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Philosophical Reconstruction of Human Needs and Ecosystem Capacity toward Sustainable Zero Waste Management in Mataram

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Abstract. The increase in waste generation in Mataram City shows that there is an imbalance between human needs and ecosystem capacity that cannot be solved through technical approaches alone. This research aims to analyze the relationship between human needs and ecosystem capacity from the perspective of philosophy of science and reconstruct the conceptual foundation of zero waste implementation in Mataram City. , This study employed a qualitative philosophical approach through literature review using ontology, epistemology, and axiology as analytical dimensions with the library research method. Data were obtained from various scientific literature, including journals, books, policy documents, and relevant research results, then analyzed using content analysis, critical analysis, and hermeneutical synthesis. The results of the study show that the application *of zero waste* requires reconstruction on the three dimensions of philosophy of science, namely ontological, epistemological, and axiological. Ontologically, humans need to be understood as an integral part of the ecosystem, not an entity separate from nature. Epistemologically, the concept of human needs needs to be distinguished from consumptive desires through a transdisciplinary approach. Axiologically, *zero waste* is an ethical imperative based on responsibility for the environment, intergenerational justice, and strengthening the local wisdom of the Sasak people. This study concludes that the integration of scientific knowledge, environmental ethics, and local wisdom is an important conceptual foundation in supporting a sustainable *zero waste* policy in Mataram City without exceeding the capacity of the ecosystem.

Keywords: Human needs, ecosystem capacity, philosophy of science, *zero waste*, Mataram City

INTRODUCTION

The relationship between humans and nature has long been a major concern in the philosophy of science, especially in the dimensions of ontology, epistemology, and environmental axiology. In this perspective, nature is not only seen as an object of exploitation to meet human needs, but also as an ecological system that has limited carrying capacity and assimilative capacity. However, the development of modern civilization has changed the relationship between humans and the environment from an adaptive to an increasingly exploitative one. Increasing population, urbanization, economic development, and changes in production and consumption patterns have encouraged the use of natural resources that exceed the regenerative capacity of ecosystems. As a result, various environmental crises, including the increase in waste generation, are a clear indicator of the imbalance between human needs and the ability of ecosystems to sustain life sustainably (Sukirman & Pratama, 2023).

This phenomenon is reflected in the condition of Mataram City as a center of government, trade, education, and services in West Nusa Tenggara Province. The rapid growth of socio-economic activities has significantly increased the volume of domestic and commercial waste, while waste management capacity has not developed proportionately. This condition causes various environmental problems, such as the increasing burden of Final Processing Sites (TPA), low levels of waste separation from sources, and the lack of optimal community-based waste management systems. Although the West Nusa Tenggara Provincial Government has initiated the Zero Waste Program as a strategic policy in realizing sustainable development, its implementation in Mataram City still faces various challenges, including low public awareness,

limited facilities and infrastructure, weak collaboration between stakeholders, and the dominance of the end-of-pipe paradigm in waste management (Evayanti et al., 2022; Silmi & Zitri, 2025).

In response to these problems, the concept of zero waste has developed into an environmental management paradigm that not only emphasizes reducing waste generation through the principles of reduce, reuse, and recycle (3R), but also prioritizes a circular economy approach, resource utilization efficiency, and changes in community behavior. From the perspective of sustainable development, zero waste is not just a technical strategy for waste management, but a paradigm transformation that places humans as an inseparable part of the ecological system. Thus, the success of zero waste implementation is not only measured by the reduction in the volume of waste entering landfills, but also by the ability of communities to build consumption and production patterns that are in harmony with ecosystem capacity. This approach shows that the waste problem is essentially a reflection of the way humans understand the relationship between the needs of life and environmental sustainability.

Although various studies on zero waste in Mataram City have been conducted, most of them still focus on policy effectiveness, program implementation strategies, community participation, environmental communication, and institutional aspects. These studies make an important contribution to the development of waste governance, but generally still place the environment as an object of management that can be controlled through technical and administrative instruments. As a result, the conceptual relationship between human needs, ecosystem capacity, and zero waste implementation has not been comprehensively explained. This gap shows that there is a space for the development of studies that integrate the ecological dimension with a philosophical foundation, so that the issue of zero waste is not only understood as a waste management issue, but also as an epistemological problem regarding the way humans build knowledge and interpret their relationship with nature (Ramdhani, 2022).

Departing from this gap, this research offers novelty through the reconstruction of the relationship between human needs and ecosystem capacity in the perspective of philosophy of science. The novelty of the research lies not only in integrating the concept of ecosystem capacity with the implementation of zero waste, but also in efforts to rebuild the ontological foundation regarding the position of humans as part of the ecosystem, the epistemological foundation on how to understand environmental problems, and the axiological foundation on ecological values, ethics, and responsibilities in the use of natural resources. The reconstruction views zero waste as a logical consequence of creating a balance between human needs and the ability of ecosystems to maintain their ecological functions. Thus, the success of zero waste is not only determined by the existence of regulations, technology, and infrastructure, but also by a paradigm shift in people's thinking towards ecological justice and sustainable development.

Based on these arguments, this research aims to reconstruct the relationship between human needs and ecosystem capacity for the implementation of zero waste in Mataram City through a study of philosophy of science. The reconstruction is directed to produce a conceptual model that explains the relationship between ecological, social, and philosophical dimensions in integrated environmental management. The results of the research are expected to be able to enrich the development of theories in the fields of philosophy of science and environmental science, as well as become an academic basis for the formulation of zero waste policies that are not only oriented to the technical aspects of waste management, but also pay attention to the balance between meeting human needs, ecosystem capacity, and sustainable development in the long term.

RESEARCH METHODS

This research uses a qualitative approach with the type of library research. This approach was chosen because it is in accordance with the characteristics of the study of philosophy of science which is oriented towards conceptual analysis, critical reflection, and interpretation of

various scientific thoughts on the relationship between humans and nature. Literature research allows researchers to examine in depth the concept of human needs, ecosystem capacity, and the zero waste paradigm through the synthesis of various theories, ideas, and results of previous research so that a comprehensive conceptual framework is obtained as a basis for reconstructing thought.

The data used in this study is secondary data sourced from various scientific literature, including national and international journal articles, academic books, scientific proceedings, research reports, government policy documents, and publications of national and international institutions that are related to the research theme. The literature was selected based on its relevance to the study of philosophy of science, environmental philosophy, ecosystem capacity, sustainable development, circular economy, and zero waste concepts. To maintain the actuality of the study, this study prioritizes references published in the last ten years, without ruling out classical works that are the theoretical foundation in the philosophy of science and environmental philosophy.

Data collection was carried out through systematic literature search on various scientific databases, such as Google Scholar, Scopus, Web of Science, ScienceDirect, SpringerLink, JSTOR, Garuda, and SINTA. The search was conducted using a combination of keywords related to philosophy of science, environmental philosophy, human needs, ecosystem capacity, zero waste, circular economy, ecological sustainability, zero waste Mataram, as well as the equivalent of terms in Indonesian. All literature obtained was then selected based on the suitability of the theme, the quality of the publication, the novelty of the references, and its contribution to the research objectives. Furthermore, each source is read critically to identify the main ideas, the relationships between concepts, as well as their relevance to the focus of the research.

Data analysis is carried out qualitatively through content analysis, critical analysis, and hermeneutical synthesis. Content analysis is used to identify key concepts, themes, and argumentation patterns that develop in various literatures. Furthermore, critical analysis is applied to evaluate the ontological, epistemological, and axiological assumptions underlying the relationship between human needs and ecosystem capacity, as well as identify various contradictions and common points among developing perspectives. The results of the analysis were then integrated through hermeneutical synthesis to build a conceptual framework that was able to explain the reconstruction of the relationship between human needs and ecosystem capacity as a philosophical foundation for the implementation of the zero waste paradigm in Mataram City. The interpretation process is carried out by considering the social, ecological, and environmental management policy context in Mataram City so that the research results not only have theoretical strength, but are also relevant to empirical conditions.

The validity of the research is maintained through the application of source triangulation by comparing various references from different disciplines and perspectives. In addition, the literature search, selection, and analysis process is systematically documented to ensure the transparency of the research. The researcher also applies academic reflexivity in each stage of analysis by considering various viewpoints proportionally and avoiding subjective interpretations. Thus, the results of the research are expected to have a level of credibility, consistency, and conceptual validity that can be scientifically accounted for.

RESULTS AND DISCUSSION

The relationship between human needs and ecosystem capacity is the main foundation in understanding development sustainability. Human needs continue to develop along with population growth, urbanization, technological advancements, and increasing consumption patterns that tend to be linear. This pattern encourages intensive exploitation of natural resources so that the ability of ecosystems to provide ecosystem services decreases. The modern ecological perspective views that sustainability is determined not only by the success of meeting human needs, but also by the ability of ecosystems to maintain their ecological functions in the

long term. Ecosystem capacity is an important indicator to assess the limit of resource utilization so that it does not exceed the carrying capacity and assimilative capacity of the environment. The imbalance between these two aspects is one of the causes of increasing environmental degradation and the complexity of waste problems in urban areas.

In the perspective of the philosophy of science, the relationship between man and nature cannot be understood only through empirical and technical approaches, but also requires ontological, epistemological, and axiological analysis. Ontology describes the nature of humans as an integral part of the ecological system, while epistemology directs how to acquire knowledge about human interaction with the environment comprehensively. In terms of axiology, the use of natural resources is positioned as an activity that contains moral responsibility for the sustainability of life. This approach shows that environmental problems are not just the result of increasing waste volumes, but are rooted in the construction of knowledge that places nature as an object of exploitation without considering the limited capacity of the ecosystem. Reconstructing the relationship between human needs and ecosystems is important to build a development paradigm that is more oriented towards ecological balance and intergenerational justice.

The zero waste paradigm developed in response to increasing pressures on natural resources due to production and consumption systems that produce large amounts of waste. This concept not only emphasizes the reduction of waste generation through the principle of reduce, reuse, and recycle (3R), but also changes the perspective of materials as resources that still have value in a circular system. Various studies show that the success of zero waste is greatly influenced by the integration of government policies, technological innovations, changes in community behavior, and resource management that pays attention to ecosystem capacity. The paradigm expands the meaning of waste management from downstream activities to a development strategy that connects resource use efficiency, circular economy, and environmental sustainability. The reconstruction of the relationship between human needs and ecosystem capacity places zero waste as an ecological paradigm that is not only oriented towards waste reduction, but also on the harmonization between human activities and the ability of nature to maintain the balance of life systems.

Ontological Dimension: Humans as Part of the Ecosystem

The ontological dimension in philosophy of science places the issue of the nature of human existence and its relationship with nature as the starting point in understanding the environmental crisis. Modern anthropocentric ontological views tend to position humans as the main subjects who have the legitimacy to dominate and exploit nature to fulfill their interests. This paradigm gives birth to a dichotomy between humans and nature so that ecosystems are understood only as providers of resources that can be utilized without considering their ecological boundaries (Stables, 2020). On the contrary, the development of contemporary environmental philosophy shifts the paradigm towards a relational ontology that views humans as an integral part of interdependent life systems. In this perspective, the sustainability of human life cannot be separated from the sustainability of ecosystem functions because all biological, economic, and social processes take place through complex interactions between biotic and abiotic components (Farley et al., 2024). This approach affirms that human existence acquires ontological meaning through a reciprocal relationship with nature, not through domination over it.

Relational ontology views that an ecosystem is not just a space in which humans live, but a network of life that forms and is shaped by human activities. The concept of co-production of ecosystem services explains that ecosystem services are born through the interaction between ecological processes and social activities so that humans not only play the role of beneficiaries, but also as actors who determine the sustainability of ecosystem functions (Woodhead et al., 2025). This perspective shows that environmental damage is a consequence of the disconnection

of the ontological relationship between humans and nature. When nature is perceived as a purely economic object, resource exploitation increases and the capacity of ecosystems to regenerate decreases. The study of environmental philosophy shows that the recognition of human interdependence with ecosystems is the basis for the formation of ecological awareness that places sustainability as the main orientation of development (Targa, 2022; Prasetyo & Fauzan, 2025).

In the context of environmental management, the ontological dimension provides a conceptual foundation for the development of a zero waste paradigm. This paradigm is not only understood as a technical strategy to reduce waste generation, but as a transformation of the perspective on the relationship between humans and materials, resources, and ecosystems. The zero waste approach srejects a linear economic pattern that is oriented towards resource exploitation and waste disposal, then replaces it with a system that maintains the circulation of materials to remain within the limits of ecosystem capacity (Hannon, 2020). The ontological reconstruction places waste not as a residue that must be disposed of, but as part of an ecological cycle that can be reused through circular economy principles. This paradigm shift shows that the success of zero waste depends heavily on changing the way humans interpret their position in ecological systems, not solely on technological innovation or the effectiveness of waste management policies (Valenzuela-Fernández & Escobar-Farfán, 2022).

The ontological reconstruction of humans as part of the ecosystem results in the philosophical consequence that the fulfillment of human needs must always consider the carrying capacity and assimilative capacity of the environment. Sustainability is no longer interpreted as an effort to maintain economic growth alone, but as a process of maintaining a balance between human needs and ecosystem integrity. The ecological justice perspective expands the concept of justice from human relationships to relationships that include all components of life, so that the existence of ecosystems has intrinsic values that deserve respect (Moyano-Fernández, 2023). This approach strengthens the argument that sustainable development requires an ontological shift from an anthropocentric paradigm to an ecocentric paradigm that recognizes humans as one of the elements in the network of life. This reconstruction is the philosophical foundation for the implementation of zero waste which is not only oriented towards reducing waste, but also on creating an ecological balance between human needs and ecosystem capacity.

The Epistemological Dimension: Reconstructing Knowledge of Needs

The epistemological dimension in philosophy of science questions how knowledge about human needs is constructed, validated, and used as a basis for decision-making. For decades, the concept of needs has been better understood through an economic approach that places production and consumption growth as the main indicators of people's well-being. This perspective results in a knowledge construct that identifies increased consumption with an increase in quality of life, although the consequences are in the form of increased exploitation of natural resources and waste generation that are increasingly difficult to control (Klimska, 2020; Costanza, 2020). Knowledge of needs ultimately develops partially because it emphasizes more material dimensions than its relation to the carrying capacity of ecosystems. The study of sustainability epistemology shows that the process of knowledge formation must consider the interconnectedness between humans, nature, and social systems so that needs are not understood as a separate concept from the ecological capacity that sustains life (Yuan & Lo, 2020; Mazzocchi, 2020).

The reconstruction of knowledge about needs requires a paradigm shift from an anthropocentric approach to a socio-ecological approach that views needs as the result of interaction between humans and ecosystems. Knowledge is no longer built only through economic indicators, but also through the integration of ecological sciences, social sciences, environmental ethics, and local knowledge. This approach expands the way of understanding human needs because the sustainability of life depends on the ability of ecosystems to provide

environmental services in a sustainable manner (Budds & Zwarteveen, 2020). Scientific knowledge also needs to be developed through the process of co-production of knowledge, which is a collaboration between academic knowledge, community experience, and cultural values in understanding the relationship between humans and nature. The integration of various knowledge systems results in a more comprehensive understanding of the limits of human needs as well as the ecological consequences of each production and consumption activity (Dewulf et al., 2020; Mazzocchi, 2020).

In the context of zero waste, the epistemological dimension changes the way of looking at waste and consumption through the reconstruction of the meaning of needs. The zero waste paradigm does not view waste as the end result of the production process, but as a consequence of a knowledge system that is still dominated by linear economic patterns. The shift towards a circular economy requires the birth of new knowledge that places materials as resources that continue to circulate in production and consumption systems, so that the concept of needs is no longer measured based on the number of goods consumed, but on the efficiency of resource use and the sustainability of ecosystem functions (Hannon, 2020). This perspective shows that the reconstruction of knowledge about needs is an important prerequisite for changes in individual, institutional, and public policy behavior in realizing a sustainability-oriented zero waste system (Valenzuela-Fernández & Escobar-Farfán, 2022; Gibbons, 2020).

Epistemological studies also show that knowledge about needs must be built through a transdisciplinary approach that connects environmental science, philosophy, economics, and public policy. This kind of knowledge not only generates scientific information about environmental conditions, but also forms a critical awareness of ecological boundaries that must be respected in every development activity. The epistemological reconstruction of needs leads people to understand that welfare is not synonymous with increased consumption, but rather with creating a balance between human needs, ecosystem functions, and intergenerational sustainability. This perspective strengthens the conceptual foundation that the implementation of zero waste is a transformation of knowledge towards a way of thinking that respects the relationship between humans, natural resources, and ecosystem capacity as a unit of living systems (Costanza, 2020; Yuan & Lo, 2020; Dewulf et al., 2020).

Axiological Dimension: Zero Waste as an Ethical Imperative

The axiological dimension in the philosophy of science places values, morals, and ethics as the basis for determining the direction of the use of science for human life. In the context of the environment, axiology not only questions how knowledge about nature is produced, but also how it is used to maintain the sustainability of life. The environmental crisis marked by increasing waste generation, pollution, and declining ecosystem quality shows that the development of science and technology has not been fully accompanied by moral responsibility for the environment (Joaquin & Biana, 2020). This perspective views that development success is not only measured through economic growth or increased consumption, but also through the ability of humans to implement ethical values in the responsible use of natural resources (Valenzuela-Fernández & Escobar-Farfán, 2022). The value of sustainability is an axiological foundation that directs every human activity to remain within the limits of the carrying capacity and capacity of the ecosystem and to respect the rights of future generations to obtain a decent environment.

From an environmental axiology perspective, zero waste is understood as an ethical imperative**,** which is a moral obligation that must be realized by individuals, society, the business world, and the government in reducing the ecological impact of human activities. This paradigm places waste not just as a technical problem solved through transportation and disposal, but as a consequence of a value system that is still dominated by consumptive culture and linear economy. Hannon (2020) explained that the development of zero waste is an interdisciplinary movement that integrates environmental science, public policy, circular economy, and social behavior change towards a system that minimizes waste formation. Studies on zero waste also

show that its success is greatly influenced by the formation of ethical awareness of human responsibility for the sustainable use of resources and material management (Valenzuela-Fernández & Escobar-Farfán, 2022). These values expand the meaning of waste management from operational activities to part of the moral responsibility for ecosystem sustainability.

The axiology of zero waste also places ecological justice as the main principle in the relationship between humans and the environment. Justice is no longer understood only as a relationship between people, but includes respect for the integrity of ecosystems and the sustainability of all components of life. This perspective encourages a change in development orientation from resource exploitation to utilization that pays attention to the material cycle, energy efficiency, and restoration of ecological functions through a circular economy approach (Avilés-Palacios & Rodríguez-Olalla, 2021). These changes require the presence of collective responsibility that is realized through reducing excessive consumption, optimizing material reuse, increasing recycling activities, and implementing environmentally friendly production patterns. These axiological values form an ecological culture that places sustainability as a common goal in the development of modern society.

The reconstruction of the axiological dimension shows that the implementation of zero waste requires a transformation of the value system that places the environment as an entity that has intrinsic value, not just an economic resource. This shift in values is shaping a new paradigm that every decision on consumption, production, and waste management has moral consequences for the balance of the ecosystem. Research on environmentally responsible behavior shows that ethical awareness has a significant influence on changing people's behavior in support of sustainable consumption and zero waste practices (Valenzuela-Fernández et al., 2023). The study of wastephilian ethics also emphasizes that waste management is a form of moral responsibility towards the planet that must be realized in concrete actions at the individual and institutional levels (Kahambing, 2021). This axiological perspective places zero waste as an ethical commitment that connects human needs, ecosystem capacity, and development sustainability in a complementary set of values.

Philosophical Integration of Human Needs, Ecosystem Capacity, and Zero Waste Management

The philosophical reconstruction of human needs toward sustainable zero waste management begins with an ontological recognition that humans are not autonomous entities separated from nature but inseparable components of interconnected socio-ecological systems. This ontological perspective challenges the anthropocentric paradigm that legitimizes unlimited resource exploitation and redefines human existence as fundamentally dependent on ecosystem integrity. The epistemological dimension extends this foundation by reconstructing the concept of human needs through a shift from consumption-oriented knowledge toward a transdisciplinary understanding that integrates ecological science, environmental ethics, local wisdom, and public policy. Human needs are interpreted as socio-ecological constructs whose fulfillment is inseparable from ecosystem carrying and assimilative capacities. In the context of Mataram, where urban expansion and increasing municipal solid waste intensify pressure on environmental systems, waste generation reflects a structural imbalance between patterns of human consumption and the ecological capacity that sustains social and economic activities.

The philosophical reconstruction reaches its normative dimension through axiology, where zero waste is understood as an ethical commitment that guides production, consumption, and resource management within ecological boundaries. Environmental responsibility becomes a shared moral obligation founded on ecological justice, intergenerational responsibility, and circular resource utilization. Sustainable zero waste management in Mataram requires institutional reform, technological innovation, and a transformation of societal values that recognize ecosystems as entities possessing intrinsic value beyond their economic functions. The integration of ontology, epistemology, and axiology forms a coherent philosophical framework

in which ontology defines humanity's ecological identity, epistemology reconstructs knowledge concerning human needs, and axiology directs ethical action toward maintaining equilibrium between human well-being and ecosystem capacity. This integrated perspective strengthens the theoretical foundation for sustainable waste governance capable of harmonizing social welfare, ecological resilience, and long-term environmental sustainability.

CONCLUSION

This study concludes that the relationship between human needs, ecosystem capacity, and sustainable zero waste management cannot be adequately understood through a purely technical approach to waste management but requires a philosophical reconstruction encompassing ontological, epistemological, and axiological dimensions. The ontological dimension positions humans as integral components of interconnected ecosystems, making the fulfillment of human needs inseparable from ecological carrying and assimilative capacities. The epistemological dimension reconstructs the concept of needs by shifting from consumption-oriented perspectives toward an integrated understanding that incorporates ecological, social, cultural, and scientific knowledge. The axiological dimension establishes zero waste as an ethical imperative grounded in ecological responsibility, environmental justice, and intergenerational sustainability, framing waste reduction, resource efficiency, and circular resource use as moral commitments rather than solely operational objectives. The integration of these three philosophical dimensions offers a comprehensive conceptual framework that enriches environmental philosophy by explaining sustainable waste management as a transformation of human–nature relationships, knowledge systems, and societal values. This framework also provides practical implications for policymakers by supporting the design of zero waste policies that are grounded in ecological ethics, ecosystem capacity, and long-term sustainability rather than relying exclusively on technological or regulatory interventions. For local governments, particularly in Mataram City, the framework may guide the development of integrated waste governance that combines environmental education, community participation, circular economy strategies, and ecosystem-based planning. These findings establish a philosophical foundation for future sustainability policies and encourage further empirical research to operationalize the proposed framework across different socio-ecological contexts.

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