

## Integration of Physiotherapy in Healthy and Sustainable Ecotourism: A Case Study of River of Mudal Ecotourism

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Keywords	Abstract
physiotherapy, healthy ecotourism, sustainable ecotourism, nature-based therapy	Amid the growing public interest in tourism that is not only refreshing but also provides health benefits, the integration of nature-based physiotherapy services represents a strategic innovation. This study examines the implementation of physiotherapy concepts within healthy and sustainable ecotourism, emphasizing the use of nature-based therapy at Sungai Mudal Ecotourism (ESM) in Kulon Progo, Special Region of Yogyakarta. Ecotourism is generally analyzed from environmental and socio-economic perspectives; however, its potential contribution to health promotion and rehabilitation remains underexplored. Given its natural assets, ESM serves as a relevant example of incorporating physiotherapy activities into ecotourism practices. This study employed a qualitative case study design, utilizing participatory field observations, in-depth interviews, focus group discussions (FGDs) with ESM managers, document analysis of reports and related literature, tourist perception surveys, and light intervention studies on the benefits of therapy-based tourism activities. The results indicate that the natural environment, including rivers, waterfalls, and natural pools, provides opportunities for therapeutic activities such as hydrotherapy and musculoskeletal mobility exercises. These activities benefit both physical and mental health, thereby enhancing the attractiveness and sustainability of ecotourism. This study presents the paradigm of “healthy ecotourism,” which integrates physiotherapy-oriented environmental therapy techniques into ecotourism planning and management. Such integration encourages ESM to strengthen ecotourism sustainability through service diversification, support for local livelihoods, and the reinforcement of health–environment linkages.

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### INTRODUCTION

Public concern for environmental sustainability is increasingly reflected in the vigorous promotion of sustainable practices, including in the tourism sector. Ecotourism represents a tangible manifestation of how this sector can foster public awareness not only of traveling for leisure but also of conserving the environment. With concepts and principles rooted in environmental conservation, ecotourism offers tourism experiences that support not only environmental health but also public health.

The positive trend of ecotourism has encouraged numerous innovations in providing diverse tourism options, packages, and themes. One ecotourism innovation that is increasingly practiced and promoted is wellness ecotourism, a combination of nature-based tourism and preventive and promotive health approaches. Wellness ecotourism is oriented not only toward recreation but also toward the restoration of physical and mental health. This practice has evolved into a societal need alongside growing awareness of healthy lifestyles, fatigue caused by urbanization, and the surge in musculoskeletal disorders and stress cases in the post-pandemic period (Brymer & Lacaze, 2013). Consequently, ecotourism has increasingly been examined from a health perspective, given its contributory potential to public health.

Among the various branches of health sciences, physiotherapy is a field of study and practice with strong potential to be integrated into ecotourism. The integration of physiotherapy-based therapy into ecotourism activities is highly relevant in addressing the growing public demand for health-enhancing tourism. A study by Vitoulas et al. (2022) found that physiotherapy, as a health science discipline, plays a role in supporting public health, including in workplace settings. In a broader context, physiotherapy practices are closely associated with healthy lifestyles, particularly in the prevention and rehabilitation of musculoskeletal disorders, stress, and declines in fitness due to sedentary lifestyles (Marijančić et al., 2023).

In the context of ecotourism, physiotherapy has been widely adopted within healthy tourism concepts. In many developed countries, concepts such as forest therapy, balneotherapy, and adventure rehabilitation are incorporated as complementary health services (Gobster et al., 2022). For example, with the natural components it offers, forest-based tourism can serve as an alternative form of physical therapy for rehabilitation as well as for mindfulness therapy (Bassi et al., 2024). Public perceptions and mindsets in developed countries have reached a level where physiotherapy is considered an inseparable part of tourism activities (Varnado et al., 2024). This integration positions physiotherapy as a discipline frequently examined within public health frameworks.

In Indonesia, however, the integration of physiotherapy practices into ecotourism activities remains limited. Moreover, the lack of preventive approaches such as physiotherapy within tourism packages indicates that this practice has strong potential to realize ecotourism not only as a form of entertainment but also as a medium for health education, prevention of degenerative diseases, and improvement of quality of life. This study aims to identify potential and design a model for integrating physiotherapy into sustainable ecotourism through the utilization of nature-based therapy. The case study in this research is Sungai Mudal Ecotourism (ESM), which possesses significant potential for water-based therapy and outdoor physical activities. Located in Kulon Progo, Special Region of Yogyakarta, ESM is a nature-based tourism destination with strong potential to be developed into a healthy and sustainable tourism area (Waluyo et al., 2025). Its lush protected forest landscape, clear river flows, and well-organized trekking trails make ESM ideal for light physical activities that are refreshing and health-promoting.

This study identifies the potential of ESM in supporting physiotherapy-based nature therapy activities. By exploring and designing a model for integrating physiotherapy into nature-therapy-based ecotourism at ESM, this effort is expected to encourage health-friendly tourism innovation, empower local communities, and support the achievement of the Sustainable Development Goals (SDGs), particularly in the areas of health, decent work, and sustainable community development. Physiotherapy activities integrated into ESM can enhance the value proposition and branding of healthy and sustainable ecotourism. This integration is also expected to expand ESM's market segment, targeting not only healthy tourists but also visitors who are patients undergoing care or therapy (Hari Krishna et al., 2023).

The urgency of this study lies in the underutilization of ESM's therapeutic assets for community- and nature-based physiotherapy interventions. This research emphasizes community empowerment through multisectoral collaboration by positioning the integration of physiotherapy into ecotourism as an opportunity for communities to engage in the provision

of tourism-based health services, while also enhancing the capacity and competitiveness of sustainability-based tourism.

Although many ecotourism studies have been conducted, few have integrated physiotherapy into their analyses. Research linking ecotourism with health, particularly physiotherapy, remains limited. Leuwol and Sibarani (2020) examined ecotourism for health purposes, but their study focused on mangrove forests with an emphasis on forest therapy. Additionally, community service activities conducted by Syafrianto et al. (2024) introduced physiotherapy interventions into tourism with a focus on first aid training for accidents or injuries. Another community service initiative by Adiyanto et al. (2025) also examined river-based ecotourism, namely Tour Kali Papah, with a focus on waste management. Meanwhile, several studies related to ESM have been conducted, including those examining the role of local communities in developing and managing ESM (Waluyo et al., 2025). However, none of these studies have explored the integration of physiotherapy into activities at ESM.

This study offers a fresh perspective in tourism research by positioning physiotherapy as the main focus of tourism practice. Specific health interventions in the field of physiotherapy have not been widely explored within the ecotourism context in Indonesia. This research also has the advantage of an integrative, multidisciplinary approach that combines physiotherapy science, environmental sustainability, and community development through local tourism management at ESM. This community-based study takes local contexts into account, enabling it to address real needs and potentials in the field. The practical output of this research is a physiotherapy-based healthy tourism model that can be replicated in similar destinations. Positioning physiotherapy in ecotourism as a promotive and preventive service extends beyond clinical care and can also support the broader agenda of community-based health service reform.

## **RESEARCH METHOD**

This study employ a qualitative method to help understand context, perceptions, and socio-cultural values. Qualitative exploration was conducted through data collection techniques including participatory field observations, in-depth interviews, focus group discussions (FGDs) with ESM managers, document analysis of reports and related literature, tourist perception surveys, and light intervention studies examining the benefits of therapy-based tourism activities.

The primary data were mainly obtained through observation of natural features by directly examining the therapeutic potential of features available at ESM. This observation represents an exploratory qualitative approach that also involved stakeholders (ESM managers, visitors, and physiotherapy practitioners) to focus on exploring perceptions, needs, potentials, and challenges at ESM. The results of this stage served as the basis for determining forms of integration and collaboration between physiotherapy and healthy tourism at ESM. ESM managers were involved in these observations to ensure clearer and more valid identification, given that ESM's therapeutic assets had not yet been utilized.

Physiotherapy practitioners were involved to assist ESM managers in identifying potential and mapping existing therapeutic features at ESM. Field observations mapped trekking routes, waterfalls, water therapy areas, vegetation, clean air, and potential therapeutic activities that could be integrated into ESM's tourism services. From the identified locations,

suitable physiotherapy activities were determined. The recommended nature-based therapies were then lightly intervened with a number of ESM visitors to identify the benefits of therapy-based tourism activities.

To gain a comprehensive and detailed understanding of ESM, in-depth interviews were conducted with ESM managers, particularly daily administrators such as the chairperson and vice-chairperson. These interviews explored information ranging from the history and development of ESM to its management practices. An interview guide was prepared to obtain detailed information regarding the distribution of tasks within the ESM management team, efforts undertaken to develop ESM, and their understanding of physiotherapy as well as healthy and sustainable ecotourism. The fundamental concept of healthy and sustainable ecotourism was one of the crucial points explored with ESM managers. Several key questions were designed to deepen managers' understanding of the principles and practices of healthy and sustainable tourism, which constitute the primary objective of this study.

Observations and interviews with ESM managers were conducted in parallel to obtain continuous and coherent information and data. The results of exploratory observations and interviews could not be directly used as a basis for integrating physiotherapy activities. The data and notes obtained needed to be disseminated to all ESM managers, as every individual must understand the potential and integration plan. To accommodate this, FGDs were conducted to provide a shared understanding among all ESM administrators and managers, as they would ultimately implement the practices. In addition, FGDs were used to design realistic and contextual healthy tourism program ideas.

Considering that ESM managers do not have backgrounds in health sciences, particularly physiotherapy, FGDs provided space for each ESM manager to ensure mutual understanding and assist in formulating the integration of physiotherapy into ESM. With the support and guidance of physiotherapy practitioners, ESM managers were directly involved in formulating suitable physiotherapy activities. They were also involved in determining specific locations within the ESM area where physiotherapy practices could be carried out. Physiotherapy practitioners played not only a facilitative role in FGDs but also a crucial role in ensuring the success of integration and intervention by transferring practical knowledge to ESM managers.

Shared perceptions and perspectives among all ESM managers and administrators are far more important for implementing the recommended activities, particularly those aimed at tourists or visitors. To enable ESM managers to deliver and explain physiotherapy activities that tourists can perform, they received training from physiotherapy practitioners. The practical form of this integration occurs at the level where tourists practice physiotherapy activities at designated locations, even if the intensity is light. To determine the extent to which these light interventions produced results, interviews were conducted with tourists and stakeholders focusing on how they received and experienced the benefits of nature-based therapy and physiotherapy services.

Involving tourists on a limited scale through participation in simulated activities served as an initial method, with data recorded via questionnaires to measure tourist perceptions of the benefits of the designed activities, such as physical comfort, relaxation, and improved mobility. The assessment covered aspects including physical benefits, accessibility of activities, safety and comfort, and willingness to repeat or recommend the activities. Based on the potentials and perceptions obtained from ESM managers and samples of tourists who

received light interventions, the collaboration between physiotherapy and healthy tourism at ESM is expected to become more firmly established.

The collected data were analyzed and synthesized triangulatively among three main stakeholders ESM managers, physiotherapy practitioners, and tourists. This approach was employed to enhance the credibility of the research findings by comparing data from different sources, methods, researchers, or theories to reduce potential bias and researcher subjectivity. The results of the analysis will serve as the basis for designing practical training modules that can be implemented by ESM managers. Furthermore, the findings from all data analyses will also form the basis for formulating policy or program recommendations not only for ESM but also for broader stakeholders such as local government authorities.

## **RESULT AND DISCUSSION**

The results of the study indicate that ESM has five main ecological features that can be utilized as media for physiotherapy-based nature therapy. These features include: (1) vegetation and clean air quality, (2) an open field or flat ground in the upper area, (3) uphill trekking trails, (4) waterfalls, and (5) natural pools. All five features possess therapeutic characteristics that can be integrated into physical activities, rehabilitative exercises, and physiotherapeutic relaxation. These findings were validated through field observations, discussions with ESM managers, and light intervention trials involving several visitors.

### **Vegetation, Clean Air, and Green Environment as Nature Therapy**

The protected forest vegetation surrounding ESM provides important ecological contributions in the form of clean, oxygen-rich, and pollution-free air. Observations show that tourists experience a sense of mental calm and mood improvement when walking along lush green paths. Vegetation and clean air function as components of nature therapy by improving respiratory function through cool and humid air, reducing stress levels through exposure to phytoncides released by trees, and enhancing mental well-being through the restorative effects of nature (Piedimonte et al., 2025). According to Piedimonte et al. (2025), based on Attention Restoration Theory (ART), natural scenery encourages involuntary attention and facilitates recovery from mental fatigue. This was also reported by ten visitors who experienced inner calm while breathing fresh air and listening to the sounds of flowing rivers and waterfalls.

Walking among dense vegetation induces physiological responses such as reduced heart rate and increased relaxation (Pamungkas et al., 2025). ESM visitors also stated that both body and mind felt more relaxed during their time at ESM. These findings support the development of forest breathing trails or mindfulness walking programs, which are highly relevant to the concept of healthy ecotourism (Farkic et al., 2021). Although this feature has existed since the early development of ESM, managers had not fully understood its scientific basis. This finding serves as positive input for educating tourists and local communities about the benefits of vegetation and clean air at ESM.

### **Utilization of the Open Field as a Jogging Track and Balance Training Area**

The open area in the upper part of ESM has stable land contours and a relatively flat surface, making it safe to use as a light jogging track. Developing a jogging path with the addition of fine sand not only provides a recreational experience but also creates a facility for balance training and strengthening intrinsic foot muscles (Sativani & Pahlawi, 2020). This recommendation for additional features and activities is considered the most feasible for

implementation by ESM. Walking or running on sand provides proprioceptive challenges that stimulate small muscles in the feet and ankles and improve postural stability (Lee & So, 2019). If implemented, this light intervention would allow visitors to experience a sensation of “lighter” legs, improved stability, and higher levels of relaxation compared to walking on hard surfaces.



**Figure 1. Open field in the upper area of ESM**

The use of open land as a therapeutic walking path can become a significant asset in supporting the concept of environment-based physiotherapy, particularly for tourists who require preventive exercise for foot and ankle injuries and for improving general fitness (Olafsdottir & Petursdottir, 2025). Environment-based physiotherapy practices are increasingly promoted not only for individuals with specific exercise needs but also for the general public as part of healthy lifestyle behaviors and preventive measures. Given its significant potential benefits, the recommendation to utilize this open area through the development of jogging tracks and the addition of fine sand is being considered by ESM management.

### **Uphill Trekking Trails as a Medium for Knee Stability Training**

The trekking trails at ESM have a natural incline that is ideal for lower limb muscle strengthening exercises. A key observation indicates that these trails can be used for training individuals with grade 1–2 knee pain, provided that the trail design maintains natural land contours without steps. For individuals with grade 1–2 knee pain, walking on these trekking trails can improve knee muscle stability (Prasetyo Catur Utomo et al., 2025). In addition, walking along these trails can help regulate breathing. All ten interviewed respondents reported feeling stronger and more stable knees as well as easier breathing.

Non-stepped inclined surfaces minimize compressive loads on the knee joint and better stimulate activation of knee stabilizer muscles, including the quadriceps, hamstrings, and gastrocnemius (Abulhasan & Grey, 2017). Several intervention participants reported that walking on these trails felt “safer” than climbing stairs, as the movement was more natural, rhythmic, and did not trigger excessive pressure on the patellofemoral joint. The utilization of these trekking trails has the potential to be developed into a knee-friendly trail program as an innovative healthy tourism offering for adult and elderly visitors.

### **Mechanical Effects of Waterfalls as Natural Massage Therapy**

The waterfalls at ESM have a relatively consistent flow rate and intensity throughout the year. Observations and intervention trials indicate that the falling water pressure produces mechanical effects similar to massage (hydro-massage), which are beneficial for relaxing muscles in the back, shoulders, neck, and lower limbs (Afif et al., 2025). This therapeutic asset has been a strong feature since the early development of ESM; therefore, integrating physiotherapy activities into it is relatively easy, provided that ESM managers can educate tourists on proper positioning to maximize mechanical effects.



**Figure 2. Waterfall at ESM**

Exposure to waterfall water striking the body triggers physiological effects such as increased blood circulation, reduced muscle tension, stimulation of the parasympathetic nervous system, and significant mental relaxation (Zhu et al., 2021). Most tourists who tried light therapy under the waterfall reported deep relaxation, a refreshed feeling, and reduced muscle tension. These findings reinforce ESM's potential to develop simple therapy programs such as a waterfall massage zone that is safe, structured, and offers high tourism value (Ambarwati & Herlambang, 2023).

### **Natural Pools as Media for Hydrotherapy and Muscle Strengthening Exercises**

The natural pools at ESM have water depth and clarity that are safe for light physical activities. There are two main pools located at the lower and upper areas, with depths of 1–2 meters. The study results show that these areas can be utilized for water-based exercises such as walking in water, lower limb movements in floating positions, joint mobility exercises, and muscle strengthening activities using water resistance. Ten respondents reported that these exercises were relatively easy to perform. Bathing in the pools can function as hydrotherapy to improve body balance, including reducing fall risk among the elderly (Pramithasari et al., 2021).



**Figure 3. Natural pools at ESM**

The aquatic environment provides buoyancy that reduces joint loading, enabling safer exercise for individuals with mild musculoskeletal complaints (Wibisono LS et al., 2025). The relatively cool water also provides mild cryotherapy benefits, helping to reduce swelling and muscle tension. These activities received positive responses from visitors, particularly in terms of physical comfort and a refreshed feeling after exercise. As the pools are a favorite attraction for visitors, physiotherapy activities in this feature should be promoted more intensively.

### **Integrating Findings into a Physiotherapy-Based Healthy Ecotourism Concept**

The formulation of a healthy tourism model based on physiotherapy interventions goes beyond passive nature therapy by incorporating active approaches such as light movement exercises, posture tracking, water therapy, and muscle relaxation. The designed activities are promotive, preventive, and light in nature, making them feasible for replication by local managers. Supported by the five therapeutic features, these findings demonstrate that ESM has significant potential to become a healthy tourism destination that integrates physiotherapy principles into recreational activities. The study aligns with global trends in nature-based therapy, eco-physiotherapy, and wellness ecotourism. This integration contributes to service diversification, enhancement of visitors' physical and mental health benefits, empowerment of local managers through nature-therapy training, and strengthening of ESM's branding as a healthy and sustainable ecotourism destination. Through ecological potential mapping and physiotherapy-based interventions, ESM can implement innovative strategies that enhance tourism attractiveness while supporting sustainable development goals.

## **CONCLUSION**

ESM has very strong ecological and therapeutic potential to be developed into a healthy ecotourism destination based on physiotherapy. Five main ecological features vegetation and clean air, open spaces, trekking trails, waterfalls, and natural pools have been shown to be integrable into nature-based therapeutic activities that are promotive and preventive for both physical and mental health. The results of observations, light intervention trials, and

triangulation with managers and tourists indicate that integrating physiotherapy into tourism activities can enhance relaxation, mobility, physical comfort, and visitors' overall fitness. In addition, this practice strengthens the capacity of ESM managers to organize sustainable, community-empowerment-based healthy tourism. The expected outcomes include the formulation of an applicable, inclusive, and sustainable physiotherapy-based ecotourism development model, as well as policy recommendations as a contribution to innovation in community-based physiotherapy services. This study also contributes to strengthening local community involvement in healthy and sustainable ecotourism practices.

Nevertheless, this study has several limitations. First, recommendations for developing the use of open fields as jogging tracks and balance-training areas could not be analyzed in depth because these features are still proposals and have not yet been implemented by ESM management. The actual therapeutic impacts—such as improvements in balance, proprioception, or lower limb muscle strengthening—still require long-term trials after these facilities are realized. Second, the nature-based therapeutic interventions provided to visitors were still simulational and light in nature; therefore, tourist responses were limited to immediate perceptions and do not yet reflect long-term benefits. This study did not measure objective changes such as increases in range of motion (ROM), muscle strength, postural stability, or physiological reductions in muscle tension.

Based on these limitations, future studies are recommended to: (1) conduct structured evaluations after ESM management implements jogging tracks and balance-training areas, including quantitative measurements of their effectiveness; (2) expand the sample size and apply nature-based therapeutic interventions over a longer period to obtain more comprehensive data; (3) develop objective, physiotherapy-based assessment instruments to measure long-term impacts such as changes in mobility, balance, cardiorespiratory capacity, and well-being; and (4) pilot sustainable physiotherapy training models for ESM managers so that healthy tourism integration can be implemented optimally. Through such further development, ESM has the potential to become a national model of innovative, scientific, and sustainable physiotherapy-based ecotourism.

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