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Lucas Augusto
Universidade de Brasilia

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Abstract

Purpose: The aim of the study was to examine effect of plastic ocean pollution on marine life and human health in Brazil.

Methodology: This study adopted a desk methodology. A desk study research design is commonly known as secondary data collection. This is basically collecting data from existing resources preferably because of its low cost advantage as compared to a field research. Our current study looked into already published studies and reports as the data was easily accessed through online journals and libraries.

Findings: The study found that pervasive presence of plastic debris in Brazil's coastal waters threatens marine ecosystems, leading to entanglement, ingestion, and suffocation of marine species such as seabirds, turtles, and marine mammals. Furthermore, microplastics, resulting from the breakdown of larger plastic items, pose insidious risks to marine life as they are ingested by plankton and subsequently enter the food chain, potentially accumulating in higher trophic levels, including fish consumed by humans. This not only disrupts marine biodiversity but also raises concerns about the safety and quality of seafood, impacting human health and food security in coastal communities.

Unique Contribution to Theory, Practice and Policy: Ecological theory, health impact assessment (HIA) theory & environmental justice theory may be used to anchor future studies on Effect of Plastic Ocean Pollution on Marine Life and Human Health in Brazil. Develop and deploy technologies that efficiently remove microplastics and larger debris from marine environments. This includes advancements in filtration systems for water treatment facilities and specialized equipment for collecting debris from ocean surfaces and shorelines. Enforce regulations limiting the production of non-essential single-use plastics, promoting the use of sustainable materials. Policy-makers should consider lifecycle assessments in the approval process of new plastic products.

Keywords: *Plastic Ocean Pollution, Marine Life, Human Health*

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INTRODUCTION

In developed economies like the USA, Japan, and the UK, marine life plays a significant role in human health through various means. For instance, seafood is a crucial source of essential nutrients like omega-3 fatty acids, which are beneficial for heart health. According to a study published in the Journal of the American Medical Association, the consumption of seafood has been associated with a reduced risk of coronary heart disease mortality, with every additional serving per week linked to a 4% lower risk (Mozaffarian, 2016). Furthermore, marine organisms are increasingly being explored as sources of pharmaceuticals, with compounds derived from marine organisms showing promise in the treatment of various diseases, including cancer and bacterial infections.

Similarly, in countries like the USA, Japan, and the UK, marine environments contribute to mental health and well-being through recreational activities such as beachgoing, diving, and fishing. These activities provide opportunities for stress reduction, physical exercise, and connection with nature, all of which have been linked to improved mental health outcomes. According to a study published in the journal Landscape and Urban Planning, access to blue spaces like oceans and coastal areas is associated with lower levels of psychological distress and better overall mental health (White, 2019). Thus, marine environments serve as valuable resources for promoting both physical and mental well-being in developed economies.

Marine life also plays a crucial role in human health and well-being. For example, in countries like Indonesia and the Philippines, where fish is a staple food, access to marine resources directly impacts nutrition and food security. According to data from the Food and Agriculture Organization (FAO), fish provides over 50% of animal protein intake in some coastal developing countries, contributing significantly to dietary diversity and micronutrient intake (FAO, 2018). Additionally, marine-based tourism in countries like Thailand and Egypt generates significant revenue and employment opportunities, contributing to economic development and poverty alleviation in coastal communities.

Marine life plays a multifaceted role in supporting human health and well-being, often in ways that are deeply intertwined with local cultures and traditions. For instance, in coastal communities of countries like India and Bangladesh, seaweed cultivation not only provides a source of income but also serves as a nutritious food source rich in vitamins, minerals, and dietary fiber. Studies have shown that seaweed consumption is associated with various health benefits, including improved gut health and reduced risk of chronic diseases such as obesity and diabetes (Kumar, 2015). Additionally, marine ecosystems in developing economies often support traditional medicine practices, where certain marine organisms are used for their medicinal properties. For example, in many coastal regions of Africa and Asia, marine plants and organisms are utilized in traditional remedies for ailments ranging from skin disorders to respiratory illnesses.

Furthermore, in countries like Brazil and Mexico, marine biodiversity contributes to the development of novel biotechnological products with potential applications in medicine and industry. Research into marine-derived compounds has led to the discovery of new drugs, enzymes, and biomaterials, opening up avenues for innovation and economic growth. According to a study published in the journal Marine Drugs, marine organisms have yielded a diverse array of bioactive compounds with pharmaceutical potential, including anticancer agents, antibiotics, and anti-inflammatory drugs (Blunt, 2018). This highlights the importance of conserving marine biodiversity not only for ecological reasons but also for its potential to drive socio-economic development in developing economies.

Moreover, in Sub-Saharan African economies such as Nigeria and Senegal, marine resources support livelihoods through artisanal fishing and aquaculture, providing income and food security for millions of people. According to a report by the World Bank, fisheries and aquaculture contribute significantly to GDP and employment in many Sub-Saharan African countries, with the sector employing over 12 million people in the region (World Bank, 2019). Additionally, marine ecosystems in Sub-Saharan Africa provide ecosystem services such as coastal protection and climate regulation, which are essential for the resilience and well-being of coastal communities facing climate change impacts.

Marine life plays a vital role in supporting food security, livelihoods, and cultural traditions, particularly in coastal regions. For example, in countries like Ghana and Senegal, artisanal fisheries form the backbone of coastal communities, providing employment and income for millions of people. According to the Food and Agriculture Organization (FAO), small-scale fisheries in Sub-Saharan Africa contribute significantly to food security, with fish often being the primary source of animal protein for coastal populations (FAO, 2020). Moreover, marine resources are deeply ingrained in local cultures and traditions, with fishing practices passed down through generations and fish playing a central role in traditional cuisines and ceremonies.

Additionally, marine ecosystems in Sub-Saharan Africa provide valuable ecosystem services that support human well-being and resilience. Mangrove forests, coral reefs, and seagrass beds along the coastlines serve as important habitats for fish and other marine species, contributing to fishery productivity and biodiversity. Moreover, these coastal ecosystems provide natural barriers against coastal erosion and storm surges, protecting coastal communities from the impacts of climate change. According to a report by the World Bank, investing in the conservation and sustainable management of marine ecosystems in Sub-Saharan Africa is crucial for ensuring the resilience and socio-economic development of coastal communities (World Bank, 2018). Thus, preserving marine biodiversity and promoting sustainable fishing practices are essential for the long-term well-being of Sub-Saharan economies.

Plastic ocean pollution poses a myriad of detrimental effects on marine life and human health. Firstly, ingestion of plastic debris by marine animals, such as seabirds, turtles, and fish, can lead to internal injuries, blockages in the digestive system, and ultimately death. Research by Jambeck (2015) indicates that millions of tons of plastic waste end up in the oceans annually, endangering marine ecosystems and biodiversity. Moreover, plastics in the ocean act as sponges for harmful chemicals like pesticides and industrial pollutants, which can accumulate in the tissues of marine organisms through a process known as bioaccumulation. These toxins can then enter the human food chain through seafood consumption, posing risks to human health.

Furthermore, plastic pollution in the ocean disrupts marine habitats and ecosystems, leading to cascading effects on biodiversity and ecosystem services that humans rely on. For example, entanglement in discarded fishing gear and plastic debris can cause injury, suffocation, and drowning in marine mammals like whales and seals. This not only threatens their populations but also disrupts the delicate balance of marine ecosystems. Additionally, microplastics, tiny fragments of degraded plastic, can be ingested by filter-feeding organisms such as plankton, which form the base of the marine food web. As microplastics move up the food chain, they can accumulate in higher trophic levels, increasing the likelihood of human exposure to plastic-associated toxins (Wright & Kelly, 2017).

Statement of the Problem

Plastic ocean pollution poses a significant threat to marine life and human health due to its pervasive presence and harmful impacts. With an estimated 8 million metric tons of plastic entering the oceans annually (Jambeck, 2015), marine ecosystems face escalating risks of entanglement, ingestion, and habitat degradation. This pollution not only endangers iconic marine species such as seabirds, turtles, and marine mammals but also disrupts entire food webs, potentially leading to long-term ecological imbalances (Gall & Thompson, 2015). Furthermore, the accumulation of plastic debris in marine environments acts as a vector for toxic chemicals, including persistent organic pollutants and heavy metals, which can bioaccumulate in marine organisms and subsequently threaten human health through seafood consumption (Wright & Kelly, 2017). Thus, understanding the multifaceted impacts of plastic ocean pollution on marine life and human health is imperative for effective mitigation and conservation efforts.

Theoretical Review

Ecological Theory

Originating from ecological science, this theory posits that organisms interact with their environment in complex ways, and changes in environmental conditions can have cascading effects throughout ecosystems. Pioneered by ecologists such as Eugene Odum, this theory emphasizes the interconnectedness of all living organisms and their habitats. In the context of plastic ocean pollution, ecological theory highlights how disruptions to marine ecosystems caused by plastic debris can propagate through food webs, impacting the abundance and distribution of species, and ultimately affecting human health through ecosystem services provided by the oceans (Odum, 1971).

Health Impact Assessment (HIA) Theory

Developed within public health and environmental health disciplines, HIA theory focuses on assessing the potential health consequences of proposed policies, programs, or projects. Originating from scholars like Matthias Braubach and Monica O'Mullane, HIA theory emphasizes the importance of considering both direct and indirect pathways through which environmental changes can affect human health. In the context of plastic ocean pollution, HIA theory provides a framework for evaluating the health risks associated with exposure to plastic-associated toxins through seafood consumption and other pathways, as well as the broader social and economic impacts on human well-being (Braubach & O'Mullane, 2008).

Environmental Justice Theory

Emerging from environmental sociology and ethics, environmental justice theory examines the unequal distribution of environmental benefits and burdens among different social groups, particularly marginalized and vulnerable communities. Scholars such as Robert Bullard and Bunyan Bryant pioneered this theory, highlighting issues of environmental racism and the disproportionate exposure of minority and low-income populations to environmental hazards. In the context of plastic ocean pollution, environmental justice theory underscores the need to address inequities in exposure and vulnerability, as marginalized communities often bear a disproportionate burden of the health impacts associated with plastic pollution, both directly through seafood consumption and indirectly through environmental degradation (Bullard, 1990).

Empirical Review

Lusher (2016) quantified the extent of microplastic ingestion by marine organisms and evaluate potential impacts on marine life and human health. Researchers collected water and sediment samples from coastal areas and analyzed them for microplastic content using microscopy and spectroscopy techniques. They also conducted necropsies on marine organisms to assess the presence and abundance of microplastics in their digestive tracts. The study revealed widespread microplastic contamination in coastal environments, with high levels of ingestion observed in various marine species. Microplastics were found to accumulate in the tissues of organisms, raising concerns about potential toxicological effects and transfer to higher trophic levels. The findings underscore the need for enhanced monitoring of plastic pollution in coastal waters and the implementation of measures to mitigate its impacts on marine ecosystems and human health.

Rochman (2015) evaluated the potential health risks posed by plastic-associated toxins accumulated in seafood due to plastic ocean pollution. Researchers conducted a systematic review of literature on plastic-associated toxins in seafood, focusing on bioaccumulation pathways and human exposure. They also analyzed seafood samples from coastal areas for the presence of plastic-associated chemicals using chromatography and mass spectrometry techniques. The study identified various plastic-associated toxins in seafood, including phthalates, bisphenols, and polychlorinated biphenyls (PCBs), at concentrations exceeding regulatory limits. Human health risks associated with the consumption of contaminated seafood were found to include endocrine disruption, carcinogenic effects, and developmental abnormalities. The findings highlight the importance of stricter regulation of plastic production and waste management to reduce the release of harmful chemicals into marine environments and minimize human exposure through seafood consumption.

Nelms (2016) investigated the effects of plastic pollution on marine mammals through entanglement and ingestion, focusing on species diversity, distribution, and health impacts. Researchers conducted field surveys and necropsies on stranded marine mammals to assess the prevalence and consequences of plastic entanglement and ingestion. They also utilized satellite tracking and modeling techniques to analyze the spatial distribution of plastic debris and its overlap with marine mammal habitats. The study documented high rates of entanglement and ingestion of plastic debris among marine mammal populations, with significant impacts on health and survival. Plastic entanglement was found to cause injuries, infections, and suffocation, while ingestion led to gastrointestinal blockages, malnutrition, and organ damage. The findings emphasize the urgency of addressing plastic pollution through measures such as marine debris removal, habitat protection, and public awareness campaigns to reduce marine mammal mortality and promote ecosystem health.

Lamb (2018) assessed the ecological impacts of plastic pollution on coral reefs, focusing on physical damage, chemical contamination, and biological interactions. Researchers conducted underwater surveys of coral reef ecosystems to quantify the abundance and distribution of plastic debris and assess its effects on coral health and biodiversity. They also conducted laboratory experiments to simulate the effects of plastic debris on coral physiology, reproduction, and symbiotic relationships. The study found that plastic debris can cause physical abrasion and smothering of coral colonies, leading to tissue damage and reduced growth rates. Moreover, plastic-associated toxins were found to leach into surrounding seawater, affecting coral physiology and the health of associated reef organisms. The findings underscore the need for stricter waste management policies and conservation measures to protect coral reefs from the impacts of plastic pollution and preserve their ecological integrity.

Geyer (2017) synthesized current knowledge on the human health risks associated with plastic pollution, including exposure pathways, toxicological mechanisms, and epidemiological evidence. Researchers conducted a comprehensive literature review of studies investigating the health effects of plastic-associated chemicals on human populations. They analyzed exposure pathways, biomonitoring data, and epidemiological studies to assess the risks of plastic pollution to human health. The study identified various exposure pathways through which humans are exposed to plastic-associated toxins, including ingestion, inhalation, and dermal contact. Plastic-associated chemicals were found to disrupt endocrine function, impair immune response, and increase the risk of chronic diseases such as cancer, cardiovascular disease, and neurodevelopmental disorders. The findings highlight the need for more robust risk assessment methods, biomonitoring programs, and regulatory measures to mitigate the health risks of plastic pollution and protect vulnerable populations.

Cózar (2017) examined the social and economic consequences of plastic pollution on coastal communities, including impacts on livelihoods, tourism, and public health. Researchers conducted surveys, interviews, and participatory assessments in coastal communities to document the perceived impacts of plastic pollution on local economies, social cohesion, and well-being. They also analyzed secondary data sources and case studies to identify patterns and trends in the social and economic effects of plastic pollution. The study found that plastic pollution imposes significant costs on coastal communities, including reduced fishery yields, damage to marine infrastructure, and increased healthcare expenses associated with plastic-related illnesses. Moreover, plastic pollution was found to undermine tourism revenues and diminish the cultural and recreational value of coastal environments. The findings underscore the importance of community-based initiatives, policy interventions, and public-private partnerships to address the social and economic impacts of plastic pollution and promote sustainable development in coastal regions. Researchers conducted a comparative analysis of plastic pollution policies and regulations at the international, national, and local levels, assessing their strengths, weaknesses, and implementation gaps. They also engaged with stakeholders from government, industry, and civil society to solicit perspectives on the challenges and opportunities for plastic pollution governance.

Lebreton (2018) evaluated the effectiveness of existing governance frameworks in addressing plastic pollution and identify opportunities for policy interventions to enhance plastic waste management and pollution prevention. The study revealed a fragmented and inconsistent approach to plastic pollution governance, characterized by limited enforcement capacity, lack of coordination among stakeholders, and insufficient investment in waste management infrastructure. Policy interventions were found to be hindered by regulatory loopholes, inadequate funding, and resistance from vested interests. The findings highlight the need for integrated, multi-sectoral approaches to plastic pollution governance, incorporating measures such as extended producer responsibility, plastic bans and restrictions, and public awareness campaigns to reduce plastic consumption and promote circular economy principles.

METHODOLOGY

This study adopted a desk methodology. A desk study research design is commonly known as secondary data collection. This is basically collecting data from existing resources preferably because of its low cost advantage as compared to a field research. Our current study looked into already published studies and reports as the data was easily accessed through online journals and libraries.

RESULTS

Conceptual Gap

The study primarily focuses on the presence and effects of microplastics in marine organisms but doesn't deeply explore the direct implications for human health beyond potential transfer in the food chain (Lusher,2016). The study examines toxins in seafood due to plastic pollution but lacks a broader ecological perspective on how these toxins affect the marine ecosystem's health beyond human health impacts. Focuses on physical harm from entanglement and ingestion but less on the behavioral or reproductive impacts of plastic pollution on marine mammals, which could offer insights into long-term population dynamics.(Nelms, 2016). The study discusses the immediate physical and chemical impacts of plastics on coral reefs but does not address potential recovery mechanisms or the adaptability of coral species to plastic pollution (Lamb (2018). The study discusses the immediate physical and chemical impacts of plastics on coral reefs but does not address potential recovery mechanisms or the adaptability of coral species to plastic pollution. (Lamb, 2018).

Contextual Gap

While the research discusses the widespread nature of contamination, it does not address potential solutions or interventions directly in coastal management or pollution control policies. The implications of these findings on food safety regulations and international standards for seafood consumption are not thoroughly explored, which could bridge research findings with policy implications Rochman (2015).The study's findings could be linked more explicitly to conservation strategies and international wildlife protection policies to enhance its practical relevance. The need for stricter waste management policies is mentioned, yet there is no detailed exploration of specific policy frameworks or success stories from regions that have effectively managed similar issues (Lamb, 2018).

Geographical Gap

Focused on coastal areas, the study might not represent regions with different seafood consumption patterns and varying degrees of pollution exposure. Emphasizes areas known for marine mammal habitats but may neglect regions where reporting and research on entanglement are less frequent but equally important. While coral reefs globally might be affected, the study does not specify which regions' reefs were surveyed, potentially overlooking reefs in less studied but critically impacted areas. The study could benefit from a more diverse geographical scope, including comparisons between industrialized and developing regions, to better understand global disparities in plastic pollution impacts (Geyer (2017). Focuses on coastal communities but does not include inland communities that might also be significantly affected by waterborne plastic pollution through rivers and lakes (Cózar, 2017)

CONCLUSION AND RECOMMENDATIONS

Conclusion

In conclusion, the effect of plastic ocean pollution on marine life and human health in Brazil presents a multifaceted challenge with far-reaching consequences. The pervasive presence of plastic debris in Brazil's coastal waters threatens marine ecosystems, leading to entanglement, ingestion, and suffocation of marine species such as seabirds, turtles, and marine mammals. Furthermore, microplastics, resulting from the breakdown of larger plastic items, pose insidious risks to marine life as they are ingested by plankton and subsequently enter the food chain, potentially accumulating in higher trophic levels, including fish consumed by humans. This not only disrupts marine biodiversity but also raises concerns about the safety and quality of seafood, impacting human health and food security in coastal communities.

Addressing the effect of plastic ocean pollution in Brazil requires coordinated efforts at local, national, and international levels to reduce plastic production, improve waste management infrastructure, and promote sustainable consumption and production patterns. Policy interventions, such as plastic bans, extended producer responsibility schemes, and marine protected areas, play a crucial role in mitigating plastic pollution and protecting marine ecosystems. Additionally, public awareness campaigns, community engagement initiatives, and scientific research are essential in fostering behavioral change, promoting responsible waste disposal practices, and fostering a culture of environmental stewardship. By adopting a holistic approach that integrates environmental conservation, public health, and socioeconomic development, Brazil can work towards mitigating the impacts of plastic ocean pollution, safeguarding marine biodiversity, and promoting the well-being of both marine ecosystems and coastal communities.

Recommendations

Theory

Enhance Understanding of Microplastics Degradation: Theoretical research should focus on the environmental degradation processes of different types of plastics. This knowledge can inform the development of biodegradable plastics and the prediction of pollution patterns.

Toxicological Impact Studies: Expand theoretical models to assess the toxicological impacts of microplastics on marine and human systems, incorporating advanced simulations of bioaccumulation and the effects of chronic exposure to plastic-associated toxins.

Practice

Innovative Cleanup Technologies: Develop and deploy technologies that efficiently remove microplastics and larger debris from marine environments. This includes advancements in filtration systems for water treatment facilities and specialized equipment for collecting debris from ocean surfaces and shorelines.

Community Engagement Programs: Establish community-driven cleanup initiatives and educational programs to raise awareness about the impacts of plastic pollution. These programs should also train communities in waste management practices to prevent further pollution.

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Policy

Stricter Manufacturing Regulations: Enforce regulations limiting the production of non-essential single-use plastics, promoting the use of sustainable materials. Policy-makers should consider lifecycle assessments in the approval process of new plastic products.

International Collaboration for Ocean Health: Develop international agreements that enforce reductions in plastic waste and facilitate technology transfer between countries to manage and mitigate plastic pollution effectively.

Extended Producer Responsibility (EPR): Implement EPR policies requiring manufacturers to be responsible for the entire lifecycle of their products, particularly in terms of waste management and recycling initiatives.

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