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Ashtamudi Lake: Balancing Ecosystem Conservation and Socio-Cultural Heritage

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Abstract

Ashtamudy Lake is one of the most famous backwaters in Kerala. It is situated in the district of Kollam, formerly Quilon, and is one of Kerala's most extensive backwaters. The name 'Ashtamudi' means 'eight branches', and it has got its name because of the eight arms-like branches of the lake. Ashtamudi Lake is one of the famous Ramsar Wetlands of International Importance, an ecological and socio-cultural asset of the area. This research examines the environmental risks that endanger the lake's existence, such as water pollution, loss of biodiversity, unsound human interference, and their effects on the sensitive ecosystem of the lake. The study also highlights the socio-cultural and economic importance of Ashtamudy Lake as a hub for fisher folk's traditional employment, such as fishing, fish curing, and coir making, which are the relevant occupations of the area's inhabitants. The study highlighted the importance of adopting sustainable practices, implementing policies for the development of the Ashtamudi Lake ecosystem and culture, and encouraging people's participation in the conservation of the area. This study highlighted the importance of a sustainable approach in the balance between the protection of the environment and the socio-cultural values of the lake, which will benefit the state's sustainable development in the long run.

Keywords: Pollution, Coir industry, Tourism, Ramsar wetland, Bio-diversity

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Introduction

Geological records show that most of the world's barrier-beach-lagoon systems formed between 5000 and 6000 years ago, during the post-glacial sea level increase. An estuary's history may involve natural and progressive changes. However, in the case of Kerala's backwaters, they are historically significant. Kerala's backwaters are part of the wetland system. Backwaters have significantly impacted the state's socio-economic and cultural history (Gopalan et al., 1983). They are called lakes, lagoons, estuaries, mangroves, and backwaters. They bear the following names, from south to north: Vembanad, Kodungallur, Kadinamkulam, Paravur, Ashtamudi, Kayamkulam, Kavvai, Korappuzha, Valiyangadi, and Valiyapattanam. This network of backwaters along the coast is linked by a vast canal network that eases the flow of people and commodities. Human influence has resulted in significant system alterations, particularly over the last 150 years. The backwaters have been regularly filled for various purposes, including agricultural growth, fish farming techniques, port development, urban development, and other governmental and private demands.

Backwaters in Kerala

Kerala is a picturesque Indian state best known for its backwaters. Backwaters are an essential part of Kerala's landscape; many people visit them yearly. The backwaters of Kerala cover more than 200,000 hectares. The backwaters and navigable canals that connect them have created several rural tourist spots of exceptional beauty. The backwaters of Kerala are the state's most important source of fresh water, and they have created a vast habitat for marine flora and fauna (Narwariya, 2023, p. 359). The Kerala backwaters are in Alappuzha, Kottayam, Kollam, Kozhikode, Kasaragod, and Ernakulam districts. The Kerala backwaters are a network of brackish backwaters and lakes situated parallel to the Arabian Sea in the state.

Ashtamudy Lake

Ashtamudy Lake is located in the Kollam district of southern Kerala and covers an area of approximately 61.4 sq km. The tranquil surroundings and diverse wildlife attract visitors. Ashtamudi is the

second largest estuary in Kerala and the deepest, reaching a maximum depth of 21 feet near the confluence. The Kallada River (the longest river in the Kollam district, which originates in the Kulathupuzha River in the Western Ghats) is the primary source of Ashtamudy Lake water. Its western side opens into the Arabian Sea in Shakthikulangara, contributing to the saline nature of the water. Fish in the Ashtamudy Lake are delicious due to their salinity. Ashtamudi Lake is an ecological treasure and a popular tourist attraction, nominated as a Ramsar Site (No. 1204) in November 2002. The Ashtamudi Wetlands, one of the 42 Ramsar Sites in India of International Importance, are ecologically significant (Lakes of India, 2022). This study examines the environmental challenges faced by Ashtamudi Lake and the severe consequences on its biodiversity. It emphasises how the lake has shaped the livelihoods and traditions of local communities. This study highlights the deep connection between environmental stewardship and cultural preservation, advocating for integrated policies that protect biodiversity while ensuring the well-being of those who rely on the lake. Ashtamudi Lake is one of India's most iconic backwater destinations. This study delves into the rich socio-cultural connections that have cemented the lake as a central part of Kollam's history and identity.

A boat ride on Ashtamudi Lake, which borders the city, has been a unique and captivating experience for a long time. The lake has been of great significance to Kollam's international trade and social interaction, with the eight-branched river the lifeblood of the city and the cultural and historical hall of the region. The lake and the city have been depicted in many message poems, and Kollam is described as a place with a majestic and flowing lake. History also proves that Ashtamudi is a natural splendour and a cultural and historical landmark of Kollam. This lake is unique in that it is surrounded on three sides by backwaters, and on the fourth side, it is well-connected by land and water, which are means of transport, thus providing visitors with an enchanting sightseeing experience as they sail through the lake. One of the unique experiences that one can enjoy while travelling to Ashtamudi by water is the natural environment, which is very beautiful and serene. The Ashtamudi estuary supports fish, prawns, crabs, clams, etc. Among the species reported to be available in the commercial fishery of the Ashtamudi region, there are 57 fish species, six shrimp species, one prawn

species, five crab species, and six bivalve species (Kurup & Thomas, 2001). This category comprises marine migrants, residents, and true estuarine species (Ashtamudi Estuary: An Integrated Management Plan, 2017:61).

Significance of the Study

Ashtamudi Lake is not just a natural wonder but also a lifeline for the populations that live in and around Kollam. This study is notable for several reasons, including its focus on critical environmental, social, cultural, and economic sustainability areas. Ashtamudi Lake is important in supporting biodiversity and climate control, and is a water source for aquatic life forms. It is important to comprehend ecological issues to work on ways to prevent pollution, rehabilitate affected areas, and preserve natural phenomena. The lake is inextricably linked with local inhabitants' customs, livelihoods, and daily lives. Traditional methods like clam fishing, coir production, and toddy tapping are valuable cultural treasures demonstrating how to cohabitate with nature sustainably. This study highlights the importance of maintaining these routines.

This study emphasises the importance of maintaining traditional traditions while minimising environmental threats. Ashtamudi Lake supports livelihoods through fishing, tourism, and small-scale industries. Emphasising its economic contributions and the hazards posed by environmental deterioration offers the groundwork for achieving a balance between economic development and conservation. This study underlines the value of integrated approaches to sustainable development by bridging the gap between environmental conservation and socio-cultural preservation. Its goal is to encourage local, national, and international action to preserve Ashtamudi Lake for future generations. Ashtamudi Lake is a designated Ramsar site and a major tourist attraction. The State Government is interested in boosting tourism around Ashtamudi Lake, which, while increasing employment opportunities, also subjects the Lake to increased anthropogenic pressures. Further, fresh efforts at promoting tourism need to factor in the region's ecological balance.

Rich biodiversity

Ashtamudi Lake is a paradise for wildlife enthusiasts, boasting a rich and diverse ecosystem. It is home to various fish, amphibians, reptiles, and invertebrates. The surrounding wetlands and mangrove forests further enhance its biodiversity. Birdwatchers can spot avian species, including kingfishers, herons, egrets, and cormorants. The Kallada River, which connects with Ashtamudi Lake, serves as a breeding ground for many fish species, particularly the pearl spot fish, 'Karimeen'. The lake's diverse mangrove and water plant species play a crucial role in supporting its rich biological life.

Ashtamudi Lake: History, Culture, and Heritage

Ashtamudi Lake is one of the oldest tourist destinations of India and holds a significant position in the state's history. Kollam was one of the earliest business places with a harbour and a lake as the most significant economic assets. As part of the historical monuments, several temples and cathedrals are constructed on the lake's shores. The name Ashtamudi, which means eight coned, is given based on the geographical structure of the lake, which is quite important. The external length of this lake is 10 miles, its breadth is 9 miles, and its area is 20 square miles (Nagam Aiya, 1999). This palm-shaped water body, with its distinctive eight arms extending toward Kollam town (Sitaram, 2014), has been designated a Ramsar Wetland of International Importance. Renowned for its biodiversity and commercial significance, the lake serves as a critical habitat for diverse species, supports local economies, and is integral to the socio-cultural identity of the region. However, Ashtamudi Lake faces mounting threats from pollution, urbanisation, unsustainable tourism, and climate change. These challenges disrupt its ecological balance and jeopardise the socioeconomic stability of the communities that have long thrived around it. The resulting environmental degradation endangers traditional lake-based activities such as clam fishing, coir production, and small-scale farming, underscoring the urgent need for conservation and sustainable management efforts.

Ashtamudi Lake was pivotal in shaping Kollam's identity as a historical hub. Many of Ashtamudi's population remains engaged in

traditional livelihoods deeply rooted in the area's cultural heritage. Activities such as coir production, fishing, and other age-old occupations form the backbone of the local economy, sustaining communities while preserving their unique way of life. These are practices that are relevant not only to the existence of the local people but also to defining the cultural and economic potential of Ashtamudi. Kollam has been described in detail by many foreign travellers, especially Ashtamudi, since it is a significant trade and cultural centre. In the present scenario, Kollam continues to be a famous tourist spot, and tourists from across the globe visit the place. As historical chronicles and travellers' writings suggest, Kollam was once a very active hub of trade and expeditions. Even now, one can witness the presence of Chinese trade influence in Chinnakada, Chinawala, which are Chinese fishing nets, and Chinachatti, the frying pans of Chinese origin. They remain as evidence of the long and strong relationship of the region to international sea commerce.

Myth and Legend

The place is closely associated with the mythological story of the Daksha Yajna, a sacred ritual performed by Daksha Prajapati, the father of Sati. In the given story, Daksha offended his daughter Parvati during the wedding ceremony, and she died of shame and anger. Frustrated with her role, Shiva pulled a hair from his head and threw it on the ground. Veerabhadra and Bhadrakali appeared from this act, and the hair was divided into eight parts, forming Ashtamudi Lake. This legend is further strengthened by the fact that the Veerabhadra Temple is close to the Bhadrakali Temple by the side of the lake. Ashtamudi has its own cultural and religious importance, and it is worth noting that the Veerabhadra Temple is the only temple of its kind in South India. This place also enhances the lake area's importance and makes it a culturally significant zone.

According to historical descriptions by Moroccan adventurer Ibn Battuta, Quilon (modern-day Kollam), located on the banks of Ashtamudi Lake, was a significant commercial city in antiquity. Kollam remains an important city in Kerala, serving as the lake's access point. The lake's socio-cultural significance is enhanced by a 1,000-year-old temple and a 200-year-old church on its shores (Lakes of India, 2022). Several notable landmarks surrounding Ashtamudi

Lake's coastal villages reflect its rich historical and cultural heritage. *PalliamThuruthu*, where the Venad kings are believed to have worshipped, is historically significant. *Munrothuruthu* (Munroe Island), named after Lord Munro, the then-Dewan of Travancore, is a testament to colonial influence in the region. Padappakkara, reputed to have served as an anchorage for a warship, adds a layer of military history to the lake's narrative. Meanwhile, *Sambranikodi* (a picturesque island in Ashtamudi Lake), also known as the site of the Chinese "small Chambrani ship," hints at ancient trade links with China, underscoring Ashtamudi Lake's role in facilitating international commerce. It is thought that little Chinese ships anchored here in antiquity. Locals referred to these ships as 'chambrani', and the area became known as Sambranikodi. These sites, steeped in history and legend, contribute to the cultural tapestry of Ashtamudi Lake, solidifying its place as a vital historical and geographical landmark in Kerala.

Bridging Ecosystems and Economies

Ashtamudi Lake is a vital ecological and cultural landmark in the Kollam district. The incredible beauty of Kerala, Ashtamudi Lake, has its name derived from two Malayalam words: Ashta, meaning eight, and mudi, meaning branch. In Kerala, it is the second-largest lake (Kurup, 2024). Ashtamudi Lake is of great importance among Kerala's fourteen major lakes. It is the 2nd-largest Lake in the state, following Vembanad. In Kollam, Ashtamudi Lake is complemented by other prominent water bodies, including Paravoor Lake and Sasthamkotta Lake. Spanning an area of approximately fifty square kilometres, Ashtamudi Lake extends across almost all the panchayats in the Kollam district.

The lake has an inextricable connection to the lives of the people in the coastal villages, profoundly influencing their traditions, livelihoods, and culture. Its fame is such that it is widely known, and its significance is celebrated throughout the region. According to historians, Kollam once hosted a thriving port on the banks of Ashtamudi Lake. Evidence suggests that numerous commercial and sailing ships navigated the lake, highlighting its importance as a hub for trade and maritime activity.

Industrial Resources

The Ashtamudi region is rich in natural resources, such as rare earth elements, clay deposits, and other raw materials, which have fuelled industrial development. Its proximity to Kollam City and well-established linkages to highways, canals, and fishing port facilities have expedited industrial growth. However, releasing industrial effluents into Ashtamudi Lake has led to significant ecological problems. Several key industries contribute to this issue. Kundara Ceramics, which specialises in clay-based ceramics, disposes waste into the lake, affecting sediment quality and aquatic life. Kerala Metals and Minerals Ltd and Indian Rare Earths Ltd., both mineral extraction companies, contribute to heavy metal contamination, which can bioaccumulate in the environment. The Kerala State Cashew Development Corporation Ltd, noted for its large-scale cashew processing operations, and Aluminium Industries Kundara contribute to water quality degradation through untreated or partially treated effluents (Sitaram, 2014).

Coir Industry

The Ashtamudi region is also known for its traditional coir industry. Visitors can explore coir manufacturing units and witness the intricate process of converting coconut husk fibres into coir products such as mats, ropes, and baskets. These traditional crafts are an important part of the local culture and economy. Ashtamudi is known for its coir processing and manufacturing units, which are integral to Kerala's socio-economic fabric. This bustling coastal town is famous for the coir industry, which has existed for many years. Kollam is also known as the "Coir Capital of Kerala" because this region is famous for coir processing and exportation. The lake's surroundings are covered with numerous coconut trees that grow along the lake's coast; the coconut husks are used to obtain coir. Culturally, the old-age practices in coir extraction and weaving are still used today, thus maintaining the region's culture.

The process of coir production in Ashtamudi is exciting. Female employees mainly dominate this industry. It involves using coconut husks, which are collected and preserved by soaking them in the waters of Ashtamudi Lake, which helps extract coir fibres. Water quality is another important factor that makes the lake suitable for

producing the fibres. After that, the husks are beaten and combed to obtain long and strong fibres used to produce ropes. This has been a very labour-intensive industry, requiring highly skilled craftsmen's services. The fibres are then spun into coir yarn using the conventional spinning wheels. It is used to make mats, carpets, and many other usable products, which may have different beautiful designs and patterns. Even though it is a mini-industry in the local setting, it can employ hundreds of people, most of whom are women. The coir industry is an exhibition of its fine cultural and commercial connection with the culture of Kerala and the Ashtamudi Lake.

Fishing and Fish Processing

Fish from Ashtamudi Lake are very much preferred in international markets due to their taste and flavour. The fishery of Ashtamudi Lake was declared the first Marine Stewardship Council-certified fishery in India in 2016 by the former Union Minister of State for Environment, Prakash Javadekar (The Hindu). Over 10,000 tons of mussels have been harvested from the lake. According to studies, its carrying capacity has decreased over time. The Ashtamudi estuary demonstrates to the world that development and environmental conservation are inextricably linked and that a local participatory approach to biodiversity management is an important part of that. Backwater fishing attracts a large number of participants. Some women carry the fish on their heads and sell them at home, and fishing is seen as a method of livelihood.

Fishermen, scientists, and environmentalists have all admitted that fish availability in the Ashtamudi estuary is declining (Binushma Raju, 2011). The primary causes of the decline in the diversity of the lake's fisheries include pollution, sand mining, loss of mangrove habitat, and harmful fishing techniques (Raj et al., 2014). In Ashtamudi Lake, the size of pearl spotfish (Karimeen) and crabs has fallen to one-third of their previous size. A census conducted in March 2022 discovered that the average length of a pearl spot fish had decreased to 20 centimetres, and the average weight of a crab caught from the lake had decreased from 1 kilogram to 500-700 grams (Ravi, 2022). Fishing is the primary income source for most people living near the estuary.

The first fish census in the lake revealed a quick invasion by the invasive bivalve species Charu mussel and a rise in pollution levels. The census, which was coordinated by the Department of Fisheries, Ashoka Trust for Research in Ecology and Environment (ATRE), and the Department of Aquatic Biology and Fisheries at the University of Kerala, was carried out by researchers and professionals with the assistance of fishermen. According to published data, the lake included 156 species divided into 60 families. The shift in species composition of some unique species, such as the number of fish in Ashtamudi, demonstrates that the first census discovered that 85% of the species in the lake are marine species. Known as '*Koozhavali*', it was first identified in Ashtamudi Lake and is currently only in restricted regions. Ashtamudi Lake is the only lake in India that supports these species, and the number of catfish is also decreasing," says A. Bijukumar, professor and head of the Department of Aquatic Biology and Fisheries at the University of Kerala. Another significant result is the shift in species makeup, with marine species accounting for around 85% of the lake's 51 species. "The increased dominance of marine species even in the freshwater zone suggests that the Kallada River's freshwater flow is diminishing due to climate change." Saltwater intrusion is increasing, and only highly tolerant species can survive. The primary concerns are pollution, landslides, and mangrove loss. Other illicit fishing activities can have an impact on biodiversity. If all of these conditions persist, marine species will become dominant. Heat is a consideration. According to fishery officials, hot weather contributes to the reduction of species richness, and the water system is hoped to be altered soon. "We have lost migratory fish and other species that only come out to spawn. This is not a substantial decline (Sudhish, 2022).

Even in the freshwater zone, the increased dominance of marine species suggests that the Kallada River's freshwater flow is diminishing due to climate change. Saltwater intrusion is increasing; only highly tolerant species can survive in such conditions. The main threats are pollution, landslides, and the loss of mangroves. In addition, various illicit fishing activities have an impact on biodiversity. If all of these conditions persist, marine species will dominate in the future. Heat is a factor. According to fishery officials, hot weather reduces species biodiversity, and the water system is hoped to be altered soon. "We have lost migratory fish and other

species that only come out to mate. This cannot be considered a significant decline (Sudhish, 2022).

Tourism Hotspots

Ashtamudi Lake is a popular tourist destination because of its natural beauty and boating. Munro Island and Sambranikkodi are two renowned tourist attractions in Ashtamudy Lake. Munro Island, sometimes called Munrothuruth, is a tranquil and lovely island in Kerala's Kollam district. Munro Island is famed for its breathtaking natural beauty, which is highlighted by a network of canals, lakes, and rivers that run throughout the island. This lovely island, located at the junction of Ashtamudi Lake and the Kallada River, is named for Colonel John Munro, a British resident of the former princely state of Travancore. Munro Island, famous for its beautiful backwater, lush green vegetation, and historical importance, offers guests a unique and exemplary experience while cruising through the backwater of Kerala. The area has wildlife, making it ideal for people who love bird watching and other related activities. These two factors also increase their economic value because the mangroves and water bodies are home to birds such as kingfishers, herons, egrets, and migratory birds. For the tourist searching for a peaceful sojourn in the untouched beauty of Kerala, Sambranikodi in the southern part of Ashtamudi Lake is a discovery. The Kollam District Tourism Promotion Council, or DTPC, has arranged a boat facility for the tourists to travel through its pristine and crystal-clear water. It is said that in the past, Chinese boats used to anchor on this coast, and the place was called' Chambrani' by the people, which, in time, became Sambranikodi. Today, it forms one of the major attractions in the district of Kollam, where tourists can have a vantage view of the canals that border the green mangrove forests.

Environmental Degradation of Ashtamudi Lake

Water is an essential precondition for life and the economy as a whole. However, over the decades, water quality has rapidly deteriorated due to the impact of numerous natural and human-made activities. Due to increasing pollution and climate change, the decline in surface water quality has become a serious concern worldwide.

Ashtamudi Estuary, with a population density of over 2,500 per km, is in a densely populated urbanised area. The area is characterised by poor waste management facilities and numerous industrial units along the shoreline (Ashtamudi Estuary: An Integrated Management Plan, 2017). Recently, there has been a significant anthropogenic intrusion into the lake. Fish, sediment, shellfish fragments, and water fibres all contain films, which have been identified as the most common type of microplastic. Most particles were predominantly in the lower size range, indicating their potential bioavailability to aquatic species (Devi et al.,2024). Many lake areas closer to Kollam town's urbanisation are under pollution stress. At its southern end, the lake is joined by several major and minor drainage channels filled with industrial and municipal trash. In the eastern arm of the estuary, coconut husk retting to produce coir fibre is common in several areas (Krishnan et al., 2015). A substantial component of these anthropogenic activities is the coir industry. This industry seriously harms the water environment (Divya Ashok & Ramasamy, 2022). It also poses substantial environmental risks, damaging water bodies, air, and land, with serious health consequences. Natural retting of coconut husk, which occurs early in the coir manufacturing process, has always been hazardous (Najee & Philipose, 2013). Large amounts of hydrogen sulfide and polyphenols are released from coconut husks during retting, creating anoxic conditions. The Neendakara harbour and Kandachira region have become some of the most polluted areas of the estuary, necessitating immediate intervention (Ashtamudi Estuary: An Integrated Management Plan. 2017:38).

The water quality of the Ashtamudi estuary has significantly degraded. Because of a decline in rainfall and less inflow from the Kallada Basin, freshwater inflows into the Ashtamudi Estuary have declined (Ashtamudi Estuary: An Integrated Management Plan, 2017: 41). In general, the water in estuarine is alkaline, ranging from mixed saline to saline, with localised areas of oxygen depletion. The estuary receives efflux from multiple drains connected to adjacent households and tourist resorts (Ashtamudi Estuary: An Integrated Management Plan. 2017:37). Sewage from the Kollam Canal, a central sewer that runs through Kollam City south of the estuary, also contributes to the extreme oxygen deprivation in these areas. Substantial oxygen depletion occurs in these areas because of the

Kollam Canal, a significant drain that transports sewage through Kollam City, which is situated south of the estuary. Coliform levels are higher than allowed, with a maximum of 1500 MPN/100ml for total coliform and 600 MPN/100ml for faecal coliform, according to data from the KSPCB (Kerala State Pollution Control Board), 2014 (Ashtamudi Estuary: An Integrated Management Plan. 2017:37).

The lake supports a diverse range of life, including about 43 marshy mangroves, 57 bird species, and 97 fish species, along with an exclusive copepod species that plays an important role in the food chain (Sitaram, 2014). In addition to its biological value, the lake supports traditional activities such as fishing, coir production, and clam harvesting, all of which are inextricably linked to the local culture and economy. However, this has been threatened by the increasing pollution, urbanisation, unsustainable tourism and climate change. Biodiversity and water quality depletion adversely affect wildlife and the region's socio-economic development. To overcome these challenges, the principles of inclusive governance, community participation, and sustainability must be applied to achieve a balance for the conservation of the lake and cultural values, as well as the sustainability of the lake for the continuous contribution to the development of Kollam.

Especially in the areas near Kollam city, the TS Canal, and the Kallada River, the water quality of Ashtamudi Lake is decreasing. In addition to the direct discharge of human waste from hanging latrines and domestic waste, the lake is contaminated by untreated sewage from Kollam City. Some areas have incredibly high levels of microbial contamination, particularly around the port area and the Kallada River zone. Agricultural activities in the area considerably utilise chemicals, organic fertilisers, insecticides, and pesticides, with runoff entering the lake, causing pollution and eutrophication (Kumar, 2006). Because of the direct flow of untreated sewage and waste from Kollam City, adjacent industrial units, boats operating from Neendakara harbour, and tourist houseboats, the Ashtamudi estuary has become a waste dump. Pollution is predicted to become a significant health risk shortly via contaminating food chains (Ashtamudi Estuary: An Integrated Management Plan, 2017: 44).

The southern portion of Ashtamudi Lake receives the majority of industrial and anthropogenic trash. Coconut husk retting and trash

from the pottery, paper, and palm oil industries contribute to pollution. Tourism-related activities, such as houseboats and commercial operations, generate garbage, contributing to heavy metal sedimentation and bioaccumulation. The cashew factories, hospitals, and small-scale companies in the vicinity emit untreated effluents, further decreasing water quality. In addition to industrial pollutants, the growing presence of small and medium-sized businesses in the region exacerbates the situation. These companies cannot frequently properly process trash, directly releasing hazardous chemicals and residues into the lake. Collaborative efforts between the government, industries, and local communities are critical for ensuring the sustainable development of the Ashtamudi region while preserving the lake's ecological integrity.

Ashtamudi Lake is an important source of fish, and it is one of the primary sources of income for the people living in the area. As it is widely known, unscientific fishing practices negatively affect the lake's aquatic community by reducing the fish abundance and jeopardising young fish. Also, wastes from food processing industries, shipbuilding industries, oil pollution, and slaughters have further polluted the river water (Nair, 1989). In the long run, these pollutants settle down at the bottom of the lake, thus reducing the number of species and affecting basic processes in the ecosystem. It is therefore important to monitor and control the usage of this important resource in order to sustain the fishery in the future. However, overfishing continues to exert more pressure on the lake's fragile ecosystem (Sitaram, 2014). As if these problems were not enough, climate change aggravates them as the rainy season becomes unpredictable and the temperatures rise, affecting water flow and quality. Urbanisation of the lake's edges for tourism has also contributed to the loss of habitat for the fish and birds. It is necessary to act without delay and install proper wastewater treatment, strengthen anti-industrial waste legislation, regulate tourism, and encourage eco-friendly farming practices. This way, by maintaining the balance of the lake and raising the people's awareness and their participation, it will be possible to preserve the lake for future generations.

With uncontrolled tourism, pollution increases, causing eutrophication, infringement, land reclamation, mining, and

depletion of species diversity. Kollam Municipal Corporation's solid waste and untreated sewage have become significant sources of pollution, often turning the lake into an unfortunate "garbage dump." As per the estimation, roughly 60% of residences near the lake have latrines, including hanging ones, that drain straight into its waters. Furthermore, the Kollam Municipal Corporation's waste-dumping yard lies dangerously close to the lake's southern shores at Mammoottikkadavu, worsening the pollution problem (Sitaram, 2014). Furthermore, several small-scale businesses operate near the lake, including fish processing plants, seafood manufacturing facilities, and motor and welding workshops. These machines produce effluents containing a wide range of toxic compounds, including acids, alkalis, heavy metals, suspended particles, and other hazardous chemicals. These pollutants represent immediate and long-term hazards to the lake's aquatic environment, affecting water quality and creature health (Sitaram, 2014). These releases have a cumulative effect that undermines the lake's fragile ecological equilibrium. Heavy metals and other poisons settle in the sediment and can bioaccumulate in aquatic creatures, reducing biodiversity and increasing the risk of toxins entering the food chain. Suspended sediments and chemicals can also affect the lake's physical and chemical qualities, lowering light penetration, oxygen levels, and water quality.

Mangrove cover is essential in determining the Ashtamudi estuary's biodiversity. The estuary's numerous mangrove species are strong soil binders and prevent shoreline erosion. However, the speed at which mangroves are being destroyed has caused shoreline erosion and the disfigurement of backwater islands. A wide variety of fauna, which includes fish, prawns, and crabs, is supported by the environment in addition to mangrove species. These organisms rely on mangroves at various life cycle stages, using them as spawning, nesting, and breeding grounds. Changes in land use, such as reclamation for real estate purposes, are the leading cause of the mangrove area's rapid decline. The loss of habitat has directly impacted the flora as well as fauna of the estuary, altering its natural equilibrium (Ashtamudi Estuary: An Integrated Management Plan, 2017: 53).

The total area of mangroves in the Ashtamudi estuary has significantly declined. Mangrove coverage has diminished from 1.46km² in 1967 to 0.95km² in 2016 (Sajeev & Subramanian, 2003). They are limited to only three places — Asramam, Munroe Islands, and Kumbalam. Many national and international studies have highlighted the ecological degradation of the Ashtamudi Lake system and suggested several remedial measures. The objective of these investigations is to understand waste management practices in the vicinity and address encroachment and landfilling, which, if not checked, will not only cause a nuisance but also lead to serious environmental consequences.

Ashtamudi's regeneration has been negatively influenced by a number of anthropogenic stresses such as ecosystem ecological degradation, husk removal, and pollution (Ashtamudi Estuary: An Integrated Management Plan 2017:48). In key sectors like tourism, coir production, and mineral mining, sustainable and conservation-based approaches should be adopted in order to protect the natural peace and ecological balance of Ashtamudi Lake and its associated ecosystem. Ashtamudi Lake is unique in that it has a number of inhabited islands, enriching its ecological and cultural importance. Large numbers of dead fish were discovered floating in Ashtamudi Lake because of pollution, and in an interview with the researcher, Indhu Mohan, an environmental activist and the President of Jeevani, an environmental NGO, observed that illegal encroachment and pollution are the lake's biggest challenges. Several sewage flow canals also intersect in the lake. The canals are loaded with various forms of garbage, including plastic, toilet paper, hospital waste, etc.

Methodology of the Study

A mixed-methods study design was employed to explore the complex relationship between environmental conservation and the socio-cultural heritage of Ashtamudi Lake. This descriptive and exploratory study sought to establish the environmental problems of Ashtamudi Lake, the conservation measures regarding the lake and its socio-cultural importance to the people, and its historical significance. The primary data collected from the local people were derived from the focus group discussions, which provided data on the significance of the lake and the problems facing the protection of

the same. To investigate these issues, 50 residents from various places around the lake's coastline were surveyed. The researcher conducted the study from 2023 to 2024 by conducting focus groups with fishermen and environmental activists. In 2024, a survey was undertaken in Ashtamudy's coastal areas in partnership with Jeevani, an environmental organisation committed to encouraging sustainable practices. The survey analysed locals' impressions of the lake's biological changes and their impact on local fishing practices to provide valuable information for future conservation efforts. The secondary data were collected from journals, government and non-government documents, records, and other sources. Nonetheless, the study faced the following limitations. There were some limitations on socio-cultural development due to a lack of adequate records in the past, and again, some areas within the lake were inaccessible.

Objectives of the Study

This study aims to focus on the lake's various environmental challenges and explore its socio-cultural significance.

The main objectives of the study are:

i. To analyse traditional practices such as fishing, coir production, and festivals and their role in shaping local identity.

ii. To identify major environmental threats such as pollution, biodiversity issues, and ecosystem degradation;

iii. To examine how anthropogenic activities such as industrial waste and the impact of uncontrolled tourism affect the lake's ecosystem;

iv. To investigate the local people's social, cultural, and economic activities.

v. To create awareness among the local people, politicians, and tourists about the ecological and cultural significance of Ashtamudi Lake.

Conclusion

Ashtamudi Lake is a victim of pollution and encroachment. Deterioration of water quality, loss of biodiversity, and depletion of fishery resources adversely affect people's economic and social well-being, especially those working in traditional professions like fishing, tourism, and coir. The ongoing contamination of Ashtamudi Lake threatens the ecological balance and the bread and butter of generations that depend on the lake. Ashtamudi Lake could be rehabilitated with a concerted and collective approach. The participation of governments, industries, local communities, environmental groups, and research institutions is essential. Potential solutions include better waste disposal systems, limited tourism and industrial operations, restoration of mangrove cover, and stringent anti-pollution regulations. As per the Wetlands (Conservation and Management) Rules, 2010, pollution and encroachment of water bodies designated under the Ramsar Convention are prohibited. Promoting community projects and sustainable livelihoods could also act as a driver for the management of lakes at the community level. Restoration of the ecological integrity of Ashtamudi Lake requires timely and sustained intervention comprising innovative tech and conservation of physical behaviours.

Conflict of interest

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