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UNREGULATED FISH FARMING MAY TRANSFORM KOLLERU LAKE INTO A HEALTH HAZARD FOR KAIKALURU

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ABSTRACT
Kolleru Lake, a Ramsar site and India's largest freshwater lake, is experiencing severe environmental degradation primarily due to the unchecked expansion of commercial aquaculture. This activity has led to extensive conversion of the lake into fishponds, resulting in significant water pollution through organic loading, chemical contamination, and salinity intrusion. These environmental changes directly compromise the quality and availability of drinking water in surrounding areas, particularly Kaikaluru Mandal. Local communities face a heightened incidence of waterborne diseases and chronic health issues, including skin allergies, neurological disorders, and potential cancer risks, stemming from exposure to contaminated water and bioaccumulated toxins in farmed fish. Despite existing robust regulatory frameworks and past government interventions like "Operation Kolleru," the persistent economic incentives for aquaculture, coupled with enforcement gaps and socio-economic vulnerabilities, have hindered sustainable management. The situation underscores a critical environmental justice concern, where economic benefits are disproportionately offset by severe health and environmental burdens on local populations, necessitating a comprehensive and integrated approach to restore ecological balance and safeguard public health.

KEYWORDS: Kolleru Lake, Aquaculture, Water Pollution, Public Health, Kaikaluru Mandal, Environmental Degradation.

1. INTRODUCTION

Kolleru Lake, located between the Krishna and Godavari deltas in Andhra Pradesh, India, spans approximately 245 square kilometers, making it one of Asia's largest freshwater lakes. Designated a Ramsar site in 2002 and a Wildlife Sanctuary in 1999, it supports over 200 bird species, diverse aquatic life, and serves as a natural flood-balancing reservoir for the region (Wikipedia, 2004). Since the 1970s, however, the unchecked growth of aquaculture, particularly shrimp farming, has likely led to severe ecological degradation and public health challenges. This report examines these impacts, drawing on recent reports and studies, including a 2025 article from The Hindu highlighting the urgent concerns raised by the Central Empowered Committee (CEC) about pollution and unregulated aquaculture threatening the lake's future (The Hindu, 2025).

2. HISTORY OF AQUACULTURE IN KOLLERU LAKE

Aquaculture in Kolleru Lake began in the 1970s when the Andhra Pradesh government authorized the conversion of the lake's shoreline into fish farms, initially for carp cultivation (The Wire Science, 2022). Fuelled by global seafood demand and government subsidies, shrimp farming expanded rapidly. By 2001, satellite imagery indicated that 42% of the lake—103 square kilometers—was occupied by 1,050 fish ponds and 38 dried-up ponds (Wikipedia, 2004). This shift from traditional rice farming to aquaculture has transformed the lake's landscape and economy, setting the stage for significant ecological and social challenges (The Wire Science, 2022).

3. ENVIRONMENTAL IMPACTS OF AQUACULTURE

Unregulated aquaculture has profoundly affected Kolleru Lake's ecosystem, as detailed below:

3.1 Pollution and Water Quality Degradation

Aquaculture operations release nutrient-rich effluents, antibiotics, and chemicals, leading to eutrophication and heavy metal contamination. A 2020 study found elevated levels of heavy metals like chromium, copper, manganese, and zinc in the lake's water, posing health risks through oral and dermal exposure, with chromium levels raising concerns about carcinogenic effects (Subrata Das Sharma, 2020). Additionally, pollution

from chemical treatments in ponds and industrial waste has rendered the water unsuitable for drinking, as confirmed by government reports (Wikipedia, 2004). The use of fertilizers and manure in fish ponds further exacerbates water quality issues (SlideShare, 2021).

3.2 Loss of Biodiversity

The conversion of wetlands into fish ponds has destroyed habitats, leading to a decline in native fish species like bullseye snakehead and catfish, as well as migratory birds such as flamingos and pelicans. Historically, Kolleru was a critical stopover for over 200 bird species, but practices like firing gunshots to deter birds have driven many away (Wikipedia, 2004). Geospatial analysis reveals that fishponds within the Kolleru Wildlife Sanctuary increased from 12% in 1990 to 64% in 2004, rebounding to 43% by 2015 despite conservation efforts (Research Gate, 2024). The introduction of non-native fish species has further disrupted the lake's ecological balance (Test book, 2024).

3.3 Hydrological Alterations

Illegal fish tank bunds obstruct natural water flow, causing flooding in upper sanctuary areas and affecting thousands of acres of crops (Wikipedia, 2004). Seawater intrusion due to these structures has increased salinity, damaged the ecosystem and influenced local rainfall patterns (Amoghavarsha IAS Academy, 2025). These hydrological changes compound the environmental challenges faced by the lake (Table-1)

Table-1: Environmental Impacts of Aquaculture on Kolleru Lake.

S.No	Environmental Impact	Description	Consequences
1	Pollution and Water Quality Degradation	Nutrient-rich effluents, antibiotics, and heavy metals from aquaculture cause eutrophication and contamination.	Algal blooms, oxygen depletion, health risks from heavy metals, and unfit drinking water.
2	Loss of Biodiversity	Conversion of wetlands into fish ponds and introduction of non-native species.	Decline in native fish and migratory birds, disrupted ecological balance.
3	Hydrological Alterations	Illegal bunds block water flow, causing seawater intrusion and flooding.	Increased salinity, crop damage, altered rainfall patterns.

4. SOCIOECONOMIC IMPACTS

Aquaculture has brought both benefits and challenges to local communities.

4.1 Economic Benefits and Conflicts

As India's top seafood exporter, Andhra Pradesh benefits economically from aquaculture, which provides jobs and income (The Wire Science, 2022). However, this has displaced traditional livelihoods like rice farming and small-scale fishing, leading to conflicts among fishermen, farmers, and environmentalists (EJAtlas, 2016). The economic reliance on aquaculture complicates efforts to regulate it, as local communities often prioritize immediate economic gains (Earth5R, 2024).

4.2 Public Health Crisis

Water contamination from aquaculture effluents has caused a public health crisis, particularly in areas like Kaikaluru Mandal. Regional health surveys report increased waterborne diseases such as cholera and dysentery, as well as skin infections due to exposure to polluted water (The Hindu, 2024). Stagnant water in fishponds has become breeding grounds for mosquitoes, contributing to a rise in vector-borne diseases like dengue and malaria (Good Food Movement, 2024). Aquaculture workers face additional risks from exposure to toxic chemicals without adequate protection, and contamination of the local food chain raises concerns about reproductive and neurological health (Subrata Das Sharma, 2020). The loss of clean drinking water sources further exacerbates these issues (Wikipedia, 2004). The socioeconomic impacts of aquaculture in given in Table-2

Table – 2: Socioeconomic Impacts of Aquaculture.

S. No.	Socioeconomic/Public-Health Impact	Positive Aspects	Negative Aspects
1	Economic & Labor Market Effects	Productivity gains & new opportunities Automation of repetitive tasks	Job displacement and labour market disruption:Inequality concerns:
2	Education & Cognitive Impact	Personalized learning support AI literacy promotion	Critical-thinking erosion: Overreliance may diminish students' independent reasoning, creativity, and research skills.
3	Mental Health & Public Health Risks	Scalable psychoeducation & support: ChatGPT can provide coping strategies and referrals, especially when human care access is limited.	AI-induced delusional thinking ("psychosis"): Prolonged or intense use has been linked to paranoia, obsession, and breaks from reality in vulnerable individuals.

5. CONSERVATION EFFORTS AND CHALLENGES

Efforts to restore Kolleru Lake include.

5.1 Government Initiatives

Operation Kolleru, launched in 2006, aimed to remove illegal encroachments but achieved limited success (The Wire Science, 2022). Despite these efforts, the state government has promoted aquaculture expansion, with plans to triple fish production, which may conflict with conservation goals (The Wire Science, 2022). The lake's designation as a Wildlife Sanctuary and Ramsar site provides legal protections, but enforcement remains weak. Supreme Court rulings have mandated buffer zones to curb degradation, yet compliance is inconsistent (Testbook, 2024).

5.2 Community-Based Conservation

Some communities support conservation, but economic dependence on aquaculture leads to resistance. Organizations like Samayu have engaged local farmers in restoring water bodies and promoting sustainable practices, providing employment through schemes like the Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA) (Earth Matters, 2024). Awareness campaigns and vocational training are needed to promote sustainable livelihoods (Earth5R, 2024).

5.3 Challenges

Restoration efforts are hindered by weak enforcement, political interests prioritizing economic growth, and climate change impacts like erratic rainfall (Amoghavarsha IAS Academy, 2025).

Illegal aquaculture activities continue despite regulations, underscoring the need for stronger governance (The Hindu, 2025). The Conservation Aspects and Challenges are given in Table-3

Table-3: Conservation Aspects and Challenges.

Conservation Aspect	Description	Challenges
Government Initiatives	Operation Kolleru, legal protections, buffer zones	Limited success, weak enforcement, conflicting economic priorities
Community-Based Conservation	Restoration projects, employment through MNREGA	Economic dependence on aquaculture, resistance to regulations
Challenges	Weak enforcement, political interests, climate change	Persistent illegal activities, need for stronger governance

6. RECOMMENDATIONS FOR SUSTAINABLE MANAGEMENT

To restore Kolleru Lake and mitigate the adverse impacts of unregulated aquaculture, a comprehensive and multi-pronged approach is essential, focusing on both environmental protection and community well-being.

- **Strengthen Water Quality Monitoring:** Robust and continuous water quality monitoring is paramount. This involves utilizing advanced tools like satellite imagery to track land-use changes and the spread of aquaculture encroachments, which directly correlate with pollution levels. Regular and frequent water quality tests should be conducted at numerous points across Kolleru Lake and its interconnected waterways, assessing physico-chemical parameters (e.g., dissolved oxygen, biochemical oxygen demand, pH, salinity, conductivity), bacteriological indicators (e.g., coliforms), and the presence of heavy metals and pesticide residues. This comprehensive monitoring is crucial to overcome discrepancies between official reports and on-the-ground realities, ensuring accurate data for effective management.

- **Mandate Effluent Treatment:** A critical step is to strictly mandate that all aquaculture units install and operate effective effluent treatment plants. These systems are necessary to treat the wastewater discharged from fishponds, which is often laden with organic matter, excess nutrients (nitrogen and phosphorus), antibiotics, and unlabelled chemicals used for fish growth and disease prevention. Strict penalties for non-compliance must be enforced to deter direct discharge of untreated effluents into Kolleru Lake and its drains, which currently contributes significantly to water degradation and eutrophication.

- **Enforce Spatial Zoning:** Rigorous enforcement of spatial zoning regulations is vital to protect the ecological integrity of Kolleru Lake. This includes strictly designating and protecting "no-aquaculture zones," particularly within the notified Kolleru Wildlife Sanctuary area and its critical 5-km contour. Despite past interventions like "Operation Kolleru" which aimed to demolish illegal fish tanks, aquaculture activities have shown a significant resurgence, indicating persistent challenges in sustained enforcement and the need for continuous vigilance by local authorities to prevent new illegal constructions.

- **Support Sustainable Livelihoods:** Addressing the socio-economic drivers of unregulated aquaculture is key. This requires implementing programs that support sustainable alternative livelihoods for communities currently dependent on environmentally damaging aquaculture practices. Providing comprehensive training and incentives for farmers to adopt eco-friendly aquaculture methods, such as

Integrated Multi-Trophic Aquaculture (IMTA) or Recirculating Aquaculture Systems (RAS), can reduce environmental impact while maintaining economic viability. Such initiatives can help mitigate the displacement of traditional fisherfolk and farmers who have lost their livelihoods due to the lake's degradation and agricultural land salinization.

- **Launch Awareness Campaigns:** Extensive awareness campaigns are necessary to educate local communities, including farmers and residents, about the severe health risks associated with consuming and using contaminated water, as well as the broader ecological importance of Kolleru Lake. These campaigns should promote responsible practices in aquaculture, such as the judicious use of feed and antibiotics, and highlight the long-term benefits of conservation for both environmental health and human well-being.

- **Integrate Public Health Surveillance:** A robust public health surveillance system should be established to systematically monitor and document the prevalence and types of waterborne diseases (e.g., diarrhea, typhoid, amoebiasis, cholera, dysentery) and other health issues like skin allergies, neurological disorders, and potential cancers, which are linked to water contamination in Kaikaluru Mandal and surrounding areas. Collaboration between environmental agencies and healthcare providers is crucial to correlate water quality data with health outcomes, ensuring timely interventions and targeted public health responses, especially given the current underreporting of health issues.

- **Promote Research:** Investing in further scientific research is essential to develop and implement effective long-term solutions. This includes funding studies on the precise distribution and toxic effects of various contaminants in Kolleru Lake, including emerging pollutants like microplastics. Research should also focus on developing and optimizing sustainable aquaculture technologies and advanced wastewater treatment methods tailored to the local context, as well as exploring mathematical modeling for water quality management to predict and mitigate future impacts.

7. CONCLUSION

Kolleru Lake's transformation from a vibrant ecosystem to a polluted landscape highlights the urgent need to address unregulated aquaculture. While it provides economic benefits, the environmental and public health costs are significant. Recent reports from 2025 indicate that these challenges persist, with ongoing efforts to tackle pollution and encroachments (The Hindu, 2025). Collaborative efforts involving stricter regulations, community engagement, and innovative solutions are essential to restore this vital Ramsar site and ensure its sustainability for future generations.

8. REFERENCES

1. Wikipedia. (2004). Kolleru Lake. https://en.wikipedia.org/wiki/Kolleru_Lake
2. The Wire Science. (2022). How Aquaculture Turned Kolleru Lake, Known for Its Biodiversity, Into Fish Ponds. https://science.thewire.in/environment/how-aquaculture-turned-kolleru-lake-known-for-its-biodiversity-into-fish-ponds/
3. The Hindu. (2025). Central Empowered Committee flags urgent environmental and infrastructure concerns at Kolleru Lake. https://www.thehindu.com/news/national/andhra-pradesh/central-empowered-committee-flags-urgent-environmental-and-infrastructure-concerns-at-kolleru-lake/article69709247.ece
4. Undark. (2022). In India, Aquaculture Has Turned a Sprawling Lake Into Fish Ponds. https://undark.org/2022/01/14/in-india-aquaculture-has-turned-a-sprawling-lake-into-fish-ponds/
5. Earth Matters. (2024). Kolleru Lake: A Once-Thriving Ecosystem Drowned by Aquaculture's Growth.https://earthmatters.co.in/kolleru-lake-a-once-thriving-ecosystem-drowned-by-aquacultures-growth/
6. Test book. (2024). Kolleru Lake & Wildlife Sanctuary. https://testbook.com/ias-preparation/kolleru-lake
7. Subrata Das Sharma et al. (2020). Risk assessment via oral and dermal pathways from heavy metal polluted water of Kolleru lake- A Ramsar wetland in Andhra Pradesh, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7656164/
8. SlideShare. (2021). Kolleru Lake Aquaculture. https://www.slideshare.net/kolleru-lake-aquaculture
9. Research Gate. (2024). Geospatial Analysis of the Changing Environment of Kolleru Lake. https://www.researchgate.net/publication/374837614_Geospatial_Analysis_of_the_Changing_Environment_of_Kolleru_Lake
10. Amoghavarsha IAS Academy. (2025). Kolleru Lake. https://amoghavarsha.com/kolleru-lake/
11. SRKR Engineering College. (n.d.). Kolleru Lake. https://www.srkrec.ac.in/kolleru-lake/
12. EJAtlas. (2016). Aquaculture in Kolleru Wildlife Sanctuary and pollution, AP, India. https://ejatlas.org/conflict/aquaculture-in-kolleru-wildlife-sanctuary-and-pollution-ap-india
13. Earth5R. (2024). Kolleru Lake Near Vijayawada: A Dying Wetland in Need of Urgent Restoration. https://earth5r.org/kolleru-lake-near-vijayawada-a-dying-wetland-in-need-of-urgent-restoration/
14. The Hindu. (2024). A catch in Andhra Pradesh's aquaculture success story. https://www.thehindu.com/news/national/andhra-pradesh/a-catch-in-aps-aquaculture-success-story/article67776563.ece
15. Good Food Movement. (2024). Blue revolution backfires in Kolleru lake.

https://gfm.akshayakalpa.org/read/feature-article/blue-revolution-backfires-in-kolleru-lake