The 3rd International Conference on Materials Chemistry and Environmental Engineering
DOI: 10.54254/2755-2721/3/20230347

The human impact of marine ecosystem imbalance: an analysis of society and ocean management

Muyun Li

Simon Fraser University, Burnaby, B.C., Canada

muyun_li@sfu.ca

Abstract. Throughout world history, truly great nations have had to find their place in the oceans. Over 40% of the global population and most of the world's megacities are located in coastal areas. The development of proper ocean management and the implementation of marine resource construction are the core strategies for national development on the world stage. Due to the increasing needs of national development, the oceans have gradually become ecologically unbalanced after enduring human exploitation. These ecological imbalances, such as marine plastic pollution, fish overfishing, and increased climate change, will eventually return to humans and pose a serious threat to human life and health. This paper discusses the desirable and undesirable interactions between the oceans and human health and the social structure of marine resource management. Besides, this paper will propose solutions to alleviate marine ecological problems as well as promote sustainable social development based on two structural analyses. The paper concludes that the relationship between human oceans should be mutually beneficial. Oceans desire to be managed and regulated by humans for their ecosystems and do not desire to be over-exploited and polluted. Humans' desire to derive resources from the oceans to meet their spiritual and health needs while not being exposed to the risks of disasters Analysis of the socio-ecological system should be used to determine options for reducing marine ecological issues while fostering sustainable social development (SES). To put it briefly, we can now strengthen policies that prioritize the health of the ocean and people, develop trustworthy relationships among stakeholders, and encourage economic incentives that alter behavior.

Keywords: ocean ecosystem, resource management, human health, environmental science, social framework.

1. Introduction

Approximately 97% of the planet's water is found in the ocean, which is the name given to the largest body of water [1]. The oceans that make up 70% of the surface of the Earth resemble one another in various respects and have global significance [2]. At the time, it was believed that a marine ecosystem this big and stable could withstand any effects from human activity. The development and utilization of ocean energy and resources, research on the ocean and global change, the ocean environment, and ecology are the most practical means for humans to ensure their own survival and development, increase their living space, and make full use of this final resource-rich treasure on Earth. Many ecosystem services are provided by marine ecosystems around the world, including food for billions of people; carbon sequestration; waste detoxification; and cultural advantages including recreation and spiritual

© 2023 The Authors. This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (https://creativecommons.org/licenses/by/4.0/).

DOI: 10.54254/2755-2721/3/20230347

uplift. However, the exploitation of marine resources and the expanding maritime trade have resulted in rapid and mostly unchecked coastal expansion in coastal nations, which has significantly strained the ecosystems of marine areas. Three key factors—plastic pollution, overfishing, and accelerated climate change—are having a severe impact on humans and are causing ecological imbalances in coastal environments.

This paper discusses the desirable and undesirable interactions between the oceans and human health and the social structure of marine resource management. Besides, this paper will propose solutions to alleviate marine ecological problems as well as promote sustainable social development based on two structural analyses. The analysis of oceans and human health allows us to identify the effects of coastal population centers on ocean health and social health, as well as the relationship between access to ocean resources and coastal quality of life, which enhances mental health and well-being. By analyzing the social-ecological systems (SES) framework, we are able to assess the robustness of current and envisioned institutions, having a better understanding of management structures appropriate to local environmental systems and sustainability.

2. Situation

2.1. Plastics pollution

Although plastics have brought many positive benefits to society and have driven development and innovation in many areas like science, technology, and medicine, there are also concerns about the problems plastic poses. The degradation and recycling of used and waste plastic products is energy-intensive and inefficient. As a result, plastic waste can accumulate in landfills and natural habitats. In this case, wildlife can easily be tangled or suffocated by plastic waste, which can threaten their lives. For humans, chemicals in discarded plastic products can leach out and pose a significant health risk [3]. Approximately 4% of the world's total oil production is used for energy, and the same amount is used to make plastics [3]. On the other hand, more than one-third of the world's plastics are currently used to package other products and are then rapidly discarded. The world's plastic production is currently in an unsustainable state due to the non-renewable nature of fossil fuels and the limitations of human technology for processing recycled waste plastics. Due to landfills on land having insufficient space for plastic, the amount of plastic pollution in the marine environment is also rising. The amount of plastic that reached the ocean from land in 2010 alone ranged from 4.8 million to 12.7 million tons, according to data. According to marine ecologists [4], over the next ten years, plastic flows are expected to multiply by an order of magnitude.

2.2. Over hunting

Fish is an important nutritional resource for the world's population, both in developed and less developed countries, providing more than 20% of the protein intake for 2.6 billion people [5]. Marine ecologists predict that, based on current trends, fish stocks will collapse within 40 years [5]. Because of the dependence on fish in less developed coastal regions and technological productivity constraints, these regions have large differences in fish consumption from those in economically developed regions. Such differences may lead to health inequalities within countries and internationally. On this ground, the continued decline in total world fish stocks will largely increase this trend of inequality. In turn, the increased demand for fish will also accelerate the extinction of fish stocks and disrupt the balance of marine ecosystems [5].

Overfishing has been shown to have indirect ecological effects on coastal systems, including coral reefs and kelp forests [6]. Environmental extinctions brought on by overfishing have been shown to occur before all other human influences on coastal ecosystems, such as pollution, water quality degradation, and anthropogenic climate change [6]. According to recent ecological research on the Canadian East Coast, the extinction of large predatory fish may have a significant effect on marine food chains [7]. The beginning of overfishing results in ecological community changes over decades to centuries, according to paleoecological, archaeological, and historical data. This is due to the ecological

DOI: 10.54254/2755-2721/3/20230347

roles that other species at comparable trophic levels to the overfished species fill until those species themselves go extinct as a result of overfishing or overcrowding [6].

2.3. Climate change

Climate change involves the ocean significantly. For instance, ocean biogeochemical changes can have a direct impact on the climate system, for instance by altering the intake or release of radioactive gases like carbon dioxide. When plankton die-offs and a decline in the ocean's capacity to absorb carbon dioxide occur, harmful algal blooms (HAB)—also known as algal overgrowth—occur [8]. A few days to several months may pass between algal blooms. When an algal bloom fades, the bacteria that decompose the dead algae use up more oxygen, resulting in a "dead zone" where fish can perish [8]. Sea level changes are related to variations in ocean circulation and have implications for human societies as well. Since 1960, the net heat intake of the ocean has been around 20 times greater than that of the atmosphere, despite the ocean's heat capacity being about 1000 times greater than that of the atmosphere [9]. The ocean expands or contracts as a result of variations in heat storage and ocean salinity distribution, affecting regionally and globally the sea level. Last but not least, changes in temperature and salinity at depth and in various regions can be used to identify climate change [10]. Heat, freshwater, and dissolved gases (such as carbon dioxide) can go from the surface ocean into the deep ocean in the density layer thanks to large-scale three-dimensional ocean circulation and the creation of water masses vented by the main thermocline [10]. These channels are crucial for the movement of anomalies in these parameters brought on by variations in the surface environment.

3. Desirable and undesirable interactions between ocean and human health

Ocean health and social well-being are profoundly affected by the modernisation of coastal cities (Fig. 1). The WHO has a broad definition of health, which states that it is "a condition of complete physical, mental, and social well-being and not only the absence of disease or infirmity"[11]. Additionally, consideration is given to people's mental health. Access to resources that promote health in a fair and equal manner is an essential component of what is meant by "human health and well-being" [12]. Ocean health is principally represented from the point of view of human desire by the ecosystem services that the ocean offers. An alternative definition of ocean health is the marine ecosystems that preserve the shape and functionality of distinct ecosystems. Our views of ocean health will constantly change as a result as we place different values on these various ecosystems [12].

DOI: 10.54254/2755-2721/3/20230347

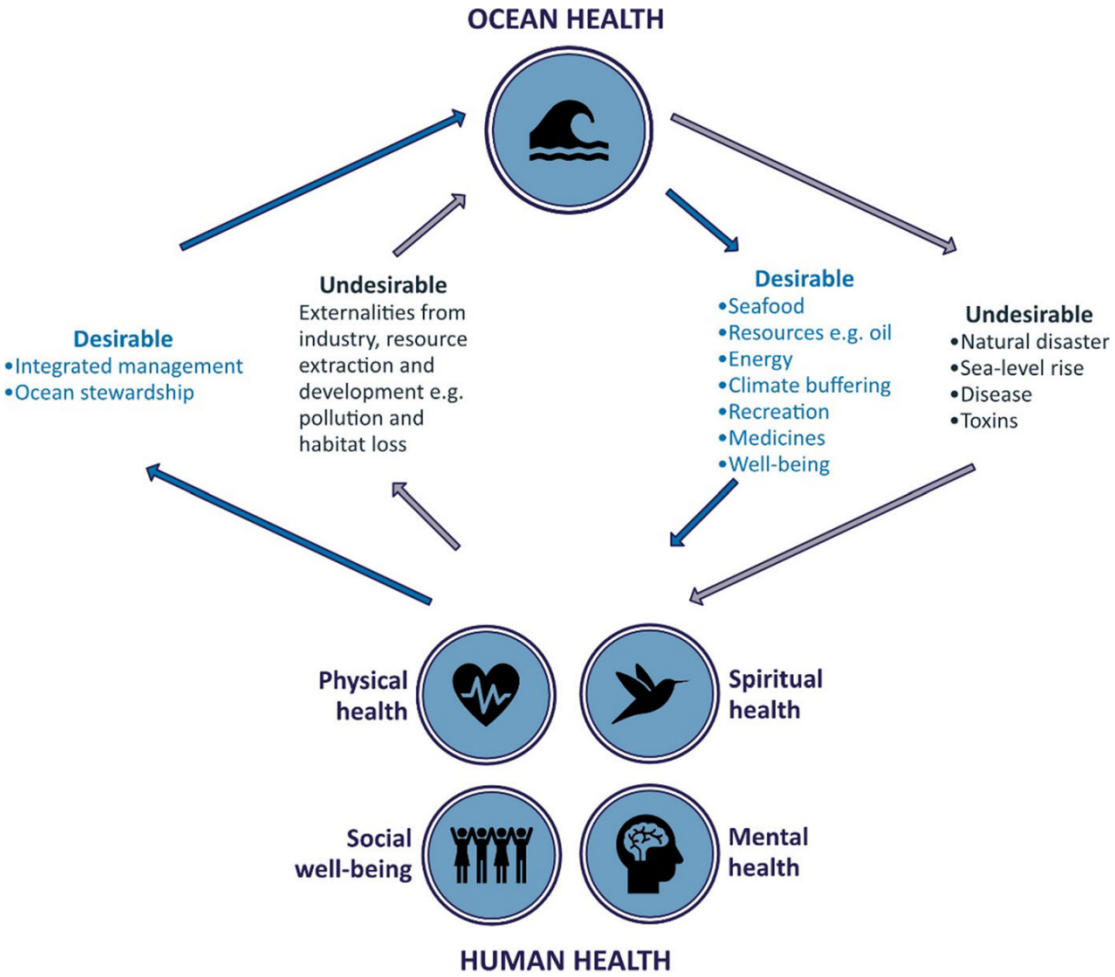

Figure 1. Desirable and undesirable interactions between ocean and human health[12].

4. Social-ecological system framework

For the study of the effectiveness and results of natural resource governance in various socio-ecological system (SES) frameworks (Figure 2) and for commons (CPR), Elinor Ostrom et al. created an analytical framework [13]. The resource system, the resource unit, the governance system, and the actor are all components of the central action scenario in a given social, economic, ecological, and political setting. Individuals in an action situation are those who "observe information, select actions, engage in patterns of interaction, and realize effects from their activity" [13]. Key interaction-directed actions that produce results and propagate to other social-ecological systems (SES) externalities are how social-ecological systems (SES) function. Local systems can be evaluated by individuals and then transmitted back to other SES components, assisting in the process of interaction-directed outcomes [14].

DOI: 10.54254/2755-2721/3/20230347

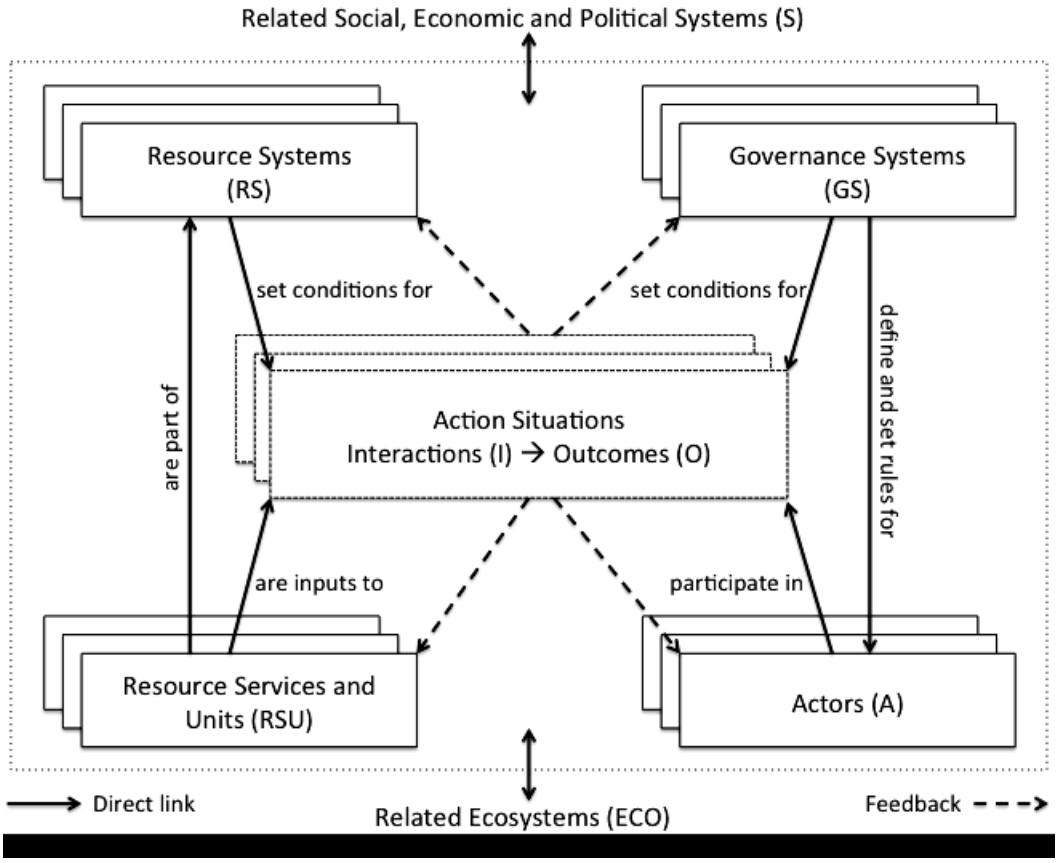

Figure 2. Social-ecological system framework [13].

5. Discussion

The extent and degree of risks to human health and wellbeing posed by the ocean have grown as the world's population has grown from roughly 2 billion people at that time to more than 7.6 billion people now [15]. Today's growing understanding of the value of safeguarding the marine environment among scientists and environmentalists offers an opportunity to consider the intricate relationships between the ocean and human health and wellbeing. In the past, risk frameworks, such as those relating to the negative effects of extreme weather, chemical pollution, and, increasingly, climate change, were the predominant way that ocean-human interactions were portrayed. With a greater understanding of its significant consequences for present-day and long-term human health and well-being, the current study has expanded from this initial premise to cover global ocean health.

Regional natural resources are typically administered by central government organizations and businesses. Understanding the social framework and resource allocation systems is crucial given the growing human effect on the environment and the frequently significant role that communities play in the management of natural resources in various contexts [16]. In order to prevent the so-called "tragedy of the commons," which occurs when local resource users over-acquire resources in order to maximize their own interests in the short term, Harding contends that top-down management mechanisms are essential [17]. Researchers and natural resource managers are increasingly acknowledging the sustainable management of shared resources by local communities as a result of the developing ecological imbalance [16]. Resource-based communities can be very helpful in fostering ecological and social resilience.

A scenario for the sustainable development of society in 2030 was proposed by Nash, K. L. et al. "Living and Connected," a more sustainable future, promotes the growth of interactions between society and the ocean to accomplish sustainable development goals [12]. We can strengthen our position as ocean residents in the ocean environment and establish a more fair distribution of power and resources

DOI: 10.54254/2755-2721/3/20230347

among stakeholders by accomplishing the social aim of "Living and Connecting." The activities that make up this pathway can be divided into four clusters: (i) strengthening ecological regulation and encouraging concern for the ocean and humpback whales; (ii) building more trustworthy relationships between stakeholders to achieve mutual communication; (iii) encouraging economic incentives to achieve sustainability outcomes; and (iv) strengthening methods for more scientific and healthy communication that take into account society's various values, beliefs, and worldviews.

A number of issues, including plastic pollution, overfishing, climate change, and ultimately harm to ourselves, will result from unchecked human use of marine resources. By examining the relationship between marine ecology, human health, and the social resource control system, we need to come up with strategies for maintaining marine ecosystems. We may take immediate steps to enhance knowledge exchange techniques and communication activities in the fields of science and health. Additionally, collaborating with governmental and non-governmental organizations offers a strong foundation for medium-and long-term actions, which call for more forethought.

6. Conclusion

The paper concludes that the desirable and undesirable interactions between the oceans and human health and the social structure of marine resource management are determined by the relationship between the human oceans should be mutually beneficial. Oceans desire to be managed and regulated by humans for their ecosystems and do not desire to be over-exploited and polluted. Humans' desire to derive resources from the oceans to meet their spiritual and health needs while not being exposed to the risks of disasters Analysis of the socio-ecological system should be used to determine options for reducing marine ecological issues while fostering sustainable social development (SES). To put it briefly, we can now strengthen policies that prioritize the health of the ocean and people, develop trustworthy relationships among stakeholders, and encourage economic incentives that alter behavior.

Although the two analytical frameworks involved in the article can provide ideas on marine ecological management in general, there are limited targeted solutions for the three typical ecological impacts mentioned in the article. Further research in these areas needs to involve scientific and technical analysis as well as the acquisition and processing of data and information. In-depth research can be conducted in the future on microplastic particles, marine fish stock derivation tracing, and global climate change data monitoring.

References

[1] Khan, N. Y. (2007). Multiple stressors and ecosystem-based management in the Gulf. Aquatic Ecosystem Health & Management, 10(3), 259-267.

[2] National Ocean Service. (2018). Ocean facts: How many oceans are there? Retrieved from https://oceanservice.noaa.gov/facts/howmanyoceans.html

[3] Thompson, R. C., Moore, C. J., Vom Saal, F. S., & Swan, S. H. (2009). Plastics, the environment and human health: current consensus and future trends. Philosophical transactions of the royal society B: biological sciences, 364(1526), 2153-2166.

[4] Beaumont, N. J., Aanesen, M., Austen, M. C., Börger, T., Clark, J. R., Cole, M., ... & Wyles, K. J. (2019). Global ecological, social and economic impacts of marine plastic. Marine pollution bulletin, 142, 189-195.

[5] Brunner, E. J., Jones, P. J., Friel, S., & Bartley, M. (2009). Fish, human health and marine ecosystem health: policies in collision. International journal of epidemiology, 38(1), 93-100.

[6] Jackson, J. B., Kirby, M. X., Berger, W. H., Bjorndal, K. A., Botsford, L. W., Bourque, B. J., ... & Warner, R. R. (2001). Historical overfishing and the recent collapse of coastal ecosystems. science, 293(5530), 629-637.

[7] Scheffer, M., Carpenter, S., & de Young, B. (2005). Cascading effects of overfishing marine systems. Trends in ecology & evolution, 20(11), 579-581.

[8] Sellner, K. G., Doucette, G. J., & Kirkpatrick, G. J. (2003). Harmful algal blooms: causes, impacts and detection. Journal of Industrial Microbiology and Biotechnology, 30(7), 383-406.

DOI: 10.54254/2755-2721/3/20230347

[9] Levitus, S., Antonov, J., & Boyer, T. (2005). Warming of the world ocean, 1955 – 2003. Geophysical research letters, 32(2).
[10] Bindoff, N. L., Willebrand, J., Artale, V., Cazenave, A., Gregory, J. M., Gulev, S., ... & Woodworth, P. (2007). Observations: oceanic climate change and sea level. 385-428
[11] World Health Organization. (1946). Preamble to the constitution of the world health organization as adopted by the international health conference. no. 2, p. 100
[12] Nash, K. L., Van Putten, I., Alexander, K. A., Bettiol, S., Cvitanovic, C., Farmery, A. K., ... & Vince, J. (2022). Oceans and society: feedbacks between ocean and human health. Reviews in Fish Biology and Fisheries, 32(1), pp.161-187.
[13] Ostrom, E. (2009). A general framework for analyzing sustainability of social-ecological systems. Science, 325(5939), 419-422.
[14] Klain, S. C., Beveridge, R., & Bennett, N. J. (2014). Ecologically sustainable but unjust? Negotiating equity and authority in common-pool marine resource management. Ecology and Society, 19(4).
[15] Fleming, L. E., Maycock, B., White, M. P., & Depledge, M. H. (2019). Fostering human health through ocean sustainability in the 21st century. People and Nature, 1(3), 276-283.
[16] Cox, M., Arnold, G., & Tomás, S. V. (2010). A review of design principles for community-based natural resource management. Ecology and Society, 15(4).
[17] Hardin, G. (1968). The tragedy of the commons: the population problem has no technical solution; it requires a fundamental extension in morality. Science, 162(3859), 1243-1248.