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Physical Environment And Sustainable Development

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ABSTRACT

Physical environment plays a strategic role in supporting sustainable development. Increasing environmental damage, such as climate change, pollution, and exploitation of natural resources, shows that development that does not consider environmental aspects will have a serious impact on human life. Therefore, Physical environment is an important instrument for shaping public awareness, knowledge, attitudes, and behavior to be more responsible towards the environment. This study aims to examine the concept of Physical environment and its relationship with sustainable development through a literature review approach. Data were obtained from various sources, including books, national and international scientific journals, and official documents from relevant institutions. The results of the study show that Physical environment plays a role in instilling values of sustainability, increasing environmental literacy, and encouraging community participation in maintaining a balance between social, economic, and environmental factors. Therefore, a key step towards achieving sustainable development is to integrate Physical environment into formal and informal physics institutions.

Keywords: Physical environment, sustainable development, sustainability

INTRODUCTION

Development is one of humanity's efforts to improve quality of life through the utilization of natural resources, technological development, and the strengthening of social and economic aspects. In practice, development is often

understood as a process of economic growth measured by increases in production and consumption. This view encourages the large-scale exploitation of natural resources without considering the carrying capacity of the environment. As a result, various environmental problems arise, such as forest destruction, water and air pollution, a decline in biodiversity, and climate change, which have a direct impact on human life.

Increasingly complex environmental issues show that the conventional development paradigm is no longer adequate. Development that focuses only on short-term economic gains has been shown to cause social injustice and ecological damage that is difficult to repair. As a result of this situation, the concept of sustainable development has emerged as an alternative strategy that focuses more on the balance between environmental sustainability and human needs. Meeting the needs of the current generation without compromising the ability of future generations to meet their own needs is a key component of sustainable development. The environment is considered an essential component in the development process in the concept of sustainable development. The environment is viewed as a living system whose sustainability must be maintained, rather than as an object of exploitation. Therefore, changes in the way people view, act, and interact with nature are necessary for sustainable development. [1]

These changes cannot be achieved instantly, but rather through a planned and sustainable process of education. Education plays a strategic role in shaping human mindsets and character. Through education, values, knowledge, and awareness of the importance of protecting the environment can be instilled from an early age. Physical environment aims to increase individual and community understanding of the reciprocal relationship between humans and their environment, as well as encourage behavior that is responsible for nature conservation.[2] Thus, physical environment not only functions as a transfer of knowledge, but also as a means of shaping attitudes and actions that are oriented towards sustainability.In the context of sustainable development, physical environment is an important instrument for preparing human resources who care about the environment. Individuals with good environmental literacy are expected to be able to make decisions that take into account social, economic, and ecological impacts in a balanced manner. This shows that the success of sustainable development is highly dependent on the quality of physical environment applied in formal, non-formal, and informal physics systems.In Indonesia, the issues of Physical environment and sustainable development are becoming increasingly relevant as environmental problems caused by human activities increase. The rate of deforestation, environmental pollution, and suboptimal

[1] Otto Soemarwoto, *Ecology, Environment, and Development* (Jakarta: Djambatan, 2004), pp. 15–17.

[2] *World Commission on Environment and Development, Our Common Future (*Oxford: Oxford University Press, 1987), p. 43.

management of natural resources indicate that ecological awareness among some communities is still low. [3]

This condition indicates the need to strengthen physical environment as an integral part of national development policy. [4] Physical environment is expected to foster collective awareness among the public to actively participate in maintaining a balance between development and environmental sustainability. Based on this description, it can be understood that physical environment plays a very important role in supporting the realization of sustainable development. Therefore, an in-depth study of the relationship between Physical environment and sustainable development is necessary. This study aims to examine the concept of physical environment and its role in supporting sustainable development through a literature review approach, with the hope of contributing theoretically and practically to the development of physics and development policies oriented towards sustainability.

RESEARCH METHOD

This study uses a literature review research design and qualitative methodology. The emphasis of the study on the analysis of ideas, theories, and opinions of experts in physical environment and sustainable development is the reason for choosing this methodology. To gain a deep understanding of the topic being studied, library research allows academics to thoroughly evaluate various academic views and previous research findings.[5] This study uses primary and secondary data sources. Academic literature and scientific publications relevant to sustainable development and Physical environment are the primary data sources. Meanwhile, secondary data related to environmental issues and physics were collected from official reports, policy documents, and national and international scientific journal publications. The reliability of the authors, the applicability of the content, and the timeliness of the information were taken into consideration in the selection of sources.[6]

Data collection techniques were carried out through a process of identifying and searching for relevant literature. The researchers collected various references related to the concepts of physical environment, the principles of sustainable development, and the relationship between the two. The collected literature was then read critically and thoroughly to obtain the main ideas relevant to the focus of the study.

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[3] UNESCO, *Environmental Education in the Light of Tbilisi Conference* (Paris: UNESCO, 1977), pp. 18–20.

[4] Emil Salim, *Sustainable Development: Environmental Dimensions* (Jakarta: LP3ES, 2010), pp. 2–24.

Ministry of Environment and Forestry of the Republic of Indonesia, Physical environment (Jakarta: KLHK, 2019), pp. 5–7.

[5] Sugiyono, *Qualitative Research Methods* (Bandung: Alfabeta, 2018), pp. 9–11.

[6] Zed Mestika, *Library Research Methods* (Jakarta: Yayasan Obor Indonesia, 2014), pp. 23– 25.

This process aimed to ensure that the data used truly supported the analysis. Data analysis in this study used descriptive-qualitative analysis techniques. Data obtained from various literature sources were analyzed by systematically classifying, comparing, and interpreting the experts' thoughts. Furthermore, the analysis results were presented in the form of a descriptive description explaining the role of physical environment in supporting sustainable development. This approach allowed researchers to draw conclusions based on a synthesis of relevant theories and scientific findings.To maintain data validity, this study applied source triangulation techniques, namely by comparing information obtained from various different references. Thus, the results obtained are not only based on one source, but are supported by various complementary academic views.[7] This step is taken to increase the validity and reliability of the research results, so that the findings produced can be scientifically accounted for [8] Physical environment is a branch of science that applies the principles of physics (such as energy, mass, heat, radiation, and mechanics) to understand the interactions between living organisms, the natural environment (air, water, soil), and the impact of human activities, with a focus on phenomena such as climate change, pollution, renewable energy sources, and contaminant transport. This science measures, analyzes, and explains physical processes in the environment to address environmental problems and find sustainable solutions. Scope and Main Topics:

- **Transportation and Transfer:** Transfer of energy (solar radiation), mass (water, nutrients, pollutants), and momentum in the soil-plant- atmosphere system.
- **Environmental Thermodynamics:** Studying the Earth as a thermodynamic system, including the greenhouse effect and global warming.
- **Radiation:** The interaction of radiation (solar, nuclear, electromagnetic) with the environment and its impacts.
- **Environmental Acoustics:** The study of sound and the effects of noise.
- **Renewable Energy:** Utilization of solar, wind, water, biomass, and geothermal energy.
- **Environmental Geophysics:** The study of the Earth and its physical processes.
- **Environmental Quality:** Measurement of physical parameters of water, air, and soil (temperature, humidity, turbidity, etc.).

Application of Physical environment in Real Life

- **Agriculture:** Understanding the movement of water and nutrients in soil for efficient irrigation.
- **Mitigation & Adaptation:** Developing solutions for climate

[7] Lexy J. Moleong, *Qualitative Research Methodology* (Bandung: Remaja Rosdakarya, 2019), pp. 159–161.

[8] Burhan Bungin, *Qualitative Research Data Analysis* (Jakarta: RajaGrafindo Persada, 2017), pp. 68–70.

change, such as clean energy and waste management.

- **Public Health:** Analyzing the impact of pollution (air, water, noise) on human health and other living organisms.
- **Technology:** Development of solar panels, wind turbines, and environmental monitoring systems.

RESULTS AND DISCUSSION

Based on the results of the literature review, Physical environment is understood as a physical process that aims to build knowledge, awareness, attitudes, and skills of individuals and communities in protecting and preserving the environment. Physical environment bridges basic physics with ecology, meteorology, hydrology, and environmental science, recognizing that organisms affect the environment and vice versa.

Physical environment does not only focus on conveying information about environmental conditions, but also emphasizes the formation of responsible behavior towards nature. [9] Thus, Physical environment has cognitive, affective, and psychomotor dimensions that are interrelated.[10] UNESCO emphasizes that Physical environment aims to help humans understand the complex relationship between humans, culture, and the biophysical environment. This understanding is important so that individuals are able to see the impact of every human action on the environment. Therefore, physical environment is not purely theoretical, but must encourage changes in attitude and real actions in everyday life. In the perspective of modern physics, Physical environment is also seen as part of character physics. Values such as responsibility, concern, intergenerational justice, and a sustainable lifestyle are at the core of Physical environment. Through the internalization of these values, students are expected to become agents of change who contribute to preserving the environment amid the rapid pace of development.In Indonesia, physical environment has been integrated into various educational policies, both through formal curricula and non-formal physics programs. This integration shows that Physical environment is seen as an urgent need to respond to the challenges of environmental damage, which are increasing. However, its implementation still faces various challenges, such as limited understanding among educators, a lack of supporting facilities, and low environmental awareness among some communities. Physical environment is essentially a transformative learning process, which not only increases students' knowledge about the environment but also changes their perspective and behavior towards nature. Physical environment seeks to build awareness that humans are part of an interdependent ecological system. With this understanding, humans are expected to be

[10]UNESCO, *Environmental Education in the Light of Tbilisi Conference* (Paris: UNESCO, 1977), pp. 19–21.

able to act more wisely in utilizing natural resources.[11]

Furthermore, physical environment emphasizes the importance of contextual learning that is closely related to everyday life. Students are not only encouraged to understand environmental concepts theoretically, but also actively involved in activities directly related to the environment, such as waste management, reforestation, and nature conservation. This approach aims to provide students with real experiences that can strengthen their attitude of caring for the environment. [12] Physical environment also plays a role in building critical awareness of various environmental issues that arise from development activities. Through education, individuals are encouraged to be able to analyze the causes of environmental damage and its social and economic impacts. Thus, physical environment is not only normative but also critical and reflective.In the long term, Physical environment is expected to produce a generation with environmental ethics. These environmental ethics form the moral basis for making decisions related to the use of natural resources. Without environmental ethics, development has the potential to continue in an exploitative and unsustainable manner.

The Concept of Sustainable Development

The direction of sustainable development is to balance social justice, environmental sustainability, and economic prosperity. The World Commission on Environment and Development report, which highlights the importance of meeting the needs of the current generation without compromising the rights of future generations, was the first to popularize this idea. Therefore, sustainable development considers the long-term impact of all development policies in addition to focusing on immediate results. Sustainable development in the environmental context requires the wise and responsible use of natural resources. Excessive exploitation of natural resources without regard for environmental carrying capacity will cause ecosystem damage and threaten the sustainability of human life. [13] Therefore, sustainable development emphasizes the principles of caution and sustainability in every development activity. Sustainable development also has a strong social dimension.

Physical environment plays a crucial role in sustainable development by providing basic principles for renewable energy (solar, wind, water), energy efficiency, climate modeling (greenhouse effect), and natural resource management, ensuring that development meets current needs without sacrificing future generations through innovative solutions such as environmentally friendly materials and climate change mitigation technologies. Key Roles of Physical environment:

[11] Otto Soemarwoto, *Ecology, Environment, and Development* (Jakarta: Djambatan, 2004), pp. 45–47.

[12] David W. *Orr, Earth in Mind* (Washington DC: Island Press, 2004), pp. 92–94.

[13] *World Commission on Environment and Development, Our Common Future* (Oxford: Oxford University Press, 1987), pp. 43–45.

- **Renewable Energy:** Applying physics principles to optimize solar panels, wind turbines, and hydroelectric power plants, as well as developing energy storage technologies for energy sustainability.
- **Climate Science:** Understanding climate phenomena such as the greenhouse effect through radiation physics and electromagnetic waves to address climate change (SDG 13).
- **Efficiency & Materials:** Developing new materials and more efficient technologies to reduce carbon footprints and environmental impacts.
- **Resource Management:** Using physics principles to understand nutrient cycles, energy movement, and sustainable natural resource management (SDG 9).
- **Environmental Health:** Studying the physical parameters of water, air, and soil to assess environmental and health impacts, as well as managing liquid waste and garbage.

Integration with Sustainable Development (SDGs)

- **SDG 7 (Affordable and Clean Energy):** Physics drives the development of clean and affordable energy sources.
- **SDG 9 (Industry, Innovation, and Infrastructure):** Building resilient and innovative infrastructure through physical technology.
- **SDG 13 (Climate Action):** Providing scientific understanding and technological solutions for mitigation and adaptation.

Practical Application Examples

- Development of micro-hydro energy systems in rural areas.
- Energy-efficient building design utilizing thermodynamic principles.
- Environmental quality monitoring systems using sensors based on physical principles.
- Social justice, equitable distribution of welfare, and improvement in the quality of life of the community are integral parts of this concept. Development cannot be considered sustainable if it only benefits certain groups and neglects vulnerable communities. Thus, sustainable development requires the active participation of the community in the planning and implementation of development. [14] In practice, the implementation of sustainable development requires a paradigm shift in development. Development is no longer seen as an effort to exploit natural resources, but as a process that must be in harmony with the principles of environmental preservation and social welfare. This paradigm shift requires the active role of Fisika in shaping a community mindset that is more oriented towards sustainability. Sustainable development is essentially an effort to integrate economic, social, and

[14] Emil Salim, *Sustainable Development* (Jakarta: LP3ES, 2010), pp. 30–33.

> environmental interests into a single, comprehensive development framework. These three aspects cannot be separated, because failure in one aspect will have an impact on the others. Economic development that ignores the environment, for example, will cause ecological damage that ultimately harms the social and economic life of the community. In the environmental context, sustainable development requires natural resource management that is oriented towards sustainability. The use of natural resources must take into account the carrying capacity and capacity of the environment so as not to exceed the natural ability to recover. [15]

This principle emphasizes that natural resources are not unlimited assets, but rather a trust that must be preserved for future generations. The social dimension of sustainable development also plays a very important role. Development should not create social inequality and injustice in society. Instead, development should be able to improve the welfare of society in an equitable and inclusive manner. Therefore, sustainable development requires the active participation of the community in the development decision-making process. Thus, sustainable development is not merely a normative concept, but a development paradigm that demands a change in the way of thinking and acting. This paradigm shift can only be realized if it is supported by a culture that is able to consistently instill the values of sustainability.[16]

The Relationship Between Physical environment and Sustainable Development

The results of the study show that physical environment is closely related to sustainable development. Physical environment serves as a means of instilling understanding and awareness of the importance of maintaining a balance between development needs and environmental sustainability. Without adequate Physical environment, the concept of sustainable development is difficult to realize in practice. Physical environment plays a role in developing human resources with good environmental literacy. Individuals with high environmental literacy tend to have the ability to understand the impact of every development activity on the environment and society. This enables them to make wiser and more responsible decisions. Thus, Physical environment becomes an important foundation in supporting the success of sustainable development. [17] In addition, Physical environment also plays a role in encouraging community participation in environmental conservation

[15] Sterling, Stephen, *Sustainable Education* (Devon: Green Books, 2001), pp. 67–69.

[16] Sachs, Jeffrey D., *The Age of Sustainable Development* (New York: Columbia University Press, 2015), pp. 56–58.

[17] Palmer, Joy A., *Environmental Education in the 21st Century* (London: Routledge, 2003), pp. 41–43.

efforts. Through education, the community is encouraged to actively participate in various activities that support sustainability, such as waste management, natural resource conservation, and the use of environmentally friendly energy. This active community participation is one of the keys to successful sustainable development. In the context of formal physics, the integration of Physical environment into the curriculum is a strategic step to instill the values of sustainability from an early age.

It is estimated that students who have a better understanding of the environment will grow into a more responsible and caring generation. As a result, Physical environment not only develops knowledge, but also sustainable character and behavior. Sustainable development and Physical environment are closely related and complement each other. Physical environment serves as the main foundation in building public understanding of the principles of sustainable development. Without adequate Physical environment, the concept of sustainable development tends to remain only a policy discourse without real implementation. Physical environment contributes to shaping human resources who are capable of long-term thinking. s with environmental awareness tend to consider the long-term impact of every development activity carried out. This is very important to ensure that current development does not harm future generations. In addition, Physical environment also plays a role in building community capacity to participate in development. Communities with environmental knowledge and awareness will be more critical of development policies that have the potential to damage the environment. This critical participation is one of the important pillars in realizing sustainable and democratic development. Thus, physical environment can be seen as a strategic instrument in bridging the interests of development and environmental preservation. The integration of Physical environment into the physics system is an important step to ensure the sustainability of development in the long term.[18]

The Role of Physical environment in the Indonesian Context

In Indonesia, the role of Physical environment in supporting sustainable development is becoming increasingly important given the high level of environmental damage. Various problems such as deforestation, marine pollution, and climate change show that development that does not take environmental aspects into account remains a major challenge. In this context, Physical environment is expected to provide long-term solutions in building public ecological awareness. Physical environment in Indonesia is not only implemented through formal channels, but also through non-formal and informal physics. Programs such as adiwiyata schools, environmental education, and environmental awareness campaigns are efforts to increase public participation in environmental protection. These efforts show that Physical environment has a strategic role in supporting national

[18] Tilbury, Daniella, *Education for Sustainable Development* (Paris: UNESCO, 2011), pp. 14–16.

development policies oriented towards sustainability. However, the effectiveness of Physical environment in Indonesia still faces various obstacles. [19] Lack of coordination between institutions, limited resources, and low awareness among some communities are challenges that need to be overcome. Therefore, a strong commitment from the government, educational institutions, and the community is needed to strengthen the role of physical environment in supporting sustainable development. In the Indonesian context, physical environment has a very strategic role given the country's rich natural resources and high level of environmental vulnerability. Indonesia faces various environmental problems, such as deforestation, marine pollution, and increasingly frequent ecological disasters. These problems indicate that development in Indonesia still faces major challenges in implementing the principles of sustainability. Physical environment in Indonesia is expected to be a means of increasing public awareness of the importance of protecting the environment. [20]

Through physical environment, communities can understand that environmental damage not only affects nature, but also their own social and economic lives. This awareness is an important asset in encouraging changes in community behavior. Physical environment programs such as Adiwiyata demonstrate the government's concrete efforts to integrate physical environment into education. The program aims to create a school environment that cares about and promotes environmental culture. However, the success of this program is highly dependent on the commitment of all stakeholders, including teachers, students, and the surrounding community. Therefore, the strengthening of physical environment in Indonesia needs to be carried out in a sustainable manner and integrated with national development policies. Physical environment should not be viewed as a supplement, but as a key part of a sustainable development strategy.[21]

CONCLUSION

Based on the results of the literature review and discussion described above, it can be concluded that Physical environment plays a very important role in supporting sustainable development. Physical environment not only serves to increase individuals' knowledge about the environment, but also plays a role in shaping awareness, attitudes, and behaviors that are responsible for nature conservation. Thus, Physical environment is the main foundation for building a harmonious relationship between humans and the environment. Sustainable development requires a balance between economic, social, and environmental aspects. Development that is only oriented towards economic growth without considering environmental

[19] Ministry of Environment and Forestry of the Republic of Indonesia, *Status of the Indonesian Environment* (Jakarta: Ministry of Environment and Forestry, 2020), pp. 7–9.

[20] Ministry *of Environment, Adiwiyata Program* (Jakarta: KLH, 2019), pp. 3–5.

[21] Emil Salim, *Environment and Development* (Jakarta: LP3ES, 2010), pp. 78–80.

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