the fisheries and many issues, such as the entanglement of seabirds and seals and by working on disentanglement as well as working with the fisheries to try and reduce their discard of bycatch… all seven species of turtles are endangered at different levels, making it valuable and impactful to be able to rescue and rehabilitate them. When we release them, we tag and track them and see their pathways that inform and provide input to policy and management of areas. (Participant 1).

> We reuse fish for lessons so that there is no wastage. (Participant 14).

These practices infer to the role of aquariums as not merely establishments for leisure, but also as important institutions in the protection and conservation of marine wildlife. This role is indicative of and similar to the view of Muka (2018), who indicated that aquariums are stakeholders in marine wildlife protection and work to conserve aquatic livelihoods through their networks. The Two Oceans Aquarium runs a turtle rehabilitation and release centre that strives to ensure that endangered turtles get a renewed opportunity for survival. Through environmental monitoring of released species, such as Bob the turtle, the TOA provides important information for coastal areas needing assistance to pave the way for the creation and development of marine protected areas.

Responsible use of water and energy

There are various ways through which TOA ensures the responsible use of water and energy, for example, by using grey water, switching off lights and unused appliances, timers for audio and visual equipment, electricity, and water audits to foster responsible behaviour.

> …we do audits of how much water we use and how much electricity we are using. (Participant 6).

> … so, we have many projects to reduce water consumption. Therefore, one of the things we are trying out is the black water treatment plant. (Participant 2).

The responsible use of water is of paramount importance, as tourism activities are synonymous with high water usage and pollution (Zhang, 2020) and aquariums are no exception. The scrutiny emanating from high water and electricity usage has propelled tourism establishments to adapt and use innovative technology to reduce their consumption (Chan et al., 2018).

Proper sorting and disposal of waste

Tourism establishments generate a large amount of waste (Zhang, 2020). Sustainability practices implemented at the TOA for handling waste include onsite waste sorting and treatment, differentiated bins for different wastes, and proper disposal of hazardous waste.

> In terms of waste, we look at our waste, we have an onsite waste treatment, and sorting facility so our waste is sorted into recyclables and composting, and then obviously the staff that cannot be recycled or composted goes to the landfill. We practice that to ensure that we are reducing the amount of waste to landfill (Participant 2).

Zhang (2020) in their study on sport tourism found that tourism activities can result in water pollution through water-based activities or the disposal of waste materials in water bodies. The findings emphasise the importance of proper disposal of hazardous waste to ensure that it does not end up in the Ocean or pollute/poisoning the environment. Cao et al. (2022) highlighted that effective waste sorting dramatically improves environmental quality as it maximises the use of waste resources and decreases waste disposal. Moreover, the proper sorting of waste induces the relevant handling of different wastes. For example, organic materials can be composted, and recyclable materials can be recycled, leading to less waste material being disposed of in landfills, thereby reducing the amount of waste that ends up in water bodies. This resonates with the study by Gill and Warrington (2017), who examined sustainability initiatives in American Zoos and Aquariums (AZA)–-certified establishments and concluded that some of the establishments engaged in waste stream reduction through composting and upcycling.

Responsible use of paper and plastic

Some of the sustainability practices implemented at TOA include the use of reusable containers and shopper bags, a no-balloon policy for the functions' venue, minimising single-use plastics, the use of reusable water bottles, and the use of accounting software to minimise paper usage through printing and recycling.

> …We have recycling bins, and no balloons are allowed in the aquarium. To practice mindfulness and make better choices, such as using a reusable water bottle and bag (Participant 19).

> We used to be on this accounting system where it involved quite a lot of printing; recently, we switched over to an accounting program called Xero so there's no printing required, so even our filing everything gets stored on a cloud or the system, so we reduced our printing on paper quite a lot (Participant 4).

Mkono and Hughes (2020) indicated that plastic is a major pollutant in marine environments. Therefore, the responsible use of plastic such as minimising the use of single-use plastics reduces the amount of plastic in circulation (Gavrilović & Maksimović, 2018) and ultimately the plastic that makes it into the oceans and water bodies. The use of accounting software reduces the printing and demand for paper in the accounting department, which over a long period would have the collective effect of a decrease in trees being cut down to make paper.

Use of biodegradable materials

Biodegradable materials are environmentally friendly because of their ability to degenerate and not accumulate in the environment. At the aquarium, biodegradable cutlery, packaging, and gloves are used. Loofah sponges are also used for cleaning tanks, and they source materials from sustainable suppliers.

> We have biodegradable gloves: we have swapped our sponges for loofas that are plants. (Participant 1).

The use of biodegradable materials and products was also suggested by Gavrilović and Maksimović (2018) as a measure for tourism greening. Conlon (2021:562) suggested that most countries in the global south lack the means of managing non-biodegradable materials, for instance, plastic once it is disposed of and coupled with the fact that most of the plastic is single-use means that they end up in the ocean. Consequently, materials that are not biodegradable for instance food packaging when in the seas and oceans leach harmful chemicals that are dangerous for marine ecosystem vitality (Conlon, 2021). Therefore, by adopting biodegradable products, the aquarium contributes to environmental sustainability and the thriving of marine environments.

Use of alternative sources of water and energy

The use of alternative sources of water and energy are imperative sustainability practices, and the responses provided indicate that the Two Oceans aquarium uses solar power, repurposes oil into biofuels, and has rainwater tanks. As noted by one of the participants:

> We use solar power. We are also using grey water in the bathrooms. We do recycling. We have a no one-use plastics policy. We also use biodegradable cutlery at events (Participant 8).

The use of solar energy is important in environmental sustainability, as established by Lemba et al. (2021), who examined renewable energies in search of a sustainable energy mix. Therefore, TOA aids in environmental sustainability by using solar energy as it is renewable and less aggressive to the environment. Moreover, the collection and use of rainwater at TOA also reduces municipal water consumption, thereby decreasing the pressure on resources.

However, from the interviews, some of the participants acknowledged that because of being an aquarium, they could be an unsustainable place because of the huge amount of energy and water that they use.

> Therefore, it is a tricky question because the aquarium is a very unsustainable place to run on so many levels. It requires a lot of electricity, and it requires a lot of moving water and things. This is quite difficult to offset (Participant 1).

This also brings forth an argument, as proposed by An and Alarcon (2020), on the sustainability of aquariums that alluded to increased waste output and, in this case, water. However, by being conscious and acknowledging weak sustainability actioning through being transparent, this challenging notion fosters a degree of accountability and transparency, which is imperative for stakeholders involved in sustainability and creates room for improvement. Through improved implementation of sustainability, aquariums can benefit from sustainable practices through improved relations with stakeholders, improved image, efficiency, and competitive advantage (Nave & Paço, 2023).

Barriers to sustainable practices implementation

Different barriers emerged in the responses. The barriers included a lack of alternatives to plastic usage, disregard of recycling rules by visitors and staff, staff apathy in the initiation of sustainability projects, resistance from clients on reduced plastic usage, lack of support mechanisms, lack of participation in projects, resistance to change, high waste output, getting suppliers to minimise packaging, getting green product suppliers, administration processes requiring printing and increasing paper usage, people not open to reusing fish from classrooms for feeding penguins, unsustainable best care for marine animals, financial constraints, lack of innovative solutions to challenges, socioeconomic status, lack of motivation for sustainable behaviour, lack of space, rules, and regulations governing sustainability practices, and lack of measures of impact causing demotivation. Drawing from TPB, the barriers to sustainable practices implementation were majorly due to perceived behavioural control and were out of the control of the employees (financial, lack of alternatives). However, a few of the barriers could be attributed to the variable on the attitude toward behaviour. These barriers are grouped into three (3) major themes, as discussed below.

Lack of alternatives

The responses indicated that one of the drawbacks of implementing and practising sustainability is the lack of alternatives. These alternatives can be based on plastic usage and the challenge that the best care for marine animals can be unsustainable; in an aquarium setup, water temperature must be maintained at a certain temperature, and plastic materials must still be used to provide care to marine animals because they are water repellent and practical. One participant indicated the following:

> …it is challenging to consistently avoid plastic use. Plastic and packaging materials are ubiquitous; therefore, it can be a challenge when the aquarium discourages the use of single-use plastics when plastic materials are used in our operations (Participant 15).

A lack of alternatives was also identified as a barrier to sustainability in a study by Anastasiadou et al. (2021) on the use of sustainable mobile carriers. From the responses offered by the participants, a complex debate arises on how sustainability should be and where to draw a line where practicality is concerned. For sustainability, compromises must be made, and a balance must be attained and achieved.

Lack of interest and cooperation in the implementation of innovative solutions to sustainability challenges

There is a need for collaborative action and continued action for successful sustainability implementation. The absence of implementation of innovative solutions to sustainability challenges, such as high waste output, getting suppliers to minimise packaging, getting green product suppliers, administration processes requiring printing, and increasing paper usage, pose a barrier to sustainability. If there is disregard for recycling rules by visitors and staff, staff apathy in the initiation of sustainability projects, resistance from clients on reduced plastic usage, lack of participation in projects, resistance to change, and people not open to reusing fish from classrooms for feeding penguins will be barriers to sustainability. Due to lack of interest and cooperation in the implementation of innovative solutions, there are continued unsustainable practices due to lack of solutions that might have otherwise solved the challenges.

> There is always a tension between wanting to provide the best level of care that requires the use of a lot of disposable medical items, warm water, and all these kinds of things and then being sustainable. Therefore, it is a concertation. (Participant 1).

> There are also people who do not have that mentality, so you would find the wrong things in the wrong bin, which always infuriates our sustainability team when they look in the bins (Participant 6).

Innovation has been used as a method for increasing competitiveness in tourism offerings and opening new market segments (Lewis, 2019). Moreover, with regard to environmental management issues, innovation is an agent of improvement in quality and product performance (Lewis, 2019). Managerial innovation is a process of empowering and motivating staff to facilitate the acceptance and adaptation of internal processes by providing sufficient compensation (Lewis, 2019). Management innovation, as suggested by Lewis (2019), is an effective motivational factor. This brings forth an element of incentive as a motivational factor for actioning buy-in from disinterested people. Mkono and Hughes (2020) proposed sustainable innovation as an effective way to implement and maintain sustainability. Therefore, innovative solutions need to be implemented to eradicate sustainability barriers.

Limited financial resources

Funding is an important factor in the implementation of sustainability practices. However, if there are financial constraints on support mechanisms and to provide motivation for sustainable behaviour, there will be a barrier to implementing sustainability. It emerged from the study that the Two Oceans Aquarium has financial constraints in implementing some of its sustainable practices.

> Obviously, there are financial constraints; for instance, we would like to put more solar panels on all our roofs, but that comes at a cost (Participant 2).

Financial constraints are one of the seven categories of barriers to sustainability implementation (Anastasiadou et al., 2021). Without the availability of the funds required to facilitate sustainability initiatives, it will be impossible to implement and sustain sustainability practices. Despite financial limitations, aquariums can advance sustainability by adopting cost-effective measures, forming strategic partnerships, and focusing on high-impact projects. Energy-efficient upgrades offer significant cost savings with short payback periods, making them feasible for budget-conscious institutions (Lu et al., 2005). Additionally, expanding eco-merchandising such as reusable bottles can generate revenue while aligning with visitor preferences for conservation-oriented brands (Powell & Ham, 2008). Further savings could be achieved through AI-driven energy management systems, which optimize HVAC efficiency and reduce consumption (Pushpavalli et al., 2024; Zhou et al., 2023).

Influence of sustainability practices on the sustainability of the marine environment

All 19 participants indicated that sustainability is important in aquariums. There are various ways in which sustainability practices at TOA are beneficial to the Marine Environment. From the responses, the following effects of sustainability practices on the sustainability of the marine environment were identified: increased conservation education and awareness, partnership with companies on marine sustainability, non-discharge of harmful waste into marine environments, decreased carbon output, marine sustainability programmes, reduced demand for red-listed seafood, and creation of responsible behaviour for marine environments. These re further categorised into the following major themes:

Increased conservation education and awareness

TOA practices benefit the marine environment through general awareness and conservation education and ultimately contribute to the creation of responsible behaviour for marine environments.

> I believe that more people are now aware of what not to do through initiatives such as beach clean-ups and education. We hopefully reduce the litter that ends up in the sea (Participant 5).

Education and awareness are important as they can be used as 'soft skills' to change choices and culture and in this regard sustainable behaviour (Anastasiadou et al., 2021; Utete et al., 2022). This has a snowball effect on environmental protection. Barbieri et al. (2020), in their study on sustainable practices in Indigenous communities, found that participants who were knowledgeable about sustainability confirmed that it was through education and training initiatives. This reinforces the findings of this study, which established increased conservation education and awareness through sustainability practices at TOA.

Improved partnerships with relevant stakeholders

Sustainability practices at TOA have necessitated the formation of partnerships with companies on marine sustainability. Through these combined efforts, the marine environment benefits more.

> …we work with the fisheries and many issues such as the entanglement of seabirds and seals are addressed… we also work with the fisheries to try and reduce their discard of bycatch or come up with alternative solutions to do it…I think we are having an impact locally in terms of sustainability practices at the harbour where there are marine animals…so I think that is quite positive and we are also going to be working at other harbours in the Cape (Participant 1).

It also emerged that TOA has a partnership with Sea-Land Gear, which mainly produces items from ghost nets, which then reduce the nets in the oceans that cause problems of marine entanglements. It is also involved in the regulation and implementation of the Southern African Sustainable Seafood Initiative (SASSI) and is a member of the World Association of Zoos and Aquarium (WAZA). These initiatives are also aligned with Jayawardena (2019), who suggests that the formation of public-private partnerships (PPPs) is critical in environmental conservation, as these are innovative methods for the implementation of sustainability in tourism entities.

Improving the quality of marine environments

There is already environmental degradation and damage to marine environments (Jayawardena, 2019). Through the non-discharge of harmful waste into marine environments, decreased carbon output, waste sorting and recycling, and reduced demand for red-listed seafood, TOA positively impacts the marine environment by not engaging in practices that cause damage to them.

> We minimised the amount of waste that would have reached the marine environment. Our need for virgin paper for printing has been reduced (Participant 9).

Owing to the reduced usage of plastic and proper waste sorting and disposal, there is a decrease in plastic that ends up in the ocean. All these efforts have substantial benefits for the marine environment as some of the main threats to the marine environment are waste, plastic food packaging, and chemical disposal in the ocean (Boone et al., 2023). A cleaner marine environment is essential for the livelihood of marine life and ecosystems and has significant economic impacts on the fishing and tourism industry (Spadaro et al., 2021).

Improved marine wildlife protection and conservation efforts

Through extensive research and their rehabilitation centre, the Two Oceans also engage in marine wildlife protection and conservation.

> One of the species we work with is the critically endangered hoax fall turtle. This means that it is much more valuable and impactful to be able to rehabilitate and rescue them. It is also just in terms of thinking on a bigger level when we release them, we tag them and track them and by seeing their pathways because they are endangered species that really inform and input policy and management of areas. You know if you know that you have got a coastline where there are many endangered species that are travelling there is more pressure to protect that area to reduce fishing, to create marine protected areas (Participant 1).

This resonates with the view of Muka (2018), who suggested that aquariums are important for the management, protection, and conservation of endangered marine species. Another way that the aquarium is involved in marine wildlife protection is the Seal Disentanglement programme, whereby seals entangled with nets in the harbour are removed.

Therefore, it can be surmised that TOA contributes to the sustainability of marine wildlife. Through these efforts, there can be better policy-making for the overall benefit of marine wildlife. Endangered species such as turtles are rehabilitated and released back into the ocean. Therefore, marine wildlife that would otherwise not have had a second lease on life is saved and continues to thrive instead of becoming extinct, as is the case with the impending decline and extinction of turtles, as all seven species are endangered at different levels.

Communication of sustainability efforts to visitors

All 19 participants responded affirmatively that the aquarium communicates sustainability issues to visitors who visit the aquarium. Twelve participants indicated that communication was interesting and educational, five indicated that it was educational, and the remaining two referred to communication as captivating and inspiring. According to Gössling (2017), travel and tourism contribute to learning, which has positive effects on conservation. Support processes for sustainability are fostered through engagement with transformative learning processes. Gill and Warrington (2017) suggest that sustainability communication is done through interpretive signage, conservation education messaging, and community-based social marketing. Gössling (2017) argued that social networking in tourism is a sustainability communication strategy for tourism entities. From the responses, communication was done through presentations, staff interactions, talks, exhibitions, social media, interactive signage, and training courses. The following major themes will be used to further explore the different communication methods:

Social networking

The staff at TOA are involved in the communication of sustainability to visitors through presentations, staff interactions with guests, talks, and training courses.

> We have lessons in our classroom, and we use exhibit areas. We use the impacts of overfishing, shark finning, penguin population decline, and pollution to show the outcomes of unsustainable practices and their devastating impacts on the ocean and its inhabitants (Participant 11).

Teaching and communicating with visitors about environmental sustainability is imperative and may allow visitors to connect with animals and ultimately influence their environmental outlook and actions (Ballantyne et al., 2021; Mann et al., 2017). Moreover, teaching children through environmental courses educates them on how to be environmentally sustainable, which is a form of sustainability that empowers future generations.

Social marketing

One of the ways through which sustainability is communicated to visitors is through the Internet, which includes vlogs, the aquarium's website, and social media.

> It is conducted through social media, media, and vlogs. (Participant 2).

A study by Mkono and Hughes (2020) examined online environmental blogs and sites and their users' feelings of guilt and shame towards environmental impact. The study established that online channels are sources of communication and learning. Moreover, with the advent of technology and the Fourth

Industrial Revolution, more people are looking at online channels as sources of communication, awareness, and education (Gössling, 2017). Tiago et al. (2021) further affirmed this, as they alluded that organisation with a savvy online presence communicated their sustainability efforts and practices better. Therefore, by using the Internet as a source of communication, TOA is widening its reach with the sustainability message.

Interactive signage

At TOA, there is interactive signage all around the aquarium that serves as communication to visitors. Interactive signage consists of posters and pictures depicting marine environmental issues that evoke emotions.

> Interactive signage throughout exhibits. With the Turtle Rehabilitation Centre and turtle patients (Participant 8).

Interactive signage serves to make visitors aware of how they contribute to marine biodiversity loss and triggers a sense of shame and guilt. According to Mkono and Hughes (2020), some people need a sense of guilt and shame as motivational factors for behavioural change. The need to never feel guilt and shame triggers a self-reflection through which a transition is made and, in this case, sustainable behaviour. Interactive signage in aquariums significantly influences visitor behaviour by enhancing engagement as the signage controls the pace and content of their learning (Heath et al., 2005). Furthermore, engaging digital displays in aquariums increase visitors' willingness to support marine wildlife conservation efforts (Ballantyne et al., 2011).

All the participants indicated that sustainability communication to visitors was educational, while 10 further alluded that it was interesting. It is imperative that communication is palatable to visitors to facilitate the learning process. Moreover, if communication is boring and unpalatable, it impedes the learning process and ultimately affects the uptake of environmentally sustainable behaviour. Ballantyne et al. (2021) suggest that communication aimed at teaching visitors should consider the interests of visitors and include a reflective engagement aspect. This ensures the engagement and involvement of the visitors.

Conclusion

This study explored sustainability practices at TOA and concluded that these practices include recycling, waste sorting, and the use of solar power and biofuel. Some of the barriers to the implementation of sustainability practices were staff apathy, financial constraints, and a lack of interest and cooperation in the implementation of innovative sustainability practices. The effects of sustainability practices included the conservation of marine animals, improved partnerships with relevant stakeholders, and increased education and awareness. Sustainability is communicated to visitors through social networking, social marketing, and interactive signage. The findings from this study provide aquariums with a roadmap for sustainability practices that they should consider implementing. The study also provides insight into aquariums and tourism establishments when considering the barriers to the implementation of sustainability that they may encounter, thus allowing them to make provisions for mitigation measures. Although Gao et al. (2017) suggested that the most important variable in TPB is the attitude towards behaviour, the study at TOA established that subjective norms are equally as important in enforcing sustainable behaviour. Most of the sustainable practices that employees were participating in were a result of conformity and adherence to the TOA rules. The barriers to the implementation of sustainability practices were majorly due to the perceived behavioural control variable as the employees perceived that some sustainability practices were not within their control.

The study has established that sustainability can be viewed as a behavioural issue focusing on the behaviour of the person engaging in sustainable behaviour that aligns with the proposition of the theory of planned behaviour. This reverberates with a study by Mann et al. (2017), who proposed that visitors kept environmental behavioural promises related to not littering and polluting, as well as recycling. Therefore, aquariums and tourism managers should produce sustainability messages aimed at influencing behavioural change. Sustainability messages can be communicated via interactive signage, social networking, and social marketing. For TOA, it is recommended that they initiate the provision of interactive messages in different languages, as they are currently only in English. There is also a need for continued training and awareness to encourage and remind employees of sustainability. Moreover, TOA can incentivise sustainability actions to encourage staff participation and buy-in.

This study's primary limitation lies in its reliance on a single case study (TOA), which may constrain the generalizability of the findings. To enhance the applicability of the results, future research should expand to multiple aquariums across diverse contexts. Additionally, the study focused solely on employee perceptions, leaving other critical stakeholder perspectives unexplored. Future investigations should incorporate the views of visitors and local communities, as their insights could yield more comprehensive and multifaceted findings, ultimately supporting the long-term sustainability of aquariums. Future studies should also explore aspects of animal welfare and the ethical concerns of marine animal captivity, as these are essential aspects of sustainability in aquariums.

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Author contributions

CRediT: **Ashleen Kudzai Chipangura**: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Validation, Visualization, Writing – original draft, Writing – review & editing; **Felix G. Bello**: Conceptualization, Data curation, Formal analysis, Methodology, Project administration, Supervision, Validation, Visualization, Writing – review & editing; **Isobel Manuel**: Formal analysis, Methodology, Validation, Visualization, Writing – review & editing.

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No potential conflict of interest was reported by the authors.

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Data availability statement

The data that support the findings of this study are available from the corresponding author, upon reasonable request.

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