SUSTAINABLE TOURISM IN ENVIRONMENTAL PROTECTION AREAS: INTEGRATING THE CIRCULAR ECONOMY FOR PRESERVATION AND DEVELOPMENT

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ABSTRACT

This article explores the intersection between sustainable tourism and the circular economy in Protected Areas (PAs). Sustainable tourism has evolved to encompass a systemic approach balancing environmental needs, local economic demands, and community well-being. The study highlights the importance of PAs for implementing regenerative practices, where the circular economy promotes waste reduction and resource reuse. It examines how tourism businesses in Barra Grande adopt circular economy practices to contribute to the United Nations' Sustainable Development Goals (SDGs). Through literature review and case analysis, the article highlights innovative strategies that mitigate negative impacts and transform tourism into a positive force for conservation and local development. It concludes that stakeholder collaboration and the adoption of green technologies are essential for sustainable and regenerative tourism in PAs.

Keywords: Sustainable Tourism; Protected Areas; Circular Economy; Waste Reduction; Resource Reuse.

Objetivo de Desenvolvimento Sustentável (ODS): ODS 12 – Consumo e Produção Responsáveis.

1 INTRODUCTION

The intersection between sustainable tourism and the circular economy has emerged as a vital field of study in the search for solutions that mitigate negative environmental impacts and promote sustainable economic development in PAs (Liburd, Menke, & Tomej, 2024; Axhami et al., 2023). Tourism, one of the largest global industries, exerts a significant influence on natural environments, especially in areas of high ecological value (Hall, 2000; Axhami et al., 2023). APAs, characterized by their rich biodiversity, often face the challenges of mass tourism, which can lead to habitat degradation, pollution and loss of biodiversity (Eagles, 2002). In this context, sustainability in tourism is not limited to mitigating environmental impacts, but expands to include the conservation and regeneration of ecosystems, as well as promoting the socio-economic well-being of local communities (Weaver, 2006).

The circular economy, in turn, offers a systemic approach to resource management, emphasizing the reduction of waste and the reuse of materials (Geissdoerfer et al., 2017; Kirchherr et al., 2023). This model stands in stark contrast to the traditional linear economy of "extract, manufacture and dispose", proposing a continuous cycle of resource use and recycling (Stahel, 2016). The application of the circular economy in tourism presents itself as a viable strategy for transforming operational practices, reducing the sector's ecological footprint and promoting economic and environmental sustainability (Lew et al., 2016).

Despite growing discussions about sustainable tourism and the circular economy, there is a significant gap in the literature regarding the integrated application of these concepts in APAs. This article seeks to fill this gap by investigating how the adoption of circular economy practices can benefit the sustainability of tourism in APAs, with a specific focus on Barra Grande, a biodiversity-rich and culturally significant area. The central research question guiding this study is: "How can the implementation of circular economy practices promote the environmental and economic sustainability of tourism in Environmental Protection Areas?"

The objectives of this article are: (1) to analyze current sustainability practices in tourism in APAs, (2) to identify the benefits and challenges of adopting circular economy practices in this context, and (3) to provide evidence-based recommendations for integrating these practices into tourism policies and operations. This study is based on a qualitative approach, using interviews with managers of eco-resorts and ecotourism operators in Barra Grande, as well as a documentary analysis of local sustainability policies.

The literature on sustainability in tourism stresses the importance of effective management to minimize negative impacts and maximize economic and social benefits (Butler, 1999; Seraphin & Chaney, 2023; Axhami et al., 2023). Weaver (2006) and Bramwell and Lane (2011) argue that the integration of environmental, economic and social dimensions is necessary to achieve sustainability goals in PAs. However, adopting a circular economy approach can amplify these efforts by promoting the reuse and recycling of resources and minimizing waste (Geissdoerfer et al., 2017; Kirchherr et al., 2023).

Tourism companies in Barra Grande, for example, have adopted innovative practices, such as water recycling systems and organic waste composting, which reduce resource consumption and generate economic benefits by lowering operating costs (Jones, 2012). Collaboration between stakeholders, including governments, tourism companies and local communities, is key to implementing

sustainable practices (Borrini-Feyerabend et al., 2013). Co-management and collaborative governance can create solutions that are better adapted to local conditions, facilitating the adoption of green technologies and promoting environmental education among tourists and the community (Buhalis & Amaranggana, 2015).

2 SUSTAINABILITY IN TOURISM

2.1 Foundations and evolution of the concept of sustainability in tourism.

Sustainability in tourism is a concept that has evolved over the last few decades, reflecting profound changes in the way tourism is perceived and managed in global and local contexts (Liburd, Menke, & Tomej, 2024). Initially, sustainability in tourism emerged as a response to the negative environmental impacts associated with the unbridled growth of the tourism industry (Liburd, Menke, & Tomej, 2024). Authors such as Han (2021) and Seraphin and Chaney (2023) point out that the principles of sustainability have been applied to the sector with the aim of minimizing environmental damage, maximizing economic benefits for local communities and ensuring the long-term viability of tourist destinations.

Over the years, sustainability in tourism has come to incorporate a broader understanding that encompasses environmental conservation, social and economic issues (Liburd, Menke, & Tomej, 2024). The concept of sustainable tourism is now often described as a systemic approach that seeks a balance between environmental needs, the demands of local economies and the well-being of host communities (Weaver, 2006). This approach emphasizes that sustainable tourism is not just about mitigating impacts, but also about creating an environment in which tourism can contribute positively to the sustainable development of the areas in which it operates.

The evolution of the concept of sustainability in tourism reflects a paradigmatic shift in the way the tourism industry is perceived and managed, evidencing a trajectory that goes from the simple recognition of negative environmental impacts to the adoption of integrated practices that promote economic, social and environmental benefits (Liburd, Menke, & Tomej, 2024). Initially, sustainability in tourism emerged as a response to the adverse effects of the industry's uncontrolled growth, where concerns about environmental degradation and biodiversity loss were prevalent (Butler, 1999). However, as global environmental awareness has increased, the concept of sustainability in tourism has come to incorporate a more systemic vision (Liburd, Menke, & Tomej, 2024).

In the 1980s and 1990s, sustainability in tourism began to gain traction with the recognition that tourism development should balance the exploitation of natural resources with the need to preserve them for future generations. This period was marked by the publication of influential reports such as the Brundtland Commission's "Our Common Future", which defined sustainable development as that which meets the needs of the present without compromising the ability of future generations to meet their own needs (World Commission on Environment and Development, 1987). This report had a significant impact on the way sustainable tourism was understood,

establishing a framework for policies and practices that take into account environmental, economic and social aspects.

The transition to a more integrated approach to sustainability in tourism was driven by authors such as Weaver (2006), who argued that sustainable tourism should go beyond mitigating negative impacts and include the active promotion of positive benefits for the environment and local communities. Weaver highlighted the need for a balance between the three pillars of sustainability: economic, social and environmental. This holistic perspective was fundamental to the development of practices that minimize environmental damage and contribute to the economic and social development of host communities.

In the 2000s, sustainability in tourism evolved to include concepts such as regenerative tourism and the circular economy, reflecting a deeper understanding of the need to restore and regenerate ecosystems impacted by tourism activity (Kirchherr et al., 2023). Davenport and Davenport (2006) were pioneers in introducing the concept of regenerative tourism, which goes beyond simple conservation to include practices that actively improve environmental and social conditions. This approach is in line with the United Nations SDGs, which emphasize the importance of protecting and restoring ecosystems while promoting sustainable economic development (United Nations, 2015).

The circular economy, proposed by authors such as Geissdoerfer et al. (2017), represents another significant evolution in the concept of sustainability in tourism. Unlike the traditional linear economy, which follows the "extract, manufacture and dispose"

model, the circular economy seeks to keep resources in use for as long as possible, extracting maximum value from them while in use and recovering and regenerating products and materials at the end of their useful life. This approach is particularly relevant to tourism, where reusing resources and minimizing waste can contribute to the environmental and economic sustainability of tourist destinations.

APAs are examples of how the evolution of the concept of sustainability in tourism can be applied in practice. These areas, often rich in biodiversity and culturally significant, face unique challenges due to the pressure of mass tourism. Eagles (2002) and Bramwell and Lane (2011) argue that the sustainable management of APAs requires an integrated approach that takes into account multiple dimensions of sustainability, including environmental conservation, economic development and the social well-being of local communities. The inclusion of circular economy practices, such as waste recycling and the use of renewable energy, can help minimize the negative impacts of tourism and promote the regeneration of ecosystems (Kirchherr et al., 2023).

In addition, the active participation of local communities in tourism planning and management is fundamental to the success of sustainability initiatives. Stronza and Gordillo (2008) point out that the inclusion of local communities improves the acceptance and effectiveness of management practices, as well as strengthening the social fabric and economic resilience. Collaborative governance, which involves governments, tourism companies, non-governmental organizations and local communities, is essential for developing local alternatives and ensuring that the benefits of tourism are widely distributed (Borrini-Feyerabend et al., 2013).

In recent years, technological innovation has also played an important role in the evolution of the concept of sustainability in tourism. From the development of mobile applications that help manage the flow of visitors to the implementation of renewable energy technologies in tourism infrastructures, technological innovations have the potential to minimize environmental impacts and maximize operational efficiency (Liburd, Menke, & Tomej, 2024). Buhalis and Amaranggana (2015) point out that the

adoption of green technologies and the promotion of environmental education among tourists and the local community are strategies to promote sustainability in tourism.

The evolution of the concept of sustainability in tourism reflects a trajectory of increasing sophistication and integration, ranging from the mitigation of environmental impacts to the active promotion of economic and social benefits. The adoption of circular economy and regenerative tourism practices, the participation of local communities and technological innovation are key elements that contribute to a tourism model that is environmentally sustainable, economically viable and socially inclusive. This holistic and integrated approach is essential for tackling contemporary tourism challenges and ensuring that future generations can continue to enjoy and learn from the world's precious natural and cultural environments.

2.2 Regenerative Tourism Strategies In Apas**.**

Regenerative tourism strategies in APAs represent an advanced and innovative approach to the sustainable management of these precious spaces. Unlike sustainable tourism, which seeks to minimize negative impacts, regenerative tourism goes further, actively promoting the restoration and revitalization of damaged ecosystems, as well as strengthening local communities. Davenport and Davenport (2006) were pioneers in introducing the concept of regenerative tourism, pointing out that it preserves the environmental and social conditions of the areas where it is implemented.

One of the central strategies of regenerative tourism is ecological restoration. This practice involves deliberate actions to recover ecosystems that have been degraded, damaged or destroyed, with the aim of rehabilitating their natural functions and processes. For example, in APAs, this can include replanting native vegetation, restoring wetlands, and reintroducing species that have become locally extinct due to human activities. According to Clewell and Aronson (2013), ecological restoration benefits the natural environment and can provide education and engagement opportunities for tourists and local communities, strengthening the connection between people and nature.

Another vital strategy is the development of sustainable, low-impact tourism infrastructure. This includes the construction of ecological accommodation, such as eco-lodges, which use local and sustainable materials, incorporate renewable energies and efficient waste management systems. Such practices reduce tourism's ecological footprint and promote harmonious coexistence with the natural environment. Authors such as Honey (2008) point out that sustainable infrastructures preserve the environment and attract conscious tourists who value ecological practices and are willing to pay a premium price for these experiences.

Promoting sustainable agricultural practices and agroforestry in and around APAs is another essential strategy for regenerative tourism. Agroforestry, which combines trees with agricultural crops and livestock, can increase biodiversity, improve soil quality and capture carbon, as well as providing livelihoods for local communities. These practices help to integrate the economic needs of communities with conservation objectives, creating a beneficial symbiosis between humans and nature. McNeely and Scherr (2003) argue that such practices are crucial for the long- term sustainability of APAs, as they promote ecological resilience and food security. Environmental education and interpretation are crucial components of regenerative tourism. Offering educational programs for tourists about the importance of conservation and regenerative practices can increase awareness and support for conservation initiatives. Activities such as guided trails, biodiversity workshops and citizen science projects engage visitors and turn them into conservation advocates. Ballantyne and Packer (2011) suggest that meaningful educational experiences can positively influence tourists' attitudes and behaviors, fostering a lasting commitment to sustainability.

The inclusion of local communities in the planning and management of tourism activities is fundamental to the success of regenerative tourism. Community participation ensures that local needs and aspirations are respected and that the economic benefits of tourism are distributed equitably. Stronza and Gordillo (2008) point out that collaboration with local communities strengthens the effectiveness of conservation strategies and promotes social and economic justice. Programs that train local communities to become

tour guides, artisans and tourism service providers create jobs and encourage sustainable economic development.

Collaborative governance between multiple stakeholders is another key strategy for regenerative tourism in APAs. Co-management involving governments, NGOs, private companies and local communities allows for a holistic and integrated approach to natural resource management. Borrini-Feyerabend et al. (2013) argue that co-management facilitates regenerative practices and ensures that decisions are made based on a shared understanding and consensus on conservation and development objectives. This inclusive and participatory approach is essential to ensure the long-term sustainability of APAs.

In addition, the use of innovative technologies for environmental monitoring and management can improve the effectiveness of regenerative tourism strategies. Technologies such as drones, remote sensors and geographic information systems (GIS) enable the collection of accurate, real-time data on the health of ecosystems, facilitating informed decision-making. Turner et al. (2015) argue that the application of these technologies can increase the capacity to respond to environmental threats, such as deforestation and poaching, and improve the management of natural resources.

Finally, ecological certification is a powerful tool for promoting regenerative tourism. Certifications such as Green Globe and Eco-Cert offer recognition and validation for tourism enterprises that follow sustainable and regenerative practices. Font and Harris (2004) suggest that eco-certification improves the reputation of tourist destinations and attracts a market segment of environmentally conscious and responsible tourists. This certification helps to establish high standards of sustainability and encourages other tourism operators to adopt similar practices.

Regenerative tourism strategies in APAs encompass ecological restoration, the development of sustainable infrastructure, the promotion of regenerative agricultural practices, environmental education, community inclusion, collaborative governance and the use of innovative technologies. These strategies minimize the negative impacts of tourism and promote ecological revitalization and sustainable economic development,

ensuring that APAs can continue to provide environmental, social and economic benefits for future generations. By implementing these practices, we can transform tourism into a powerful force for environmental regeneration and the strengthening of local communities.

3 ENVIRONMENTAL IMPACT ON THE TOURIST ECOSYSTEM

3.1 Consequences Of Uncontrolled Tourism: Ecological Certification And Collaborative Governance As Impact Mitigation Strategies.

Uncontrolled tourism can have devastating environmental consequences on tourist ecosystems, compromising both the ecological integrity and the long-term economic viability of these destinations. As global tourism grows, the negative impacts on natural environments become more evident. Without proper management, tourism can result in habitat degradation, pollution, soil erosion and biodiversity loss, threatening the resources that initially attracted tourists (Hall, 2000). The construction of tourist infrastructure often involves deforestation and modification of natural landscapes, destroying vital habitats for fauna and flora and leading to the fragmentation of ecosystems (Newsome, Moore, & Dowling, 2002). Tourism activities generate large amounts of solid waste, effluents and greenhouse gas emissions. Improper disposal of waste and sewage can contaminate water bodies, affecting water quality and the health of aquatic ecosystems. In addition, heavy traffic from tourist boats can cause spills of fuel and harmful chemicals into the oceans, harming marine life (Buckley, 2012).

Soil erosion is another significant consequence of uncontrolled tourism, especially in mountainous and coastal areas. The construction of infrastructure and heavy tourist traffic on trails and beaches accelerate erosion, resulting in the loss of fertile soil and degradation of the landscape. Soil erosion alters the natural topography and can lead to the silting up of rivers and lakes, affecting water quality and aquatic habitats (Eagles, McCool, & Haynes, 2002). Biodiversity loss is one of the most alarming consequences of uncontrolled tourism, as tourist activities can disturb local fauna, leading to the displacement or extinction of species. Overvisiting natural areas can cause stress to

animals, disrupting their feeding, reproduction and migration patterns. In addition, the introduction of exotic species by tourists can lead to competition with native species, altering ecological dynamics and reducing local biodiversity (Holden, 2003).

To mitigate these consequences, it is essential to implement sustainable tourism management strategies that balance economic development with environmental conservation. Proper land use planning, including the creation of intensive use and conservation zones, can help direct the flow of tourists to less sensitive areas and protect critical habitats. In addition, adopting sustainable tourism practices, such as limiting the number of visitors, using green technologies and

promoting low-impact activities, can reduce negative environmental impacts. Environmental education plays a vital role in mitigating the impacts of uncontrolled tourism, raising tourists' awareness of the importance of conservation and promoting more sustainable behaviors (Eagles et al., 2002).

Eco-certification and collaborative governance are emerging as key strategies for promoting sustainability in tourism and mitigating environmental impacts in APAs. Eco-certification is a voluntary process by which tourism companies and destinations are assessed against a set of environmental and sustainability standards. Certifications such as Green Globe and LEED provide formal recognition of sustainable practices, encouraging companies to adopt measures that minimize their environmental impact. Eco-certification improves the reputation of tourism enterprises and attracts a market segment of conscious tourists who are willing to pay a premium price for sustainable products and services (Font & Harris, 2004).

The adoption of eco-certifications brings multiple benefits, providing an economic incentive for companies to invest in sustainable practices and establishing a structured framework for the implementation of environmental management practices (Xu et al., 2023). In addition, eco-certification can act as an educational tool, raising awareness among tourists and tour operators about the importance of sustainability (Ballantyne & Packer, 2011). On the other hand, collaborative governance involves active participation and cooperation between various stakeholders in the management of APAs.

This model is essential for implementing sustainable practices, allowing different groups to work together to achieve common conservation and sustainable development goals.

Collaborative governance promotes inclusion and equity by ensuring that all stakeholders have a voice in the decision-making process. This approach can improve the effectiveness of management policies and practices by increasing acceptance and cooperation between the parties involved. The participation of local communities in the governance of APAs strengthens economic resilience and improves the effectiveness of conservation strategies. Including communities ensures that their needs and aspirations are respected, fostering a sense of ownership and responsibility that is crucial for long-term sustainability (Stronza & Gordillo, 2008).

The combination of eco-certification and collaborative governance can create a virtuous cycle of sustainability. Eco-certification sets high standards and encourages the adoption of sustainable practices, while collaborative governance ensures that these practices are implemented in an inclusive manner and adapted to local realities. This synergy can result in more effective management of APAs, promoting biodiversity conservation, mitigation of environmental impacts and sustainable economic development. Innovative technologies, such as satellite monitoring systems, drones and remote sensors, can support both eco-certification and collaborative governance by providing accurate, real-time data on the health of ecosystems (Turner et al., 2015).

Eco-certification and collaborative governance are interlinked strategies that promote sustainability in tourism and the preservation of ecosystems in APAs. Together, these approaches can create a responsible tourism environment that benefits both nature and local communities, promoting tourism development that is environmentally responsible, economically viable and socially inclusive.

Collaboration between all stakeholders is essential for the success of these strategies, ensuring that APAs can continue to provide environmental, social and economic benefits for present and future generations.

4 CIRCULAR ECONOMY

4.1 Principles Of The Circular Economy And Implementation Of Circular Practices In Tourism.

The circular economy is an economic model that aims to redefine the production and consumption of goods and services, promoting sustainability throughout the life cycle of products. In contrast to the traditional linear economy, which follows the "extract, manufacture, use and dispose" paradigm, the circular economy seeks to keep resources in use for as long as possible, extracting maximum value and regenerating materials at the end of their useful life (Geissdoerfer et al., 2017). One of the central principles of the circular economy is designing for longevity, reuse and recycling, creating durable, repairable and disassembled products, allowing their components to be reused or recycled (Braungart & McDonough, 2002). In addition, maintaining the value of products, components and materials in circulation is key, achieved through strategies such as remanufacturing, repair and recycling, reducing the need to extract new natural resources (Stahel, 2016).

Another crucial principle of the circular economy is reducing the consumption of natural resources and minimizing waste generation. The reuse of industrial waste and the implementation of closed-loop systems in production chains promote a more efficient use of resources (Ghisellini, Cialani & Ulgiati, 2016). The transition to renewable energy sources, such as solar and wind, is essential for reducing the carbon footprint of economic activities and mitigating climate change (Lacy & Rutqvist, 2015). Collaboration along the value chain is vital, with companies, governments and consumers working together to facilitate the reuse, repair and recycling of products. This includes creating reverse logistics networks and sharing information and best practices (Blomsma & Brennan, 2017).

The implementation of circular practices in tourism is an innovative approach to promoting environmental and economic sustainability. Tourism, as one of the largest global industries, puts significant pressure on natural resources, requiring a transformation in the way they are used and managed. Circular practices include

designing tourism products and services for longevity and reuse, such as building eco-lodges with recycled materials and renewable energy systems (Xu et al., 2023). Waste management is critical, with the implementation of recycling and composting systems that turn waste into valuable resources, such as hotels that separate waste into recyclable and organic categories, creating fertilizer for gardens (Jones, 2012). The reuse of resources in tourism can include the reuse of gray water for irrigation and the use of recycled materials in the construction of tourist facilities. Equipment rental and sharing programs, such as bicycles and kayaks, reduce the need for new products and offer tourists access to high-quality equipment (Lew, Ng, Ni & Wu, 2016). The sharing economy, facilitated by platforms such as Airbnb and BlaBlaCar, maximizes the use of existing resources and strengthens the local economy, providing additional income for residents (Bocken et al., 2016).

Tourist education and awareness are essential for the successful implementation of circular practices in tourism. Making visitors aware of the importance of the circular economy and encouraging sustainable behaviors can have a significant impact, through educational programs and interactive activities (Ballantyne & Packer, 2011). Collaboration between different stakeholders, including governments, companies, NGOs and local communities, is crucial to create systems that facilitate recycling, reuse and waste reduction. Public-private partnerships combine resources and expertise to develop sustainable infrastructures (Blomsma & Brennan, 2017).

Technology plays a vital role in implementing circular practices in tourism. Environmental monitoring technologies, such as water and air quality sensors, help detect and mitigate environmental impacts in real time. Geographic information systems (GIS) map and manage natural resources efficiently, increasing responsiveness to environmental threats and improving resource management (Turner et al., 2015). The implementation of circular practices in tourism involves durable product design, efficient waste management, reuse of resources, promotion of the sharing economy, education of tourists, collaboration between stakeholders, use of advanced technologies and favorable public policies. These practices minimize the environmental impacts of tourism and

promote economic and social sustainability, creating a more resilient and sustainable future. The transition to a circular economy in tourism requires collective commitment, but the long-term benefits make this effort essential for the preservation of natural resources and the well-being of local communities.

5 RESULTS AND DISCUSSION

5.1 Sustainable And Circular Practices In Apas Aligned With The Theory Of Networks And Tourism

Sustainable and circular practices in APAs can be improved when aligned with network theory and its application to tourism. Network theory offers an analytical framework for understanding the complex interactions between the various stakeholders involved in sustainable tourism, allowing for the identification of patterns of collaboration, diffusion of innovations and collaborative governance.

Network theory, as explored by authors such as Scott, Baggio and Cooper (2008), looks at how different actors - be they individuals, organizations or communities - are interconnected through relationships of interdependence and collaboration. In the context of APAs, these networks can include connections between governments, NGOs, tourism companies, local communities and tourists. Understanding these networks allows for a more holistic and integrated approach to implementing sustainable and circular practices, maximizing environmental, social and economic benefits.

One of the ways in which network theory can be applied is through the analysis of social networks to promote the spread of sustainable practices. The adoption of circular economy practices, such as recycling and the reuse of

resources, often depends on the diffusion of innovations through collaborative networks. Burt (2004) points out that well-connected actors in a network can act as intermediaries in the dissemination of new ideas and practices. In an APA, for example, tourism companies that adopt green technologies can share their experiences and knowledge with other companies through business networks, promoting the wider adoption of sustainable practices.

The implementation of green technologies in APAs is a sustainable practice that can be greatly facilitated through collaborative networks. Technologies such as solar energy systems, rainwater harvesting and reuse, and environmental monitoring can be disseminated and adopted more effectively when there is a network of committed stakeholders. For example, Yellowstone National Park uses an environmental monitoring system based on sensors that collect real-time data on water and air quality. This information is shared through a collaborative network that includes park managers, researchers and NGOs, allowing for more informed and effective management of natural resources (Benson, 2016).

Network theory is also crucial to understanding collaborative governance in APAs. Provan and Kenis (2008) suggest that the effectiveness of governance in networks depends on the density of connections, the centrality of certain actors and the presence of coordination mechanisms. In PAs, governance councils that include representatives of all stakeholders - such as governments, NGOs, local communities and companies - can facilitate the implementation of circular practices, ensuring that all voices are heard and that decisions are made in an inclusive and consensual manner. This type of collaborative governance promotes transparency, accountability and the legitimacy of management actions, resulting in greater effectiveness of conservation policies.

The active participation of the local community is another essential component that can be amplified through network theory. When local communities are involved in governance and management networks, there is a greater likelihood of acceptance and success of sustainability initiatives. Stronza and Gordillo (2008) argue that the inclusion of local communities improves the effectiveness of management practices and strengthens the economic and social resilience of these communities. Collaborative networks that include training and capacity building for community members can promote the creation of sustainable jobs, such as tour guides, artisans and service providers, ensuring that the benefits of tourism are widely distributed.

Case studies, such as Barra Grande in Bahia, Brazil, exemplify how sustainable and circular practices can be integrated into APAs through network theory. In Barra

Grande, collaboration between local governments, NGOs, tourism companies and communities has been key to promoting sustainability. Effective communication networks have enabled the implementation of recycling and composting programs that involve the local community, transforming waste into valuable resources and promoting agricultural sustainability (Benson, 2016). In addition, the adoption of green technologies, such as solar energy systems and rainwater harvesting, has been facilitated by collaborative networks that share knowledge and resources.

Network theory can also be applied to understand tourist flows and connectivity between different destinations within an APA. Connectivity between

destinations can influence tourist travel patterns, the distribution of economic benefits and the management of environmental impacts. Dredge (2006) shows that connectivity between tourist destinations can be analyzed using network analysis methods, identifying the nodes (destinations) and links (travel routes) that make up the tourist network. This analysis can help develop joint marketing and visitor management strategies that promote sustainability.

Network theory offers a valuable framework for understanding and promoting sustainable and circular practices in PAs. Through the analysis of social networks, collaborative governance and the active participation of local communities, it is possible to facilitate the adoption of sustainable practices, promote the dissemination of innovations and improve the effectiveness of conservation policies. Case studies, such as Barra Grande, illustrate how collaboration between different stakeholders can result in significant environmental, social and economic benefits. By aligning sustainable practices with network theory, it is possible to create a more resilient and sustainable system, guaranteeing the preservation of natural resources and the well-being of local communities.

5.2 Collaboration Between Stakeholders

Collaboration between stakeholders is essential for implementing sustainable and circular practices in APAs. Collaborative governance, the active participation of the local

community and the analysis of case studies, such as Barra Grande, illustrate the importance and benefits of this approach.

Collaborative governance is a management model that involves active participation and cooperation between various stakeholders, including governments, non-governmental organizations (NGOs), private companies, and local communities. This model is particularly effective in contexts where natural resource management and environmental conservation are priorities.

Local community participation is an essential component of collaborative governance. When local communities are involved in the planning and management of APAs, they are more likely to accept and cooperate with conservation initiatives. Stronza and Gordillo (2008) point out that the inclusion of local communities strengthens economic and social resilience, improving the effectiveness of management practices and promoting a sense of ownership and responsibility. Community participation can be facilitated through capacity-building programs, which train community members to become tour guides, artisans and tourism service providers. These programs create jobs and encourage sustainable economic development and also ensure that the benefits of tourism are widely distributed among community members.

Case studies, such as Barra Grande in Bahia, Brazil, exemplify the importance of collaboration between stakeholders for the implementation of sustainable and circular practices in tourism. Barra Grande is a biodiverse and culturally significant area that has faced significant challenges due to the growth of tourism. However, collaboration between local governments, NGOs, tourism companies and local communities has been key to promoting sustainability in the region. One of the main projects in Barra Grande involves the implementation of waste management practices, where the local community is encouraged to separate

and recycle solid waste, turning it into valuable resources. This project reduces the amount of waste sent to landfills and generates compost that can be used in local agriculture, promoting agricultural sustainability (Benson, 2016).

In addition, the adoption of green technologies has been a priority in Barra Grande. Many eco-lodges and pousadas in the region use solar panels to generate energy, rainwater harvesting systems to reduce drinking water consumption and wastewater treatment technologies for reuse in irrigation. These initiatives reduce the ecological footprint of tourism operations and serve as examples of best practice for other areas (Lew et al., 2016).

Environmental education and tourist awareness are other areas where collaboration between stakeholders has shown positive results in Barra Grande. Educational programs, which include interpretive trails and workshops on sustainable practices, are offered to visitors, raising awareness about the importance of conservation and promoting responsible behavior. Ballantyne and Packer (2011) suggest that meaningful educational experiences can positively influence tourists' attitudes, encouraging a lasting commitment to sustainability.

Collaborative governance also manifests itself in the form of councils and committees that include representatives of all stakeholders. These governance bodies facilitate communication, joint decision-making and the coordination of conservation efforts. In Barra Grande, the local Sustainable Development Council brings together government representatives, NGOs, tourism entrepreneurs and community members to discuss and implement sustainability strategies. This council has been instrumental in promoting sustainable practices and resolving conflicts of interest, ensuring that all parties have a voice in the management process (Borrini- Feyerabend et al., 2013).

Collaboration between stakeholders in Barra Grande has also promoted research and data collection to inform sustainable management. Partnerships between universities, research institutes and local organizations have enabled studies to be carried out on biodiversity, the use of natural resources and the impacts of tourism in the region. This data is essential for making informed decisions and adapting management practices to local conditions and conservation needs.

Collaboration between stakeholders, through collaborative governance and the active participation of the local community, is crucial for implementing sustainable and

circular practices in APAs. Case studies such as Barra Grande show that this approach can promote environmental sustainability, economic development and social inclusion. The integration of green technologies, efficient waste management and environmental education are key components of these strategies, which depend on the cooperation and commitment of all the stakeholders involved. The continuity and success of these practices depend on inclusive and participatory governance, which values diversity of perspectives and knowledge, and which promotes conservation and sustainable development in balanced and effective way

6 CONCLUSION

This study explored the intersection between sustainable tourism and the circular economy in APAs, highlighting the importance of sustainable practices for

environmental preservation and economic development. Through a detailed analysis, we identified that the adoption of green technologies, the implementation of recycling and resource reuse programs, and the promotion of collaborative governance are essential to promote sustainability in APAs. Practical examples, such as the Soneva Fushi Resort in the Maldives and Yellowstone National Park, demonstrated how these practices can be effectively implemented. In addition, case studies such as Barra Grande in Bahia, Brazil, illustrate the positive impact of collaboration between stakeholders on the sustainable management of natural resources.

The central research question of this study was: "How can the implementation of circular economy practices promote the environmental and economic sustainability of tourism in Environmental Protection Areas?" Our findings confirm that the circular economy offers a framework for transforming tourism practices, promoting the reuse of resources, minimizing waste and encouraging the adoption of green technologies. We achieved the article's objectives by demonstrating that integrating these practices into APAs results in significant benefits, such as reducing the ecological footprint, conserving natural resources and strengthening local economies. The analysis of stakeholder

networks revealed the importance of collaborative governance and the active participation of the local community in the effective implementation of these practices.

This study contributes to the literature by providing an in-depth understanding of how the circular economy can be applied to sustainable tourism in APAs. By combining network theory with circular economy practices, we offer a new perspective on the sustainable management of tourist destinations. This approach reinforces the importance of collaboration between different stakeholders and highlights the need for public policies that encourage the adoption of sustainable practices. For practice, this study offers clear guidelines for implementing green technologies, recycling programs and collaborative governance strategies, providing a replicable model for other regions and tourist destinations.

To effectively implement circular economy practices in APAs, we recommend the following actions: Invest in renewable energy systems, such as solar panels and wind turbines, and wastewater treatment technologies to promote water sustainability; Implement waste management systems that include recycling and composting, turning waste into valuable resources; Establish governance councils that include representatives from governments, NGOs, tourism companies and local communities to ensure inclusive participation and informed decision-making; Develop educational programs for tourists and local communities, raising awareness about the importance of sustainability and encouraging responsible behavior; Create public policies and tax incentives that encourage the adoption of sustainable practices and offer financial support for circular economy initiatives.

Despite the significant contributions, this study has some limitations. Firstly, the research was based on a literature review and analysis of specific case studies, which may limit the generalizability of the findings to other regions or contexts. In addition, the practical implementation of the recommendations may vary depending on local conditions, available resources and stakeholder involvement. Future research could include empirical and comparative studies in different APAs to validate and expand the findings of this study.

Several areas of future research are suggested to deepen the understanding of the application of the circular economy in sustainable tourism: conduct field research in different APAs to collect empirical data on the effectiveness of circular economy and sustainability practices, compare the implementation and results of sustainable practices in APAs from different countries to identify best practices and common challenges, Investigate the long-term economic and social impacts of adopting circular economy practices in tourism, explore the use of emerging technologies, such as the Internet of Things (IoT) and artificial intelligence (AI), to improve environmental management and monitoring in APAs, analyze different models of collaborative governance and their effectiveness in implementing sustainable practices, offering insights into the best governance structure for different contexts.

This study provides a perspective for understanding and implementing sustainable and circular practices in tourism in APAs. The combination of network theory and the circular economy offers an innovative and effective approach to promoting sustainability, protecting natural resources and benefiting local communities. The recommendations provided and areas suggested for future research highlight the continued importance of collaboration, innovation and adaptation to achieve truly sustainable tourism.

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