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Microplastics as an Environmental Ethical Challenge: A Comprehensive Study of Human Impact and Responsibility

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ABSTRACT

Microplastic pollution has become a global environmental issue with extensive impacts on organisms, ecosystems, and human communities. This article aims to examine the environmental challenges arising from plastic production and consumption, as well as to assess the interconnections between biological, ecological, social, and moral aspects in the context of microplastics. This study employs a literature review method, drawing from recent research on the impacts of microplastics and theories of environmental ethics. The analysis shows that microplastics cause physiological disturbances in organisms, alter ecosystem structures, and create ecological injustices, particularly for coastal communities and vulnerable groups. From an ethical perspective, the use of single-use plastics is difficult to justify, as their short-term convenience does not outweigh long-term ecological damage. Furthermore, the current linear plastic production model is proven unsustainable and requires transformation toward a circular economy. Biological scientists have a moral responsibility to provide evidence-based solutions, while Indonesia's policies show progress but still require strengthening in preventive measures and producer responsibility. Overall, this review highlights the importance of a holistic and cross-sectoral environmental ethics approach to addressing microplastic issues in order to ensure ecosystem sustainability and intergenerational justice.

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INTRODUCTION

Microplastics are plastic particles less than 5 mm in size that can come from larger plastic fragmentation or be produced in microscopic sizes for specific uses. The existence of microplastics has become a global concern because these particles are found in various environmental compartments, including water, sediment, soil, and air. Their widespread distribution and resistance to natural degradation processes make microplastics a complex environmental problem. In addition to potentially disrupting organisms and ecosystem functions, the existence of microplastics also raises questions about

environmental security, people's consumption patterns, and human responsibility for the sustainability of life (Barnes et al., 2009; Wright & Kelly, 2017).

A number of previous studies have examined microplastic pollution from various perspectives. Barnes et al. (2009), for example, discuss the accumulation and fragmentation of plastic waste in the global environment and show that plastic waste can survive and undergo fragmentation into smaller particles. Cole et al. (2011) reviewed the presence of microplastics in the marine environment, including their possible interactions with marine organisms. Meanwhile, Auta et al. (2017) discussed the source, environmental fate, impacts, and alternatives to handling microplastics in marine ecosystems. These studies provide an important basis for understanding the characteristics of microplastic pollution, its distribution pathways, and the ecological consequences it causes.

Studies on microplastics are also developing towards human health and coastal environmental pollution. Wright and Kelly (2017) discuss possible pathways of microplastic exposure to humans and their implications for health, while Aulia et al. (2023) examine the impact of microplastics on the coastal environment, marine life, and potential health risks. On the other hand, Arista (2023) examines the role of microorganisms in the plastic biodegradation process, including the mechanisms of degradation and the groups of microorganisms that are potentially involved. These studies show that the problem of plastics and microplastics requires an approach that includes ecological, biological, health, and technological aspects of environmental management.

However, the discussion of biological and ecological impacts does not in itself answer the question of moral responsibility for microplastic pollution. The production and consumption patterns of plastics, especially single-use plastics, are related to economic choices, community behavior, government policies, and the distribution of environmental benefits and risks. Coastal communities and groups that depend on natural resources can face the consequences of pollution that affect their environment and livelihoods. These conditions raise questions about fairness in the sharing of environmental burdens, the responsibility of producers and consumers, and the government's obligation to prevent ecological damage.

The development of environmental ethics studies provides a framework to examine these issues. In this perspective, the environment is not only seen as a resource that meets human needs, but also

as a living system that has value and needs to be maintained. The concept of ecological justice expands the discussion of justice by considering the impact of human activities on non-human organisms, ecosystems, vulnerable community groups, and future generations. Therefore, microplastic pollution needs to be analyzed not only based on the magnitude of the ecological impact, but also on the question of who benefits from the use of plastics, who bears the risk of pollution, and who is obliged to take corrective action.

Based on this previous research, this article places the issue of microplastics in the relationship between scientific evidence and ethical responsibility. The contribution to be developed is a conceptual synthesis that links the biological and ecological impacts of microplastics with ecological justice, the use of single-use plastics, linear production models, the responsibility of biological scientists, and Indonesian government policies. Thus, the purpose of this article is to analyze microplastic pollution as an environmental ethical challenge and identify forms of human responsibility and more sustainable management directions.

RESEARCH METHODS

Study Design

This study employed a qualitative approach using a literature review or narrative review method to examine microplastic pollution from biological, ecological, social, and environmental ethical perspectives. The review analyzed scientific publications to identify the impacts of microplastics, explore the links between plastic production and consumption patterns and ecological justice, and examine human responsibilities in preventing and addressing pollution. Rather than merely summarizing previous findings, the study developed a conceptual synthesis of microplastic pollution as an environmental ethical challenge.

The literature was obtained from Google Scholar and covered publications from 2009 to 2025, including national and international journal articles, academic books, and official reports from relevant government agencies and organizations. Sources were selected based on their relevance to the biological and ecological impacts of microplastics, ecological justice, single-use plastics, plastic production and consumption systems, the responsibilities of biological scientists, and policies addressing plastic pollution. Publications lacking substantive relevance to these research themes were excluded from the main synthesis.

Data Collection

The literature search is carried out through several stages. The first stage is to identify problems and establish the focus of

the study based on the relationship between microplastic pollution and environmental ethics. The second stage is to browse scientific publications that are relevant to the research topic. The search is directed to terms related to microplastics, ecological impacts, environmental ethics, ecological justice, single-use plastics, circular economy, scientist responsibility, and plastic waste management policies.

The third stage is to select literature based on the relevance of the title, abstract, and content of the publication to the research objectives. The inclusion criteria include publications that discuss microplastics and their impact on organisms or ecosystems, conceptual studies on ethics and environmental justice, and sources that explain human responsibility and policies to address plastic pollution. Meanwhile, publications that are not relevant to the focus of the research or do not provide sufficient information to support the discussion are excluded from the synthesis.

The fourth stage is to group the selected literature into main themes. This grouping is carried out to facilitate the comparison of findings between publications and to identify the relationship between scientific evidence on the impact of microplastics and the issue of moral responsibility and environmental sustainability.

Data Analysis

The data were analyzed qualitatively through critical reading, thematic grouping, comparison of findings, and conceptual synthesis. The analysis focused on five main themes, namely: (1) the biological and ecological impacts of microplastics; (2) the use of single-use plastics and plastic production patterns; (3) ecological justice and environmental risk distribution; (4) the responsibility of biological scientists in providing scientific evidence and developing solutions; and (5) government policies in the prevention and management of plastic pollution.

On each theme, information from relevant publications is compared to identify similarities in findings, differences of viewpoints, and their implications for research problems. Biological and ecological findings are further interpreted using an environmental ethics perspective to discuss the responsibilities of producers, consumers, scientists, and governments. The final synthesis is used to formulate a comprehensive understanding of microplastic pollution as a problem that is not only related to environmental damage, but also to moral responsibility, ecological justice, and the protection of future generations.

RESULTS AND DISCUSSION

Microplastics as a Biological and Ecological Problem

Microplastics are plastic particles less than 5 mm in size that come from the fragmentation of larger plastics as well as from particles produced in small sizes. Their presence in the environment shows that plastic pollution is not only in the form of garbage that is visible directly, but also includes small particles that can spread through various environmental media. Barnes et al. (2009) describe the accumulation and fragmentation of plastic waste in various environments, while Cole et al. (2011) describe the presence of microplastics in the marine environment and their potential interactions with organisms.

Auta et al. (2017), through their literature review, discussed the source, distribution, environmental fate, impacts, and alternative handling of microplastics. The study showed that microplastics have been found in various environmental compartments and can be ingested by a variety of marine organisms, ranging from invertebrates to vertebrates. This finding is in line with Galloway et al. (2017), who explained that microplastics are not particles that are always inert after entering the environment. Particles can interact with organic matter and other contaminants, while their surface characteristics and polymer composition can affect their bioavailability and potential toxicity.

The distribution of microplastics is also not limited to marine ecosystems. Jambeck et al. (2015) identified the importance of plastic waste input from land to ocean, while Lebreton et al. (2017) discussed the role of rivers as a transportation route for plastic waste to the sea. Ochoa et al.'s (2024) research expanded the understanding of these pathways by studying microplastics in urban rainwater runoff. Their research found different types of polymers in runoff samples and showed that microplastic loads may be related to accumulation as well as rainfall intensity. These results indicate that urban drainage systems can be one of the pathways for the transfer of microplastics from land surfaces to aquatic ecosystems.

In the Indonesian context, Salsabila et al. (2022) examined the characteristics of microplastics in the waters of the Central Island, Karimunjawa. The study is relevant to show the importance of research at the local level because the characteristics and distribution of microplastics need to be understood based on environmental conditions and pollution sources in each location. However, the results of a single region cannot be directly generalized to all Indonesian waters. Variations in land use, community activities, hydrological characteristics, and waste management

systems need to be taken into account when comparing findings between regions.

From a biological perspective, the presence of microplastics is a concern because particles can be ingested by organisms, interact with biological tissues, and potentially affect certain physiological processes. Galloway et al. (2017) discuss possible disruptions to the feeding process, energy reserves, growth, and reproduction in exposed organisms. Meanwhile, Gallo et al. (2018) highlight the need for preventive measures against plastic and microplastic waste, including attention to the chemical components contained in plastic materials. Teuten et al. (2009) also discuss the potential of plastics to transport hydrophobic contaminants in the environment. However, the level of impact cannot be equalized because it is influenced by the type of polymer, particle size and shape, concentration, duration of exposure, and characteristics of the organism.

The relevance of this issue to humans is demonstrated by the research of Ragusa et al. (2021), which reported the detection of microplastic particles in a number of human placental samples. The study is important evidence of the presence of microplastics in human biological tissues, but does not by itself prove that such exposure causes certain diseases or developmental disorders. Thus, the discussion of health risks needs to distinguish between evidence of the presence of particles, possible biological mechanisms, and causal evidence regarding health impacts.

Overall, these studies show that microplastics are a cross-ecosystem problem involving pollution sources, transportation routes, biological interactions, and potential risks. Therefore, the problem of microplastics is not sufficiently understood through the number of particles found. The analysis also needs to consider the human activities that produce pollution, the ability of ecosystems to maintain their functions, and moral responsibility to prevent and reduce environmental impacts.

Environmental Ethics as a Framework for Moral Assessment

Environmental ethics provides a basis for assessing human relationships with nature, including moral obligations that arise from production and consumption activities. Hudha et al. (2019) discuss environmental ethics as a basis for understanding human behavior towards the environment and the importance of maintaining ecosystem balance. In the context of microplastics, this approach allows pollution problems to be assessed not only based on economic or technical consequences, but also on responsibility, justice, and respect for the sustainability of life.

Bennett (2010), through the discussion of environmental ethics, can be used as a general basis for considering the moral value of the environment and the relationship of humans with nature. However, the ethical concepts used in this article need to be explained operationally so as not to remain normative terms. Ecological responsibility, for example, can be interpreted as an obligation to prevent foreseeable damage, reduce sources of pollution, and redress the impacts caused by human activities. Meanwhile, ecological justice demands attention to the distribution of environmental benefits and burdens, including consequences for non-human organisms and future generations.

Galloway et al. (2017) show that there is a tension between the practical benefits of plastic in everyday life and the potential ecological damage due to irresponsible disposal. This tension is an ethical issue because the benefits of plastic can be enjoyed in a relatively short period of time, while the waste can persist and fragment in the long term. Therefore, the decision to use plastics, especially single-use plastics, needs to consider the entire life cycle of the product, not just the ease during its use.

Rahmadhani and Widowati (2026) directly discuss the gap between knowledge about microplastic pollution and the application of environmental ethics. The article emphasizes the need for an interdisciplinary approach that connects ecological, toxicological, social, and ethical perspectives in formulating responses to microplastic pollution.

The study reinforces the argument that scientific evidence does not automatically result in behavioral or policy changes. Information about the impact of microplastics needs to be translated into moral considerations and institutional decisions. Thus, environmental ethics serves as a link between knowledge of ecosystem conditions and human obligations to reduce the risks generated by production and consumption activities.

Saputra et al. (2025) also discuss the application of environmental ethical principles in sustainable development policies, with attention to ecological responsibility, intergenerational justice, and environmental rights. The study is relevant to expanding the discussion on how moral principles can be incorporated into the policy formulation process. In the case of microplastics, these principles can be applied through the prevention of pollution at the source, reduction of unnecessary products, increased producer responsibility, and strengthening protection of affected ecosystems and communities.

Thus, environmental ethics is not merely a complement to scientific discussions about microplastics, but a

framework for assessing whether decisions on waste production, consumption, and management have taken into account ecological consequences as well as long-term interests.

Ecological Justice and Pollution Burden Inequality

Microplastic pollution also needs to be studied through the perspective of ecological justice. This problem is not only related to the amount of pollution, but also to those who benefit from the production and consumption of plastic and those who bear the impact. When economic benefits and ecological burdens are spread out unevenly, pollution becomes a matter of social justice as well as environmental justice.

Jambeck et al. (2015) show the importance of the input of plastic waste from land to the ocean, while Lebreton et al. (2017) describe the role of rivers as one of the routes for the transfer of plastic waste to the sea. Both studies provide a basis for understanding that marine pollution is related to activities in land areas and waste management systems. Therefore, the problem of pollution cannot be fully imposed on coastal communities or parties at the final location of waste accumulation.

Liboiron (2021) invites readers to examine pollution by paying attention to the power, history, and inequality relationships that shape the distribution of environmental damage. This perspective is relevant as a critical lens to assess whether certain groups have greater control over production and consumption. In contrast, other groups have more limited capacity to prevent or address the impacts of pollution. However, the application of this perspective to the case of microplastics in Indonesia requires contextual evidence regarding production patterns, waste management, resource inequality, and the experiences of affected communities.

Keller (2010), as listed in the initial bibliography, can also be placed as a conceptual reference regarding ecosystem-based ethics and environmental justice, provided that the bibliographic details are verified. In this framework, the environment is not solely assessed based on the direct benefits to humans, but also on the sustainability of ecosystem functions and the consequences of human activities on organisms and future generations.

Gardiner (2011) discusses the moral challenges that arise when the causes, benefits, and consequences of an environmental problem are separated by distance, space, and intergenerational relationships. Although the book focuses on climate change, the idea of diffuse responsibility and the difficulty of moral coordination can be used as a conceptual analogy to understand the plastic problem. The benefits of using plastic can be enjoyed

today, while the ecological costs may arise later or be borne by different parties.

From this point of view, ecological justice in the issue of microplastics can be understood through three dimensions. First, distribution justice, which is how economic benefits and pollution burdens are shared among producers, consumers, and affected communities. Second, intergenerational justice, which is the obligation not to transfer ecological burdens disproportionately to future generations. Third, responsibility for ecosystems, which is the recognition that non-human organisms and ecological functions also need to be taken into account in human decisions.

This framework helps to expand the analysis of microplastics from a technical problem to a moral and social one. However, the assertion that certain groups bear a greater burden should be supported by empirical data, such as research on environmental quality, livelihood dependence on ecosystems, waste management capacity, and access to environmental protection.

Linear Production Models, Single-Use Plastics, and Limitations of Technology Solutions

Microplastic pollution cannot be separated from plastic production and consumption patterns. Geyer et al. (2017) analyzed the production, use, and final fate of plastics that have been mass-produced. The study shows that most of the plastic that has become waste has not been recycled, so waste accumulation is an important consequence of existing production and management patterns. The findings reinforce the need to look at plastic issues through a life-cycle approach, not just through waste management after the product has been discarded.

Walker and Fequet (2023) discuss unsustainable plastic production trends as well as microplastic and nanoplastic pollution. The study is relevant in emphasizing that the increase in the production of plastic materials needs to be assessed along with the effectiveness of the system of collection, processing, reuse, and prevention of leakage into the environment. If production and consumption continue to increase without systemic change, management in the final stages risks not being sufficient to suppress the entry of plastics into the environment.

The UN Environment Program (2023) emphasizes the need for system change to end plastic pollution and develop a circular economy. The perspective directs attention to reducing unnecessary plastic use, reuse, product redesign, and improving management systems. In the context of microplastics, such approaches are important because prevention at source can reduce the chances of plastics becoming

waste and then fragmenting in the environment.

However, the transition to a circular economy cannot be interpreted simply as an increase in recycling activities. The strategy also requires an evaluation of the needs for plastic use, material choice, product lifespan, packaging design, and availability of collection systems. Products that can be recycled are not necessarily completely recyclable if facilities, financing, or markets for recycled materials are not available. Therefore, the effectiveness of the circular economy needs to be assessed based on measurable results in reducing plastic waste and leakage.

The research of Gallo et al. (2018) emphasizes the urgency of preventive measures against plastic waste, microplastics, and their chemical components. This shows that responses to pollution should not be carried out only after the impact has emerged. Prevention also needs to include decisions at the design and production stages, as well as limiting the use of products that have the potential to produce waste that is difficult to manage.

On the other hand, biology-based solutions can contribute to the development of waste management methods. Arista (2023) reviews microorganisms that have the potential to degrade plastics, enzyme-based decomposition mechanisms, and factors that affect the biodegradation process. The study explains that a number of bacteria, algae, and fungi have the ability to decompose certain types of plastics, but this ability does not always produce mineralization perfectly. Research on enzymes and the effectiveness of degradation also still needs further development.

The findings of Arista (2023) show that biodegradation can be one of the components of the solution. However, it is not exactly seen as a substitute for reducing production and preventing pollution. The effectiveness of the decomposition process depends on the type of polymer, environmental conditions, the organisms involved, and the final result of the process. The use of a biological approach therefore needs to be accompanied by an evaluation of the safety, effectiveness, and possibility of the formation of intermediate products.

From an environmental ethics perspective, the responsibility for plastic management should also not be placed solely on consumers. Producers have a role in determining materials, product designs, and packaging characteristics. Governments have a responsibility to establish standards and oversight mechanisms, while communities can contribute through the reduction of unnecessary consumption and waste segregation. Such division of responsibility needs to consider each party's contribution to the formation of the

problem and their capacity to prevent pollution.

Responsibilities of Biological Scientists in Overcoming Microplastics

Biological scientists play an important role in generating evidence regarding the source, distribution, characteristics, and impact of microplastics on organisms and ecosystems. Research on the interactions of microplastics with organisms, migration pathways through the environment, and potential biological degradation can provide a scientific basis for developing preventive and management measures.

Auta et al. (2017) show the importance of integrating information regarding the source, environmental fate, impacts, and alternatives to handling microplastics. Galloway et al. (2017) broaden the understanding of the interactions of microplastics with ecosystem components, while Arista (2023) discusses the opportunities and limitations of plastic biodegradation by microorganisms. The three studies show that the contribution of biological science is not limited to the identification of pollution, but also includes the development and evaluation of solutions that can be applied responsibly.

The scientist's responsibility includes at least three aspects. First, scientific responsibility is to ensure that methods, data quality, research limitations, and the level of certainty of conclusions are explained transparently. In microplastics research, this is important because variations in sampling methods, particle identification, and polymer classification can affect reported results. Ochoa et al. (2024), for example, point out the importance of particle size measurement and classification methods in interpreting the concentration of microplastics in rainwater runoff.

Second, communicative responsibility, i.e., to convey research results proportionately. Evidence of the presence of microplastics in biological tissues, as reported by Ragusa et al. (2021), is important to note, but should not be directly interpreted as evidence that microplastics have caused a particular disease. Scientific communication should distinguish observational findings, proposed mechanisms, and tested cause-and-effect relationships.

Third, social and ecological responsibility, namely encouraging the use of scientific evidence in policy and solution development. Rahmadhani and Widowati (2026) emphasize the need for an interdisciplinary approach to bridge knowledge about microplastics with environmental ethics. In this context, scientists need to collaborate with policymakers, business actors, educators,

and the community so that research results can be used in decision-making.

Nonetheless, scientists cannot replace the responsibility of government, industry, or society. The role of scientists is to provide evidence, evaluate solution options, communicate uncertainties, and contribute to the decision-making process. Successful control of microplastics still requires institutional support, research funding, monitoring systems, and adequate evaluation mechanisms.

Plastic Management Policy and the Implementation of Environmental Ethics in Indonesia

Public policy plays a role in translating scientific evidence and environmental ethical principles into collective action. In the case of microplastics, policies need to include prevention at source, reduction of unnecessary products, waste management, development of alternative products, producer responsibility, and pollution monitoring.

Saputra et al. (2025) discuss the application of environmental ethical principles in sustainable development policies in Indonesia. The study highlights the importance of ecological responsibility, intergenerational justice, and an approach that considers the relationship between development interests and ecosystem protection. This framework is relevant to assess whether plastic management policies not only pursue economic efficiency but also consider long-term ecological consequences.

Rahmadhani and Widowati (2026) emphasize the importance of evidence-based regulations, precautionary principles, and circular economy approaches in dealing with microplastic pollution. The precautionary principle can be used when there are indications of environmental risks that need to be addressed even though some of the mechanisms or extent of the impact still require further research. Its application needs to be proportionate, transparent, and remain open to updates based on scientific evidence.

Extended producer responsibility is one of the instruments that can encourage business actors to consider the impact of products and packaging after their use period has ended. These instruments can be associated with reducing unnecessary packaging, improving product design, strengthening collection and sorting, and reporting waste management performance. However, the effectiveness of policies is not sufficiently assessed by the existence of regulations or administrative commitments; data on implementation and results achieved are required.

The UN Environment Program (2023) emphasizes that ending plastic pollution requires changing systems that

link product design, reuse, recycling, and reducing plastic use. This approach is in line with environmental ethical principles as it places prevention and impact reduction as part of a shared responsibility. In the Indonesian context, policy evaluation should pay attention to local government capacity, infrastructure availability, community participation, producer engagement, and consistent monitoring mechanisms.

Thus, plastic management policies need to be assessed through three main questions. First, are policies able to reduce sources of pollution, not just handle waste that has already been formed? Second, are responsibilities fairly shared with parties involved in the production, consumption, and management of plastics? Third, do policies protect ecosystem functions and the interests of future generations? These questions can be the basis for linking policy assessments with the principles of ecological responsibility and environmental justice.

Synthesis and Conceptual Framework of Environmental Ethics in Microplastic Handling

The synthesis of the literature shows that microplastic pollution is formed through the relationship between production and consumption systems, the leakage of plastics into the environment, the process of fragmentation and particle transfer, as well as interactions with organisms and ecosystems. The impact is not only related to biological and ecological dimensions, but also raises questions about the distribution of pollution burden, the responsibility of producers and consumers, the role of scientists, and the effectiveness of policies.

Geyer et al. (2017). Jambeck et al. (2015) and Lebreton et al. (2017) provide a basis for understanding the relationship between plastic production, waste formation, and waste transfer from land to ocean. Cole et al. (2011), Auta et al. (2017), and Galloway et al. (2017) expand their understanding of the presence and interaction of microplastics in the environment. Meanwhile, Ochoa et al. (2024) demonstrated the importance of rainwater runoff pathways in the displacement of microplastics in urban areas, while Ragusa et al. (2021) provided evidence regarding the detection of particles in human biological tissues.

However, the scientific evidence on pollution has not by itself answered how responsibility should be shared or what decisions are most fair. It is at this point that environmental ethics becomes a normative framework for assessing the relationship between human activities, ecological risks, and long-term interests. Hudha et al. (2019), Bennett (2010), and Saputra et al. (2025) can be used to

strengthen the foundations of environmental ethics and its application in behavior and policy. Gardiner (2011) and Liboiron (2021) help broaden reflection on responsibility across time, impact distribution, and power relations in environmental issues.

The study of Rahmadhani and Widowati (2026) directly connects microplastics with the gap in the application of environmental ethics. Meanwhile, Arista (2023) provides a biological perspective on the potential and limitations of plastic biodegradation. These two studies complement the discussion because they show that handling microplastics requires a combination of scientific knowledge, moral judgment, technological innovation, and environmental governance.

Based on this synthesis, the conceptual framework of this article consists of five interconnected components (Figure 1). First, the triggering factors are plastic production, the use of single-use plastics, consumption patterns, and waste management systems. Second, the pollution process includes plastic leakage into the environment, fragmentation, and the transfer of particles through water, soil, sediment, and the food chain.

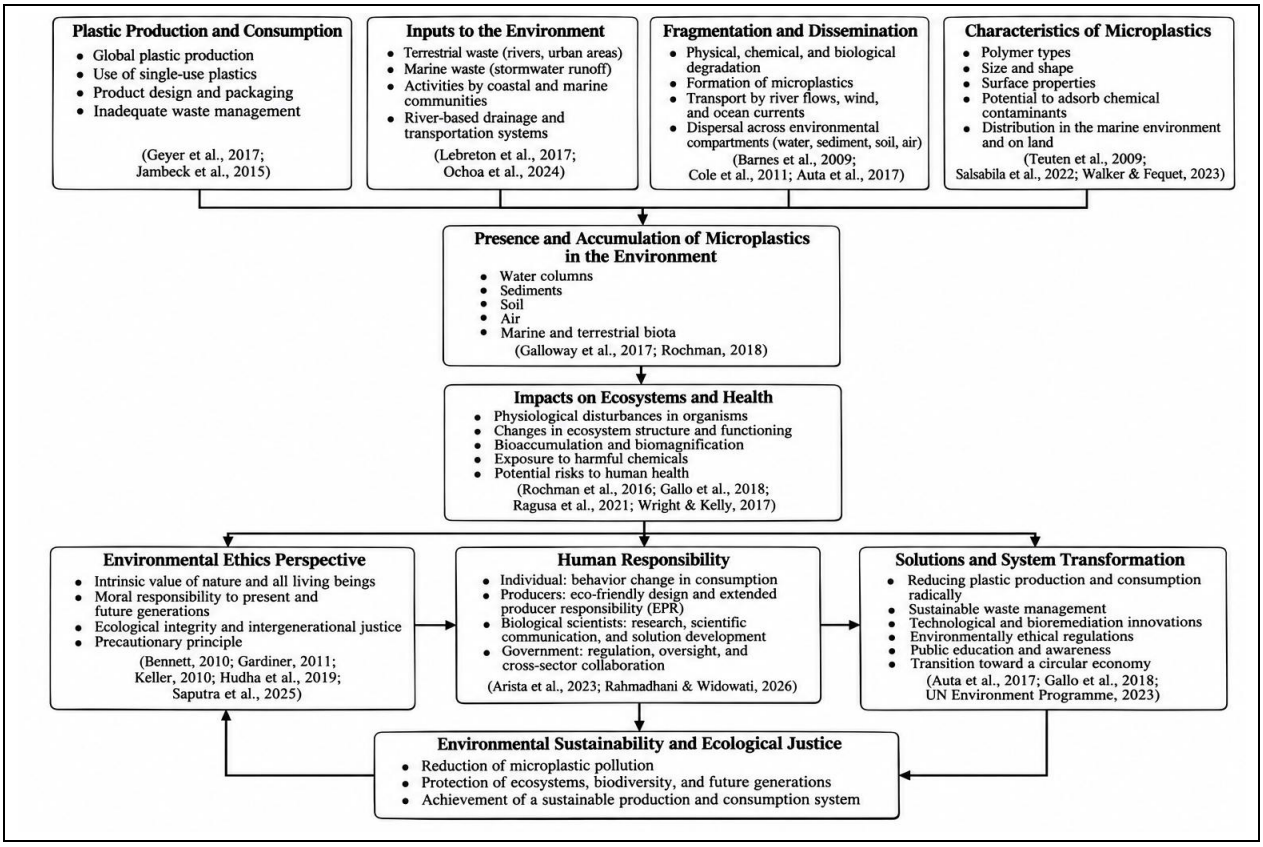


Figure 1. Conceptual framework of microplastic pollution through an environmental ethical perspective.

Third, biological, ecological, and social consequences that need to be assessed based on evidence and the context of exposure. Fourth, an assessment of environmental ethics that includes responsibility, ecological justice, the principle of prudence, and intergenerational justice. Fifth, responses in the form of pollution prevention, circular economy, tested biological innovations, environmental education, producer responsibility, and evaluative policies.

CONCLUSION

Microplastic pollution is a multidimensional problem that is not only related to environmental degradation, but also concerns human moral responsibility, ecological justice, and intergenerational sustainability. Based on the synthesis of literature, microplastics come from plastic production and consumption activities. They fragment and spread across various environmental compartments, so they have the potential to disrupt organisms, ecosystem functions, and human health. Therefore, it is not enough to handle microplastic pollution by relying only on waste management and the development of biodegradation technology, but it also requires efforts to prevent pollution sources, change consumption patterns, and strengthen environmental policies. The perspective of environmental ethics provides a basis for assessing these problems through the principles of moral responsibility, prudence, ecological justice, and protection of future generations.

This study emphasizes the importance of integrating biological and ecological evidence on microplastics with an environmental ethics perspective to build a more comprehensive approach to handling. These efforts can be realized through reducing the use of single-use plastics, strengthening producer responsibility, implementing a circular economy, developing proven technologies, environmental education, and collaboration between governments, industry, scientists, and communities. The contribution of this study lies in the development of a conceptual framework that links the impact of microplastic pollution with human responsibility and sustainability principles. However, as this study is based on a synthesis of the literature, further empirical research is needed to test the application of environmental ethical perspectives in microplastics management policies and practices, particularly in Indonesia.

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