Exploring the Coral Paradises: Sustainable tourism in Lakshadweep

Deepali Garg[1*] , SK Naznin[2] , Ritik Sharma[3]

Chandigarh University, Mohali, India

*Corresponding author: Deepaligarg6109@gmail.com

Abstract. Lakshadweep, an archipelago of 36 coral islands in the Arabian Sea, is renowned for its pristine marine ecosystems and vibrant coral reefs. As a growing tourist destination, sustainable tourism practices are crucial to preserving its delicate environment while fostering economic development for local communities. This paper explores the balance between conservation and tourism, emphasizing eco-friendly policies, community engagement, and responsible travel practices. It also highlights challenges such as coral bleaching, habitat degradation, and waste management, while presenting sustainable solutions to ensure long-term ecological and cultural preservation.

Keywords: Sustainable tourism, Coral reef conservation, Ecotourism, Marine biodiversity, Lakshadweep, Environmental impact

1. Introduction

Coastal zones are of paramount importance for both ecological and economic sustainability, providing a myriad of resources and ecosystem services. These areas necessitate a careful equilibrium between environmental preservation and economic development to ensure the well-being of both the environment and human population. The concept of blue economy (BE) emerges as a critical framework within this context, advocating for the responsible use of marine resources to foster economic growth while conserving ecosystems. This is particularly relevant for island ecosystems, such as India's Lakshadweep Islands, where integrating BE principles can significantly contribute to achieving the United Nations Sustainable Development Goals by protecting marine environments and their dependent communities. The Lakshadweep Islands, situated in the Arabian Sea off India's southwest coast, provide a unique opportunity to synergize BE and the tourism sector. These Islands, renowned for their ecological significance and cultural diversity, make the promotion of responsible tourism essential for sustaining local communities. By adopting sustainable practices, the Lakshadweep Islands can preserve their natural and cultural heritage for future generations, thereby contributing to economic growth and aligning with the global sustainable tourism trends . However, these Islands face unique challenges, including limited land availability, vulnerability to climate change and finite resources. These challenges necessitate the establishment of a sustainable BE for the enduring welfare of island communities. The interplay between BE and tourism is particularly notable in small oceanic islands, where both sectors aim to harness ocean and coastal resources for economic development through sustainable practices. Recreational tourism, being a primary income source in these Islands, stands to benefit significantly from adherence to BE principles . The effective integration of these principles in management and development strategies is vital for addressing the Islands' specific needs, contributing to sustainable development, and ensuring long-term well-being. Acknowledging environmental and socio-economic stressors in planning is crucial, and the adoption of BE concepts offers tangible benefits to local communities and the natural environment, enhancing resilience and creating economic opportunities, this study, therefore, explores the integration of sustainable tourism within the BE framework in the Lakshadweep Islands, focusing on balancing economic growth with environmental conservation and community welfare.

https://doi.org/10.52202/081568-0019

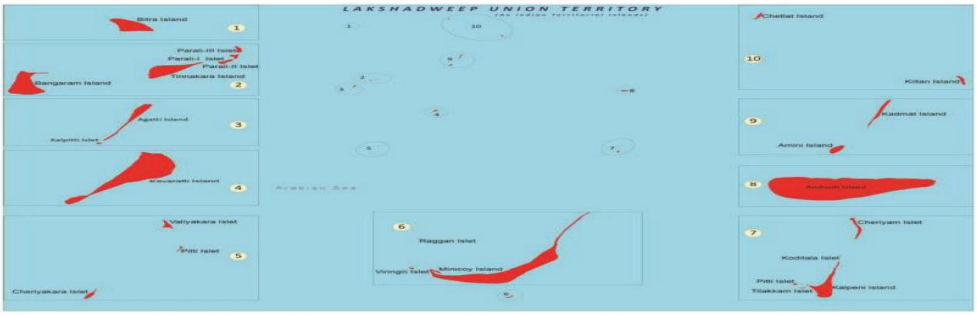

Fig. 1. Map of the Lakshadweep group of islands, India

The Lakshadweep archipelago, positioned and is India's smallest Union Territory, presenting unique ecological and socio-economic dynamics. The methodology adopted in this study involved a comprehensive assessment of the tourism capacity of these Islands, encompassing spatial analysis and ecological considerations. During 2016–17, a detailed survey was carried out across nine inhabited islands, using geo-referenced maps at the block, sub-block and plot levels to accurately calculate the area available for tourism development (Supplementary Figure 1), following the National Building Code of India 2016 and The Architects' Handbook . This approach allowed precise estimation of bed capacity and built-up area, considering floor area ratio (FAR) recommendations and excluding no-development zones (NDZs). The determination of boating density in the Lakshadweep lagoon utilized a weighted score analysis, incorporating a scoring matrix with 11 lagoon characteristics . The methodology factored in spatial requirements for different boat types and their respective restrictive scores to compute optimal boating density, recommending a density of 20 acres per motorboat and lesser densities for smaller boats 10.[11] (Supplementary Figure 2 and Table 3). The Supplementary material provides a detailed methodology elucidating the boating density calculated for the lagoon. The carrying capacity of the lagoon for boat numbers was assessed by applying this optimal boating density across the entire lagoon area, crafting three distinct scenarios based on ecological parameters and specific island lagoon areas. This included maximum (Supplementary Figure 3 and Table 4), optimum (Supplementary Figure 4 and Table 5) and sustainable (Supplementary Figure 5 and Table 6) models tailored with the ecological context of the respective islands. Ecologically Sensitive Areas (ESAs) such as seagrass, corals and fish breeding sites were included in the analysis, as well as diverse geomorphological features such as sand sheets, reef crests, reef slopes, deeper reef flats, reef flats and sandy reef flats. The lagoon features, viz. Deep intermediate and shallow lagoons were also included in the evaluation (Supplementary material). For solid waste and sewage assessment, guidelines from the Central Pollution Control Board, Government of India and Urban and Regional Development Plans Formulation and Implementation guidelines were developed by the Ministry of Urban Development. A marine litter survey, adhering to Oslo and Paris Conventions (OSPAR) guidelines, was conducted on select islands to categorize and quantify marine litter, employing the clean coast index (CCI) for assessing the cleanliness level of the coast. The limit of acceptable change (LAC) for Lakshadweep Islands was determined using key indicators like coral reef health and water quality, following established methodologies. This comprehensive methodological approach enabled a nuanced understanding of the tourism potential and environmental constraints of the Lakshadweep Islands, offering a model for sustainable tourism development within the framework of BE.

The oceans and seas are the most dominant and significant features on this planet, covering over 71 % of its surface. This environmental component, with its vast expanse and sheer volume, is of immense importance to mankind, and serves as the economic lifeline for coastal communities, fish workers and those who sail in its water. Also, the seas and oceans play a pivotal role in shaping the world climate, maintaining the water cycle and biogeo-chemical cycling of elements. It contains a great variety of flora and fauna from its upper sunlit zone to the depths. But except for hotspots like coastal wetlands, mangroves and coral reefs, little is known about the biological diversity, abundance and distribution of marine organisms or the structure and function of the marine ecosystem in its totality (USNRC 1992). Marine species that face the greatest risks of extinction

https://doi.org/10.52202/081568-0019

include corals, sponges, oysters, octopus, porpoises, whales, ornamental fishes, sea turtles and dugongs. The Lakshadweep Islands of India being oceanic in nature harbour important marine flora and fauna in the seas around it. An overview of some of the marine flora/fauna, their status, distribution, threats, sustainable uses and conservation needs in Lakshadweep archipelago are discussed here.

The economy of Lakshadweep is influenced by limitations of its geography. Though there are no per capita indicators specific to the islands available, about 45% of the population have been identified as living below the poverty line, that is, living on less than US$1 a day (World Bank, 2000). More than 4000 families receive various kinds of assistance under the rural development and poverty alleviation schemes of the Central Government. A primitive economy in many respects, coconut farming is the major source of income. The annual yield of coconuts is approximately 28 million nuts, which are processed to make copra and sold to coconut-oil mills on the mainland. However, the recent economic liberalisation and removal of import restrictions have led to a glut of cheaper oil from abroad, and have brought down the price of coconuts drastically (from an average of eight to two rupees per coconut), leaving the sector in a major crisis. Other crops include banana and a few vegetables grown in coconut plantations. Obviously, fishing is another major economic activity.There are 496 mechanised fishing boats and 500 country crafts operating in different islands. Annual fish catch in 2000 was 10,800 tons, generating a total income of Rs 220 million. About 6200 islanders are engaged in fishing as workers and small entrepreneurs. In the early 1990s, the Central Government allowed multinational trawlers entry into the Indian seas, and this resulted in a virtual desertification of the sea, leaving the fishing industry in the country, especially in the islands, in total turmoil.

The islands have been declared a ‘no-industry’ area by the Central Government, in that large-scale industrial development is neither feasible nor allowed. The geographical and environmental limitations allow only a limited number of small- and medium-scale industries on the islands. Industrial activities on the islands are mainly small-scale, and based on coconut products and fisheries. Coconut husk provides the basic raw material for a number of factories, and there are altogether 22 units manufacturing various coir-based products under the public sector, employing more than 316 islanders. There are also a number of small coir units functioning in the private sector in different islands, 63 of them set up with governmental subsidy. Two coir spinners’ cooperative societies set up by the Government help the self-employed and small units to market their products. The workforce in coir processing units consists mainly of women, the majority of whom work part time. Boat building was once an important occupation, but with the advent of motorized boats it is in decline. Only two Island Tourism and Sustainability 431 boat-building yards remain, and these along with 11 workshops in various islands take care of repairs and servicing of the fishing vessels. The canning factory in Minicoy island processes fish, especially tuna, which is available around the islands. Making handicraft products using sea-shells, coconut-shells and wood is another important occupation on the island (George, 1997). Other industrial units on the islands include a hosiery factory in the Kalpeni, a desiccated coconut powder unit in Kadmat, and a smoked fish and fish meal unit in Agatti. Coral mining, which used to be a major industry, is now banned. The islanders are also famous for their sailing skills and a large number of them, especially from the Minicoy islands, work as seamen all over the world. Except for the self-employment units and micro-enterprises in the private sector, most of the industries are in the public sector. Considering the lack of economic development in the islands, as evident from large numbers of people under the poverty line, it is not surprising that the public sector has been at the forefront in initiating industrial development activities. Moreover, the land reforms introduced in the 1970s fragmented larger land holdings, inhibiting wealth accumulation and entrepreneurial activities in the islands.

The nuanced interrelation between sustainable tourism and environmental conservation has become a cardinal focus in contemporary research, driven by the escalating need to harmonize the economic benefits of tourism with ecological preservation. Within this context, the concept of “carrying capacity” emerges as a pivotal

https://doi.org/10.52202/081568-0019

construct, explicating the optimum number of visitors that a tourist site can accommodate without inflicting irreversible damage on the ecological, social, and economic environments. This study situates itself within the multifaceted realms of sustainable tourism development in Kazakhstan, particularly focusing on the ecosystems of Katon-Karagay National Park (KKNP).
The importance of this research is underscored by the burgeoning tourism sector in Kazakhstan, particularly the sector of ecotourism and agritourism, which have been identified as significant contributors to regional sustainability, income, and cultural enrichment in the country. The meticulous exploration of carrying capacity in these diverse tourism sectors provides profound insights into the sustainable management and development of these sectors, ensuring the balance between visitor satisfaction, environmental conservation, and economic imperatives.

2. Review of Literature:

Lakshadweep, an attractive archipelago in the Arabian Sea, is increasingly noted as a promising tourist destination with its pristine beaches, diverse marine life, and rich cultural heritage. Over the past five decades, the islands have witnessed significant progress in institutionalizing tourism, driven by policy reforms and strategic planning initiatives. The initial serendipitous tourism developmental encounters have steered Lakshadweep towards adopting tourism as a stimulant for its development. However, as tourism continues to expand on the islands, it is crucial to priorities the local community's well-being and the region's ecological integrity. While the local community aspires to be the custodian of the destination's natural and cultural assets, the emphasis is now on the administration to change its centralized orientation and facilitate sustainable development based on a collaborative model. Looking ahead, the future of tourism in Lakshadweep hinges on adopting a destination stewardship model that fosters stakeholder collaboration and ensures tourism development aligns with the islands' cherished traditions and values.

Tourism in Lakshadweep is managed by the Society for Promotion of Nature Tourism and Sports (SPORTS), a society formed by the Lakshadweep Administration in 1982 with the avowed aim of tapping the tourism potential of the islands and acting as the nodal agency of the Lakshadweep Administration for the promotion of tourism in the islands. The primary aim of the organization is to promote eco-friendly tourism and recreational activities in the islands in association with and under the guidance of the Lakshadweep Administration (Society for Promotion of Nature Tourism and Sports Lakshadweep Tourism).

It is now generally acknowledged that coral reefs are among the most threatened global ecosystems, and among the most vital (Costanza et al. 1997; Bryant et al. 1998; Boesch et al. 2000; Reaser et al. 2000; Wilkinson 2000). Reefs are of critical importance to human survival (especially in developing countries) because they provide subsistence food for a substantial portion of the population, serve as the principle coastal protection structures for most tropical islands, and contribute major income and foreign exchange earnings from tourism (Costanza et al. 1997; Wells et al. 2001; Salm et al. 2001). The value of living resources (such as fisheries) and services (such as tourism returns and coastal protection) provided by reefs has been estimated at about $375 billion annually (Costanza et al. 1997). In addition, coral reefs provide habitat for some of the greatest biological diversity in the world (Ray 1988). In addition ,Controlled, sustainability-focused tourism models have been studied in Lakshadweep (Kokkranikal et al., 2003) .Carlsen and Butler (2011) highlighted the need for development patterns that preserve fragile atolls. Munjal and Baruah (2024) outline economic data emphasizing tourism's role in GDP and employment. Modi (2024) proposes eco-tourism practices—codes of conduct, waste management, community involvement—rooted in local culture and global best practices

https://doi.org/10.52202/081568-0019

T w e n t y -f iv e y e a r s a g o scientists believed that the ca. 1.6 million species they had then inventoried represented maybe 50% of plant and animal species on this planet. N ew approaches in sampling insect diversity in rainforests and small m acrobenthos in the deep sea have revised this estimate to 1.7-1.8 million described species and 10-100 million species remaining to be discovered. In parallel w ith this changed paradigm, species inventorying has also evolved from being categorized as an outdated scientific activity to a timely cutting edge megascience “enterprise”. The reason behind this change of attitude is probably rooted in our social anxiety over global climatic change and non sustainable development. The crude translation of this anxiety into science strategy is that there is no time to lose if we w ant to document and name biodiversity before it is lost forever

The Maldive Islands or 'Maldives' form the central and largest emergent part of the Laccadive Chagos Ridge which extends southwards from west of southern India to near the centre of the Indian Ocean, and consists entirely of atolls and associated coral structures. During at least the last two centuries, coral rock has been used in the Maldives for building and other construction. Prior to the 20th century, building in coral rock was limited to mosques, shrines, and tombstones; but the use of coral has increased over the past 80 years, so that it is now the main construction material on the capital island of Male and on tourist resort islands. In addition, coral rock is in demand for use as hardcore in road construction. It is predicted that, over the next two years, some 43,000 cubic metres of coral rock will have to be mined from existing reefs to meet the demand for 'aggregate' to surface roads in the capital of Male alone. The Government of the Maldives, aware of the conflict between the use of corals for building and their conservation for such purposes as maintenance of fishery resources, a rapidly expanding tourist industry, and land stability, are actively seeking alternative construction materials. This paper describes the environmental impact of mining activities on coral reefs around North Male Atoll and also discusses the possible alternative mining and construction techniques that are available for future use, given the need to conserve and protect existing reefs from further destruction.

The Saint Martin Island is one of the most beautiful islands in Bangladesh. This island is locally known as Narikel Jinjira (Coconut Island). It is located in the Bay of Bengal, approximately 9 km south of the Cox’s Bazar-Teknaf peninsula. This island is very much resourceful with enormous biological diversity i.e. mollusk-300 species, fish -150 species, amphibian-5 species, coral-66 species, turtle-5 species, snail5 species, bird-200 species, mammals-20 species. The surface area of the island is about 8 km2 , however, it may vary depending on the tidal level. This is the most attractive tourist spot in Bangladesh. At present, unplanned tourism makes this island fragile. Around 3000 tourists arrive every day in tourism season (November - March). Following the recommendation of the National Conservation Society, the small Saint Martin Island was declared as an Ecologically Critical Area under the Bangladesh Environment Conservation Act. Mahmood et al. gave a preliminary study of corals of the Saint Martin Island. Tomas Tomascik made several studies on the coral reefs describing the different types of coral species, their abundance and the condition of the corals. Chowdhury et al. have surveyed the coastal geomorphology of the Island. Ahmed et al. made an overview on the coral reef ecosystem of Bangladesh and made a detailed analysis of the coral resources in the Island. Khan et al. noticed that Saint Martin’s coral resources were started to vanish at that time. However, since no work has been done after 1997, a systematic study was needed and that is why the present study was carried out.

3. Objectives:

1. To assess the impact of tourism on Lakshadweep’s marine and coastal ecosystems.
2. To analyze the socio-economic benefits of sustainable tourism for local communities.
3. To evaluate existing sustainable tourism practices in Lakshadweep
4. To identify challenges in maintaining ecological balance while promoting tourism.
5. To propose strategies for enhancing sustainable tourism in Lakshadweep.

https://doi.org/10.52202/081568-0019

4. Impacts of Tourism on Coastal and Marine Ecosystems:

Tourism, if not managed, can hurt marine animals and coral reefs. Some of the significant effects are:
Coral Reef Destruction: Tourists trampling corals, boating, and trash pollution have resulted in coral bleaching and damage.Coral Cover Reduction: Studies indicate that absolute coral cover in the Lakshadweep islands declined sharply from 51.6% in 1998 to 11% in 2017

Bleaching Events: As of May 2024, more than 70.7% of coral reefs worldwide have been impacted by bleaching-level heat stress since January 1, 2023, with Lakshadweep being one of the worst-affected regions on India's coastline. Water Pollution: Increased disposal of waste, including plastic, impacts marine animals.

A study published in the Environmental Science and Pollution Research International journal found microplastics in the surface waters and gastrointestinal tracts of skipjack tuna around the Lakshadweep Islands, indicating pollution levels in the marine environment. The annual fisheries yield of Lakshadweep is approximately 9,000 tonnes, with tunas constituting about 7,000. The National Disaster Management Authority (NDMA) identifies factors such as natural disasters (storm surges, cyclones, tsunamis, and flooding) and human influences (construction of seawalls, groins, and jetties) as contributors to coastal erosion in Lakshadweep.

4.1 The socio-economic benefits of sustainable tourism:

Despite the environmental concerns, tourism is a major contributor to the economy of Lakshadweep.

The benefits are:

Local Employment:

Tourism provides job opportunities in hotels, travel agencies, restaurants, and transport services. Tourism is a major stimulator of economic development in Lakshadweep. The visit of tourists raises the demand for local goods andservices, thus stimulating local entrepreneurship and businesses. Promotion of Local Culture: Sustainable tourism encourages the tourists to experience local culture, arts, and food, hence perpetuating the culture. By promoting local tradition and culture, sustainable tourism promotes the preservation of the Lakshadweep islands' distinct heritage.

Awareness & Education:

The tourists receive information on marine conservation, which increases awareness on preserving nature. Sustainable tourism emphasizes the preservation of natural resources.

In Lakshadweep, this strategy enables the preservation of virgin beaches, coral reefs, and marine life, all of which are crucial to the environment and are sought after by environmentally conscious tourists. Adding the participation of local communities in tourism planning and management gives them a say in development projects so that tourism development is in their aspirations and interests.

Existing Sustainable Tourism Activities:

Lakshweep has established various environmentally friendly tourism procedures in order to preserve its fragile ecosystem, in addition to supporting responsible tourism. They include: Blue Flag Certification:

https://doi.org/10.52202/081568-0019

Kadmat Beach and Minicoy Thundi Beach received the Blue Flag, an exclusive international eco- label that certifies high environmental and qualitstandards. Blue Flag status ensures that the beaches fulfill 33 stringent FEE standards for ensuring sustainability in the form of environmental protection and education.

Restricted Tourism Policy:

To safeguard its fragile ecosystem, Lakshadweep has a policy of closed areas that limit tourist access to certain of its islands. By doing so, it prevents over-tourism, allowing genuine visitors to witness the region's beauty while keeping environmental degradation low

Sustainable Development and Community Engagement:

The vision is to develop Lakshadweep into a responsible and inclusive example of development. Strategies focus on utilizing natural beauty to develop the tourism industry, fostering economic resilience, and encouraging people's pride and well-being. Conservation Reserves: Lakshadweep has launched the PM Sayeed Marine Birds Conservation Reserve in 2020,India's first marine bird conservation area. Spread over 62 km^2, it is the breeding ground of Greater Crested Tern and Sooty Tern, which shows how vital it is to preserve biodiversity in the region. These programs reflect Lakshadweep's commitment to the integration of environmental protection with ecotourism so that its distinctive marine and coastal ecosystems are preserved for future generations. The information on the socio-economic advantages of sustainable tourism in Lakshadweep comes from a series of studies, reports, and expert opinions on the effects of sustainable tourism. The following presents some key sources:

5. Challenges in Maintaining Ecological Balance:

The ecological equilibrium of Lakshadweep is challenged by various naturaland manmade challenges. These challenges include:

1. Marine litter and plastics pollution: Marine debris, especially plastic debris, is of significant threat to Lakshadweep'scoraland marine environment. The pollution is of adverse effect on the marine plants and ani mals and lowers the islands' aesthetic appeal, thus affecting biodiversity and the tourism industry too.

2. Climate Change and Coral Bleaching: Increased sea temperatures cause more frequent cases of coral bleaching. Warm and acidic water destroys the limestone structure created by the coral, which may cause the death of the marine organisms inhabiting these reefs.

3. Sensitive Freshwater Resources: Lakshadweep's freshwater aquifers are sensitive and already strained due to climate change, pollution, and rising demand. Ambitious tourism plans will worsen freshwater shortages, testing human use and environmental sustainability.

4. Overpopulation and Spatial Planning

5. Sewage and Agricultural Runoff: Sewage contamination, coupled with the application of detergents, pesticides,and fertilizers, causes eutrophication in lagoons.

6. Human-Induced Strain on Uninhabited Islands: The growth of human populations and increased demands for land have led to the use of uninhabited islands, thereby disrupting avian habitats and other types of wildlife. Overcoming these issues needs conservation efforts integrated, sustainable tourism, and community participation to achieve the long-term ecological stability of Lakshadweep.

https://doi.org/10.52202/081568-0019

6. Strategies for Enhancing Sustainable Tourism:

Enhancing sustainable tourism in Lakshadweep involves implementing strategies that balance economic development with environmental conservation and community well-being. Key strategies include

1. Infrastructure Development: Improving transport and communication infrastructure is crucial for the attraction of tourists and sustainable development. The modernization of airports, seaports, and the internet increases the tourist experience as well as the local population.

2. Community Involvement: Local community participation in planning and executing tourism activities guarantees that development is aligned with their needs while maintaining cultural heritage. Empowering the community reinforces environmental stewardship and enhances the value of authenticity in the tourism experience.

3. Environmental Conservation Schemes: The implementation of measures aimed at reducing marine litter and promoting waste minimization is critical to the conservation of marine ecosystems. Measures like the Prevention of Marine Litter in the Lakshadweep Sea (PROMISE) aim to enhance the attraction of tourist spots while, in the process, protecting the environment.

4. Sustainable Development Planning: Creating tourism plans with focus on sustainable progress, conservation of culture, and a higher standard of living for the islanders is crucial. Providing Lakshadweep as an example of sustainable development harmonizes economic progress and the conservation of nature.

5. Premium, Limited-Scale Tourism: Focusing on premium, limited-scale tourism has the potential to minimize environmental impacts while maximizing economic benefits. This approach ensures that the growth of tourism does
not strain the island ecosystems.Placing these into action can make Lakshadweep's tourism sustainable and ena ble economic progress to be compatible with environmental preservation and community well-being.

7. Major Findings of the Case Study:

7.1 Modern Approaches to Sustainable Tourism

Blue Flag Certification: Some beaches such as Minicoy Thundi and Kadmat are Blue
Flag certified, ensuring high environmental and safety standards. This promotes eco-tourism and ensures beach cleanliness and marine biodiversity.

Restrictive tourismpolicies: In Lakshadweep entailthe administration's control over visitor numbers through th e implementation of special permits, thereby mitigating over-tourism and alleviating ecological pressure.

Marine Conservation Reserves: The government has also set apart some marine areas, such as the PM Sayeed Marine Birds Conservation Reserve, for conserving marine biodiversity and managing human influence.

Community-Based Ecotourism: People are directly involved in ecotourism pursuits, such as
guided snorkeling excursions, homestays, and crafts markets, and thus ensuring tourists' revenue gets to the islanders and promoting traditional cultural patterns as well.

7.2. Difficulty in Maintaining Ecological Balance

Climate Change and Coral Bleaching:

Rising sea temperatures due to climate change are causing more coral bleaching in Lakshadweep. This endangers marine biodiversity and degrades the natural tourist value of coral reefs.
Freshwater Shortage: The islands lack natural sources of freshwater but rely heavily on rainwater harvesting and desalination plants. Increased tourism could strain the already scarce freshwater resources. Marine debris and marine pollution are both largely affected by plastic pollution and unseemly waste disposal practices, particularly those linked with tourism and fishing. The absence of the right waste management system aggravates the issue further.

https://doi.org/10.52202/081568-0019

Overcrowding and Unplanned Development: As a result of limited space, overcrowding and unplanned development become a threat to the fragile ecosystem, resulting in coastal vegetation loss and habitat loss.

8. Conclusion:

With it clear coastlines, lively coral reefs, and abundant marine life, Lakshadweep could be a model place for sustainable traveling. Its delicate ecosystem, however, needs astute handling to see that development of tourism does not come at the expense of environmental destruction. Even if not well handled, tourism might result in major environmental damage; it can destroy a local culture as much as preserve it; it also helps the economy greatly by creating jobs, better infrastructure, and preserved property. The islands' fragile equilibrium is seriously under threat by their already high level of visitors, poor garbage management, effects of climate change, and growing demands on scarce resources.

Sustainable tourism has been encouraged via projects including marine conservation reserves, limited tourism policies, and environmentally friendly activities such as Blue Flag-certified beaches. Furthermore, being encouraged to get involved in tourism-related events are local communities, therefore guaranteeing they profit from the financial possibilities while still keeping their customs. Still impeding long-term sustainability, however, are problems such as coral reef damage, water pollution and freshwater shortage. Lacking awareness and proper legislation, these problems could spiral out of control and cause permanent destruction to the ecosystems themselves, pulling tourists to Lakshadweep.

A well-rounded strategy is needed to guarantee a sustainable future for Lakshadweep tourism—one that fuses economic development and environmental preservation. Emphasizing high-end, low-impact travel will help to keep visitor numbers in check as well as to optimize economic advantages. Further environmental damage can be avoided by means of investments in sustainable infrastructure like solar-powered resorts and waste management systems. Finally, the islands' biodiversity depends on more rigorous rules concerning marine pollution, overfishing, and haphazard development. Responsible travel policies should be made known to tourists too so their environmental effect is reduced.

In essence, Lakshadweep needs sustainable tourism for its own existence; it is not just a wish. The future of tourism on the island depends on a group of government, indigenous people, conservationists, and tourists. Lakshadweep can keep thriving as a top destination without sacrificing its natural beauty by following a responsible tourism approach that first preserves ecology and then stimulates economic development. If handled properly, this could be a worldwide model of how tourism and preservation can coexist peacefully, therefore guaranteeing that future generations can enjoy its pristine paradise just as we do now.

References

1. Ahammed, S. S., Hossain, M. A., Abedin, M. Z., & Khaleque, M. A. (2016). A study of environmental impacts on the coral resources in the vicinity of the Saint Martin Island, Bangladesh. *International Journal of Scientific & Technology Research*, *5*(1), 37-39.
2. Aktymbayeva, A., Assipova, Z., Moldagaliyeva, A., Nuruly, Y., & Koshim, A. (2020). Impact of small and medium-sized tourism firms on employment in Kazakhstan. *Geo Journal of Tourism and Geosites*, *32*(4), 1238-1243.
3. Tracey, J. B., & Hinkin, T. R. (1994). Transformational leaders in the hospitality industry. *Cornell Hotel and Restaurant Administration Quarterly*, *35*(2), 18-24.
4. Aktymbayeva, A., Nuruly, Y., Aktymbayeva, B., & Aizholova, G. (2017). Analysis of the development of modern agritourism types in West Kazakhstan oblast. *Journal of Environmental Management & Tourism*, *8*(4 (20)), 902-910.
5. Bouchet, P. (2006). The magnitude of marine biodiversity. *The exploration of marine biodiversity: scientific and technological challenges*, 31-62.
6. Brown, B. E., & Dunne, R. P. (1988). The environmental impact of coral mining on coral reefs in the Maldives. *Environmental Conservation*, *15*(2), 159-16
7. Choudhary, A., & Gopalkrishna, M. (2024). Tides of Change: The Story of Lakshadweep Tourism. *Tourism Cases*, (2024), tourism202400076.
8. Costanza, R., d'Arge, R., De Groot, R., Farber, S., Grasso, M., Hannon, B., ... & Van Den Belt, M. (1997). The value of the world's ecosystem services and natural capital. *nature*, *387*(6630), 253-260.
9. Dong, X., Gao, S., Xu, A., Luo, Z., & Hu, B. (2022). Research on tourism carrying capacity and the coupling coordination relationships between its influencing factors: A case study of China. *Sustainability*, *14*(22), 15124.
10. Hoffmann, S. (2022). Challenges and opportunities of area-based conservation in reaching biodiversity and

sustainability goals. *Biodiversity and Conservation*, *31*(2), 325-352.
11. Kokkranikal, J., McLellan, R., & Baum, T. (2003). Island tourism and sustainability: A case study of the Lakshadweep Islands. *Journal of Sustainable Tourism*, *11*(5), 426-447.
12. 1Kuentzel, W. F., & Heberlein, T. A. (2003). More visitors, less crowding: Change and stability of norms over time at the Apostle Islands. *Journal of Leisure Research*, *35*(4), 349-371.
13. 1Robin, R. S., Debasis, T., Hariharan, G., Ramesh, R., & Purvaja, R. (2024). Harnessing the blue economy in Lakshadweep Islands through a sustainable tourism perspective. *Current Science*, *126*(2), 215.
14. Tripathy, B. (2002). Marine biodiversity of Lakshadweep: An overview. *Kachappa*, *7*, 14-19.
15. Wells, S., & Ravilious, C. (2006). *In the front line: shoreline protection and other ecosystem services from mangroves and coral reefs* (No. 24). UNEP/Earthprint.
16. West, J. M., & Salm, R. V. (2003). Resistance and resilience to coral bleaching: implications for coral reef conservation.
17. Kokkranikal, J., McLellan, R., & Baum, T. (2003). Island tourism and sustainability: A case study of the Lakshadweep Islands. *Journal of Sustainable Tourism, 11*(5), 426–447. https://doi.org/10.1080/09669580308667214 Deccan Herald+12Taylor & Francis Online+12ResearchGate+12
18. Carlsen, J., & Butler, R. (Eds.). (2011). Tourism and sustainability in the Lakshadweep Islands. In *Island tourism: sustainable perspectives* (Ecotourism Series No. 8, pp. 1–xx). CABI Publishing.
19. Munjal, P., & Baruah, P. (2024, January 13). *Lakshadweep needs a supply-side focus*. *The Financial Express*. Retrieved from https://www.financialexpress.com NCAER | Quality . Relevance . Impact+1The Financial Express+1
20. Modi, P. (2024, February 19). Lakshadweep: A blueprint for sustainable eco-tourism. *The Financial Express*. Retrieved from https://www.financialexpress.com

https://doi.org/10.52202/081568-0019