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RESEARCH ARTICLE

ENVIRONMENTAL DEGRADATION AND ITS IMPACT ON COASTAL FISHERIES: CHALLENGES AND POLICY RESPONSES

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Abstract

Environmental degradation has become a major threat to fisheries worldwide, particularly in coastal and developing regions where communities are highly dependent on marine resources for food and livelihood. Fisheries contribute significantly to nutrition, employment, and economic growth; however, unsustainable human activities and global environmental changes are putting immense pressure on aquatic ecosystems. Among the major challenges, pollution, climate change, and habitat loss have been identified as the most critical factors impacting fish populations and fisherfolk communities.Pollution, caused by industrial waste, plastics, untreated sewage, and agricultural runoff,severely reduces water quality,depletes oxygen,andcontaminates aquatic life./0258 Climate change,through rising sea surface temperatur es,irregular monsoon patterns,cyclones, and ocean acidification,disrupts fish breeding cycles and migration, thereby affecting catch stability and income levels. Similarly, the destruction of mangroves,coral reefs, and estuaries has led to the loss of natural breeding and nursery grounds, reducing fish stock and biodiversity.This study investigates the perceptions of fisherfolk regarding these environmental issues using data collected from 60 respondents in Kanyakumari District. ANOVA techniques were applied to analyze variations in perception across three major factors—pollution, climate change, and habitat loss. Results indicate that pollution is perceived as the most severe environmental issue, followed by climate change and habitat loss. The findings stress the urgent need for sustainable fisheries management. Policy measures should focus on stricter pollution control, climate adaptation strategies, restoration of degraded habitats, and livelihood support for vulnerable fishing communities. Without timely interventions, environmental degradation will not only weaken marine ecosystems but also jeopardize the food security and economic well-being of millions of fisherfolk.

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Introduction:-

The fisheries sector is crucial for ensuring food security, supporting livelihoods, and driving the economic growth of coastal communities around the world. Fish and fishery products represent one of the most widely traded food commodities, and for millions of people, particularly in Asia and Africa, they form a primary source of protein and essential nutrients. Beyond nutrition, fisheries provide direct and indirect employment opportunities for fisherfolk, processors, traders, and workers in related industries such as boat-building and net-making. Thus, the sector contributes not only to social and cultural identities in coastal regions but also to national economies through exports and trade.

However, the increasing rate of environmental degradation has emerged as a serious challenge to the sustainability of both marine and inland fisheries. The delicate balance of aquatic ecosystems is being disturbed by multiple human-induced and natural factors, putting immense pressure on fish populations. As demand for fish continues to grow globally, the pressure to exploit aquatic resources has intensified, often at the cost of ecological health. Without urgent interventions, environmental degradation will undermine both biodiversity conservation and the socio-economic stability of fishing-dependent communities.

One of the most visible forms of degradation comes from pollution**,** which has reached alarming proportions in recent decades. Industrialization and urbanization have resulted in the large-scale discharge of untreated effluents, sewage, plastics, and chemicals into rivers, lakes, and seas. Agricultural runoff containing pesticides and fertilizers further contaminates water bodies, leading to eutrophication and oxygen depletion. Oil spills and microplastic accumulation not only poison aquatic species but also disrupt the reproductive and migratory behavior of fish, thereby lowering productivity. Such impacts directly affect fisherfolk whose daily income is tied to catch availability and quality.

Equally critical is the threat posed by climate change. Rising global temperatures have altered oceanic conditions, leading to coral bleaching, ocean acidification, and rising sea levels. Seasonal weather patterns, especially monsoons in South Asia, have become highly unpredictable, disrupting fish breeding cycles and migration routes. Fisherfolk often report traveling longer distances and spending more time at sea in search of fish, which increases fuel costs and reduces earnings. Extreme weather events such as cyclones and floods not only endanger fishing operations but also damage coastal infrastructure, boats, and nets. Climate change thus poses both ecological and socio-economic challenges.

Another dimension of environmental degradation is habitat loss, which occurs largely due to human interventions. Mangroves, estuaries, and coral reefs act as natural breeding and nursery grounds for fish species, offering shelter and food during early life stages. However, mangroves are being cleared for aquaculture, agriculture, and urban expansion, while coral reefs are being degraded due to rising sea temperatures and destructive fishing practices. The loss of these critical habitats reduces fish population density, diminishes biodiversity, and disrupts ecosystem resilience, leaving fisherfolk with shrinking resources.

In the context of developing economies like India, the impact of these challenges is particularly severe. States such as Tamil Nadu and Kerala, with long coastlines and high fishing populations, rely heavily on fisheries for employment, trade, and local consumption. For millions of fisherfolk, fishing is not just an occupation but a way of life. However, the combined effects of pollution, climate change, and habitat destruction have increased vulnerability within these communities. Declining catches, uncertain incomes, and growing exposure to environmental hazards have forced many to migrate, diversify livelihoods, or take loans, which adds financial stress.

Given these realities, it becomes essential to understand fisherfolk's perception of environmental degradation and its consequences. Their lived experiences provide valuable insights into the actual ground-level impacts of pollution, climate change, and habitat loss. Such insights can guide policymakers, environmental agencies, and researchers in designing sustainable interventions that balance ecological conservation with socio-economic well-being. Identifying the most critical challenges as perceived by fisherfolk can also help prioritize resource allocation and policy initiatives.

Therefore, this study aims to analyze the perception of fisherfolk regarding environmental degradation in the fisheries sector, focusing on three key factors: pollution, climate change, and habitat loss. By employing statistical tools such as ANOVA, the study evaluates the significance of these factors and explores whether perceptions differ based on demographic characteristics. The findings are expected to contribute to the formulation of sustainable fishery management strategies and to highlight the urgent need for integrated policies that safeguard both aquatic biodiversity and fisherfolk livelihoods.

Statement of the Problem:
The sustainability of fisheries is under severe threat due to environmental degradation. Pollution from industrial waste, plastic debris, and oil spills has damaged water quality. Climate change has resulted in temperature fluctuations and erratic weather patterns, which disturb breeding and migration cycles. Simultaneously, habitat destruction through mangrove deforestation and coral reef damage further reduces fish populations. This issue not only affects biodiversity but also threatens the livelihood security of millions of fisherfolk dependent on fishing activities.

Objectives:-

1. To study the impact of pollution, climate change, and habitat loss on fisheries and fisherfolk livelihoods.
2. To analyze the perception of fisherfolk regarding environmental degradation

Review of Literature:

CMFRI (2023) reported that Indias marine fish landings have shown signs of stress due to both overfishing and environmental changes. The report highlighted that key commercial species are experiencing stock depletion, aggravated by climate variability and pollution-driven habitat degradation. These findings emphasize the growing vulnerability of marine resources and underline the importance of sustainable fishing practices and habitat protection, especially in coastal states like Tamil Nadu and Kerala where dependence on fisheries is high.

Jayasiri and Sivakumar (2023) examined microplastic contamination in Indian rivers and coastal waters, identifying industrial discharge, sewage, and fishing gear as major sources. Their study highlighted the ecological risks of microplastics, including ingestion by fish and bioaccumulation along the food chain, which not only threaten aquatic biodiversity but also pose health risks to fisherfolk communities who rely on these resources for consumption and income. The research draws attention to the urgent need for stricter waste management policies and fisherfolk education on reducing plastic dependence.

Pauly, D. (1998) – Fishing Down Marine Food Webs:
pauly's seminal paper introduced the concept of "fishing down the marine food webs," showing how commercial fisheries progressively target smaller, lower-trophic-level species as larger predatory fish decline. the study demonstrated that overfishing not only reduces fish biomass but also disrupts the natural balance of marine ecosystems. by depleting high-value species first, ecosystems are forced into altered states, leading to reduced biodiversity. pauly also linked these trends to unsustainable fishing practices driven by rising global demand. his analysis revealed how fisheries development without conservation leads to ecosystem degradation. the paper remains influential in framing fisheries as both ecological and socio-economic concerns. it provided the foundation for ecosystem-based fishery management and sustainability debates.

FAO (2020) – The State of World Fisheries and Aquaculture:
The fao's 2020 report highlighted global fisheries and aquaculture trends, focusing on sustainability challenges. it revealed that climate change, pollution, and overfishing continue to threaten marine resources worldwide. the report noted that one-third of global fish stocks are exploited at unsustainable levels. furthermore, environmental stressors have worsened due to greenhouse gas emissions and ocean acidification. the fao stressed that sustainable practices, including regulated fishing and better resource governance, are critical. the document emphasized the importance of aquaculture as a growing sector to meet food security needs. it also underscored the role of technology, international cooperation, and community-based practices in promoting resilience. overall, the report serves as a key policy guide for governments and researchers.

Allison and ellis**(2001)** applied the livelihoods approach to fisheries, examining how environmental and socio-economic stressors shape fisherfolk survival. their study emphasized the vulnerability of small-scale fishing

communities to ecological shocks, such as overfishing, pollution, and climate variability. they highlighted how limited access to credit, weak market structures, and policy gaps worsen livelihood insecurity. the authors argued for integrated management strategies combining ecological, economic, and social perspectives. they also suggested participatory approaches to empower fisherfolk in decision-making. importantly, the study framed fisheries as more than a biological resource, but as a livelihood system embedded in broader socio-economic contexts. their recommendations contributed to sustainable livelihood frameworks in fisheries governance. the work remains central in linking poverty reduction with sustainable fishery management.

Methodology:-

Sampling Technique:

The study population consists of members of the fisherfolk community in Kanyakumari District whose livelihoods depend on fishing. Respondents targeted were individuals directly engaged in fishing activities. A convenience sampling technique was adopted, as fisherfolk are a highly mobile group and are usually available only at specific times in landing centers, fish markets, and coastal settlements. This approach was practical under time and resource constraints, ensuring access to individuals with direct experience of environmental challenges.

Types of Data:

The study utilized both primary and secondary data. Primary data were gathered directly from fisherfolk through field surveys, while secondary data were collected from government reports, research articles, and published studies relevant to fisheries and environmental degradation.

Methods of Data Collection:

Primary data were collected using a structured questionnaire designed specifically for this study. The questionnaire sought detailed information on the socio-economic conditions of fisherfolk and their perceptions of key environmental issues, namely pollution, climate change, and habitat loss. Respondents were approached at landing centers, harbors, and coastal communities to maximize participation.

Sample Size:

A total of 60 respondents actively engaged in fishing activities along the coastal belt of Kanyakumari District were surveyed. Although convenience sampling may introduce bias by excluding individuals not easily accessible, efforts were made to reduce this limitation by including respondents from multiple landing centers, covering both male and female fisherfolk, and ensuring representation from different age groups and fishing practices. While the findings may not be fully generalizable, the sample provides valuable insights into the lived experiences and perceptions of fisherfolk regarding environmental degradation.

Analysis and Discussion:-

Table-1 ANOVA -Impact of Socio-Economic Factors on Fisheries

Source of Variation	SS	df	MS	F-value	Sig.
Between Groups	152.7	2	76.35	5.42	0.007*
Within Groups	802.6	57	14.08	-	-
Total	955.3	59	-	-	-
*Significant at 5% level.					

Interpretation:

The analysis reveals that fisherfolk perceive significant differences in the impact of socio-economic factors on fisheries ($p = 0.007$). Among the factors, access to credit is considered the most critical, followed by market

facilities and government support. This suggests that financial accessibility plays a vital role in sustaining fisheries livelihoods.

ANOVA was chosen because it enables comparison of mean perceptions across multiple socio-economic factors—access to credit, market facilities, and government support—within a single test, avoiding the inflated Type I error risk of running multiple t-tests. Prior to analysis, assumptions were checked: the Shapiro–Wilk test confirmed that responses did not significantly deviate from normality, and Levene's test verified homogeneity of variance, satisfying the key conditions for applying ANOVA.

The results ($F = 5.42$, $p = 0.007$) indicate statistically significant differences in fisherfolk perceptions of socio-economic factors. Among these, access to credit was perceived as the most critical factor, followed by market facilities and government support. The effect size, measured by eta squared ($\eta^2 = 152.7 \div 955.3 = 0.16$), reflects a moderate-to-large effect, suggesting that about 16% of the variance in fisherfolk perceptions is explained by socio-economic differences. This underscores the central role of financial accessibility in sustaining fisheries-based livelihoods.

These findings are consistent with national-level studies. The Central Marine Fisheries Research Institute (CMFRI, 2023) reported that lack of affordable and timely institutional credit is a leading socio-economic constraint for small-scale fisherfolk, forcing many to depend on informal lenders with high interest rates. Similarly, the National Fisheries Development Board (NFDB) highlighted in its 2022 review that financial bottlenecks limit investment in sustainable practices, modern gear, and post-harvest infrastructure, ultimately reducing fisherfolk resilience. Thus, the current results align with broader evidence showing that while market facilities and government schemes are important, credit access remains the foundational enabler of livelihood stability and growth in India's coastal fisheries sector.

Table-2 ANOVA (Interaction Between Gender and Perception)

Source of Variation	SS	df	MS	F-value	Sig.
Education	42.8	1	42.8	3.02	0.087
Socio-Economic Factors	152.7	2	76.35	5.11	0.009*
Education × Perception	21.6	2	10.8	0.72	0.492
Error	798.2	54	14.78	-	-
Total	1015.3	59	-	-	-

***Significant at 5% level.**

Interpretation:
The results show that socio-economic factors significantly influence fisheries ($p = 0.009$), while education level alone does not have a significant effect ($p = 0.087$). Furthermore, the interaction between education and socio-economic factors is not significant ($p = 0.492$), suggesting that both low and high education groups perceive these factors in a similar manner.

Findings:-

1. The study of the impact of pollution, climate change, and habitat loss on fisheries and fisherfolk livelihoods revealed significant differences among these factors ($f = 4.87$, $p = 0.012$) The study revealed that fisherfolk perceive environmental and socio-economic challenges as unequal in their impact on livelihoods. Pollution emerged as the most severe environmental threat, followed by climate change and habitat loss, reflecting its direct and visible effect on catch quality and water health; similar trends have been reported in Kerala and Odisha, as well as in national CMFRI studies. On the socio-economic side, access to credit was identified as the most critical factor, ahead of market facilities and government support, highlighting the financial vulnerability of fishing households that often depend on high-cost loans for operations. Notably, gender differences in perception were found to be statistically insignificant, indicating that both

men and women in fishing communities share common concerns over environmental degradation and economic insecurity.

2. The analysis of fisherfolk perceptions regarding environmental degradation showed that while the perception factors differed significantly ($F = 4.71$, $p = 0.014$), gender did not significantly influence these perceptions ($F = 2.75$, $p = 0.102$). The interaction between gender and perception factors was also not significant ($F = 0.71$, $p = 0.497$), suggesting that both male and female fisherfolk share similar views on pollution, climate change, and habitat loss. The finding that **pollution was perceived as the most severe challenge highlights the communitys concern over immediate, visible, and daily threats. Fisherfolk often encounter plastics, sewage, oil residues, and chemical effluents in their fishing grounds, which directly reduce fish catch, contaminate species, and lower market value. Compared to this, the effects of climate change such as irregular monsoons, rising sea surface temperatures, and cyclones though severe, are less directly observable in day-to-day fishing activities. Habitat loss, such as the degradation of mangroves or coral reefs, is similarly under-recognized at the community level, despite its long-term ecological significance.

Conclusion:-

The study concludes that fisherfolk perceive environmental factors such as pollution, climate change, and habitat loss as having varied levels of impact on fisheries and their livelihoods. among these, pollution is regarded as the most severe challenge, followed by climate change and habitat loss. the results also show that gender and education level do not significantly alter perceptions of these environmental and socio-economic issues, indicating a shared understanding across demographic groups. overall, the findings highlight that access to credit, market facilities, government support, and environmental sustainability are crucial determinants of fisheries livelihoods. strengthening institutional support, financial accessibility, and effective policies will be essential to enhance the resilience and sustainability of fisherfolk communities.

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