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Unveiling resistance: Fisherfolk perspectives on marine mineral mining in Kerala

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Abstract
Marine mineral mining is emerging as a key component of the Blue Economy initiative, with governments and industries exploring offshore deposits for economic gain. However, coastal communities, particularly fisherfolk, remain concerned about the ecological and socio-economic implications of such activities. This study presents preliminary findings from a survey conducted among fisherfolk families across nine coastal districts of Kerala, India, to gauge their response to the proposed marine mineral sand mining. The survey, covering 856 families, revealed that 88.73% to 99.24% of respondents opposed the initiative, citing concerns over environmental degradation, loss of livelihoods, and reduced fish availability. These findings indicate strong resistance from the fishing community and highlight the need for inclusive decision-making processes that consider stakeholder concerns.

Keywords: Marine mining, blue economy, fisherfolk, environmental impact, stakeholder response

1. Introduction
The global push for a Blue Economy has led to increased interest in marine mineral mining, particularly the extraction of minerals from seabed sediments. With rising demand for valuable minerals industries and governments are exploring the potential of offshore deposits as an alternative to terrestrial mining. While proponents argue that such initiatives could bolster economic growth, create employment opportunities, and enhance national resource security, significant concerns persist regarding their environmental and social ramifications.

Marine mineral mining poses substantial risks to marine ecosystems. Seabed dredging and sediment displacement can lead to habitat destruction, increased turbidity, and disruption of benthic organisms, which form the foundation of the marine food web [1]. Studies have shown that mining operations can lead to long-term alterations in seabed topography and sediment composition, negatively impacting fish populations and marine biodiversity [2]. Additionally, the release of heavy metals and toxic substances from disturbed sediments can lead to bioaccumulation in marine organisms, posing risks to fisheries and human health [3]. Fishing communities, which depend on coastal and marine ecosystems for their livelihoods, are among the primary stakeholders affected by marine mineral mining. The seabed plays a crucial role in supporting marine biodiversity, including fish spawning and nursery grounds. Any disruption caused by dredging and sediment displacement could have cascading effects on fish populations, ultimately affecting the livelihoods of thousands of small-scale fishers.

Coastal erosion is another major concern, as seabed mining can alter wave patterns and sediment transport dynamics, potentially leading to increased shoreline retreat and habitat loss [4].

Kerala (South India), with its extensive 590 km coastline and a vibrant fisheries sector that provides employment to over a million people, is at the centre of this debate. The state's marine fish production contributes significantly to local food security and the economy, making any alterations to the marine environment a matter of serious concern. Proposed offshore mining projects in Kerala have met with resistance from the fisherfolk community, who fear adverse effects on fish stocks, coastal erosion, and long-term ecosystem damage. This study assesses the response of fisherfolk families in Kerala to the prospect of marine

mineral sand mining. By conducting a structured survey across nine coastal districts, this research aims to document their concerns and opposition, providing empirical evidence that can inform policymakers and industry stakeholders about the socio-environmental challenges associated with marine mining.

2. Methodology

A structured survey was conducted among fisherfolk families across nine coastal districts of Kerala (South India). The sample size included: Trivandrum district (103), Kollam district (132), Alappuzha district (143), Ernakulam district (98), Thrissur district (74), Malappuram district (71), Kozhikode district (99), Kannur district (68), and Kasaragod district (68), totalling 856 families. Respondents were asked only about their response to marine mineral mining, specifically whether they were in favour of or against it. If they opposed mining, they were further asked to state the reasons for their opposition. The survey was conducted through direct interviews with heads of fishing households, ensuring that responses were recorded accurately and without external influence. The collected data were then categorized based on the primary concerns expressed by respondents, and statistical analysis was conducted to determine the overall trend of opposition across different districts.

To maintain objectivity and accuracy, the study ensured that interviewers were familiar with the local dialect and cultural sensitivities of fisherfolk communities. The data collection process was carried out between November 2024 and January 2025, covering a representative cross-section of the fishing population. The analysis focused on quantifying the level of opposition and identifying common themes in the concerns raised by the respondents.

3. Results and Discussion

Survey results indicated overwhelming opposition to marine mineral mining, with disapproval rates exceeding 88% across various districts in Kerala. Specifically, 96.12% of respondents in Trivandrum, 99.24% in Kollam, 97.90% in Alappuzha, 89.79% in Ernakulam, 90.54% in Thrissur, 88.73% in Malappuram, 92.93% in Kozhikode, 94.11% in Kannur, and 89.70% in Kasaragod expressed their disapproval (Figure 1).

The primary concerns raised included environmental degradation, as fisherfolk feared that seabed mining could lead to sediment disruption, habitat destruction, and altered marine biodiversity, leading to significant decline in fish landings.

Seabed mining activities often result in the generation of sediment plumes, which are clouds of suspended particles created when sediments are disturbed and dispersed into the surrounding water column. These plumes can significantly increase the turbidity of the water, thereby reducing light penetration into deeper layers. This reduction in light availability adversely affects photosynthesis, which form the foundation of marine food webs by driving primary productivity. A decrease in phytoplankton productivity can have cascading effects throughout the ecosystem, ultimately impacting fish populations and the livelihoods of fisherfolk. Studies have shown that sediment plumes from deep-sea mining can disperse over extensive areas, leading to prolonged periods of elevated turbidity and associated ecological consequences [5, 6]. Furthermore, research indicates that such plumes can travel considerable distances from the mining site, extending their impact beyond the immediate vicinity [7].

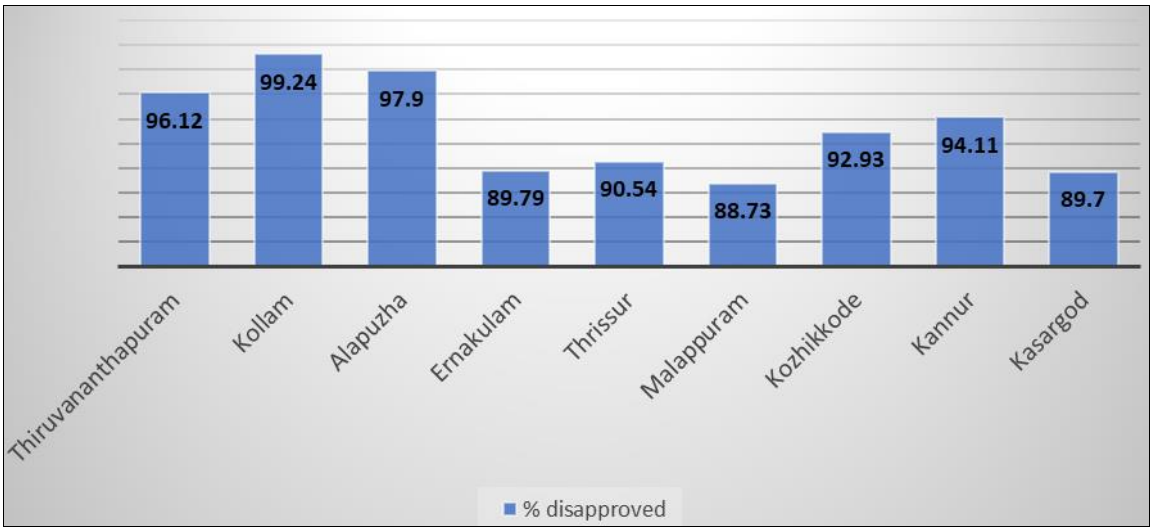

Fig 1: Percentage of fishermen opposing seabed mining among surveyed respondents

Studies indicate that seabed mining activities disturb the benthic environment, reducing primary productivity and fish stock availability, which directly impacts traditional fishing grounds. For instance, research by Spearman *et al.* (2020) [5] demonstrated that disturbances in benthic ecosystems have been linked to declining fish stocks, affecting both commercial and subsistence fisheries. Similarly, Van Dover *et al.* (2017) [8] highlighted the potential for permanent displacement of fisherfolk due to the loss of fishing grounds resulting from seabed mining operations.

Indian studies have also highlighted the environmental and socio-economic consequences of marine mineral mining. A study by Sangita *et al.* (2014) [9] along the Orissa coast revealed significant impacts of dredging on coastal water quality and alterations in sediment transport patterns, leading to habitat loss. This is particularly concerning for fisherfolk communities, as coastal erosion can accelerate the loss of critical fish breeding and nursery grounds. Similarly, a study by Krishnamurthy *et al.* (2016) [10] on the impacts of coral mining in the Gulf of Mannar emphasized how disturbances in benthic ecosystems led to a measurable decline in fish catch over time, adversely affecting local fishing economies.

Another critical issue is the potential for radioactive contamination. Some marine mineral deposits contain radioactive materials, raising concerns about bioaccumulation in fish species and the subsequent health hazards for human consumers. Guerra *et al*. (2021) [7] discussed these risks, noting the potential for long-term contamination of the seafood supply chain. An Indian case study by Derin *et al*. (2012) [11] on placer mining along the Kerala coast found elevated levels of thorium and uranium in marine sediments, further highlighting the potential for radioactive contamination.

Noise and light pollution from mining equipment further exacerbate ecological disturbances by interfering with fish migration and spawning behaviours. Boetius and Haeckel (2018) [12] noted that such pollution could have significant impacts on marine organisms, potentially disrupting entire ecosystems.

Many respondents also expressed frustration over inadequate consultation and participation in decision-making processes regarding marine resource exploitation, highlighting the need for community engagement and transparent environmental impact assessments. Jaeckel *et al*. (2020) [13] emphasized the importance of incorporating local ecological knowledge and scientific research into policy frameworks before advancing marine mining projects. These findings align with previous research conducted in Indian coastal regions, underscoring the broader implications of marine mineral mining. For instance, a study on the impact of sand mining in the Vembanad Lake region by Padmalal *et al*. (2008) [14] demonstrated how extractive activities can lead to long-term habitat degradation, fishery declines, and socio-economic distress for dependent communities.

Given the strong resistance observed in this survey, it is crucial for decision-makers to incorporate local ecological knowledge and scientific research into policy frameworks before advancing marine mining projects.

4. Conclusion

The findings of the present study underscore the profound apprehensions of Kerala's fishing communities regarding the central government's offshore mining initiatives. Fisherfolk express deep concerns that such activities could lead to significant depletion of fish stocks, thereby jeopardizing their primary source of income and sustenance. They also fear that seabed mining might exacerbate coastal erosion, further threatening their habitats and livelihoods. These concerns are amplified by the perception that the government has not adequately consulted or involved local communities in the decision-making process, leading to a sense of marginalization and distrust. The paper emphasizes the necessity for policymakers to engage in meaningful dialogue with these communities, ensuring that their voices are heard and their livelihoods protected. It advocates for a balanced approach that harmonizes economic development objectives with environmental sustainability and the socio-economic well-being of the fisherfolk. Further research and environmental impact assessments must be conducted to fully understand the long-term implications of such activities on marine ecosystems and coastal livelihoods.

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