

Evaluation of environmental management and its correlation with eco-efficiency in public Institutions in Peru

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Abstract: The study aims to determine the relationship between environmental management and eco-efficiency of workers in public institutions in Peru. For this, a quantitative approach with a correlational design was proposed, in which 320 employees from various public institutions participated. Data collection was carried out through two Likert-type questionnaires, and the Spearman's Rho coefficient was used to obtain the correlation levels. The results showed a positive correlation (0.768) between environmental management and eco-efficiency, indicating that better implementation of environmental management practices is associated with more efficient use of resources within institutions. In conclusion, the importance of promoting policies and training on environmental management in the public sector is highlighted, as this not only contributes to environmental preservation but also has a direct impact on the operational efficiency of entities.

Keywords: Conservation, Eco-efficiency, Environmental Management, Optimization, Segregation.

1. Introduction

In recent years, the world has experienced a series of environmental challenges due to changes brought about by the advancement of new technologies [1]. Excessive use and limited awareness of the environment are highlighted as the main drivers of the rapid growth of environmental issues and the continuous deterioration of environmental quality, reflected in alarming levels of pollution globally [2]. Therefore, it is vital that local government authorities take a more committed and responsible stance in the defense, care, and management of natural resources. The current environmental situation is extremely worrying, so much so that the United Nations has warned that we are on the verge of exceeding the planet's limits of resilience. This has led to the launch of the ten-year period for ecosystem restoration, which is crucial for our survival and must be preserved for future generations [3].

Globally, companies have begun to implement various environmental management strategies to counteract the impacts of increasingly serious ecological threats. They also play a simultaneous role in the degradation of the natural environment [4,5]. The current comprehensive business context is intricate, leading to greater uncertainties about how to achieve a competitive position and remain viable without compromising ecological legitimacy or addressing the concerns of interested groups [6,7]. From an organizational learning perspective, companies are committed to developing the adaptive ability to achieve competitive superiority through investment in environmental aspects [8,9].

In various parts of the world, new initiatives, mechanisms, and actions are being implemented to promote eco-efficiency and ensure the responsible use of resources [10]. A prominent example is Cuba, where a correct form of environmental management has been developed to preserve the native

environment, with the system's objective being to help with optimal resource recovery through preservation, improvement, and monitoring. This initiative reflects the country's commitment to environmental protection and the promotion of eco-practices to ensure the long-term health of the habitat [11]. Likewise, since the 1960s, awareness has increasingly spread about the available resources for progress and the importance of using them more efficiently. As a result, the world today faces significant pressures due to diverse changes, and the current demand of the global population has tripled [12,13].

Similarly, like other regions of the world, public and private institutions in Latin America are very concerned about the repercussions of their actions. As a result, they are taking steps to protect our environment through Environmental Management [14]. On the other hand, according to [15,16], most local authorities in Latin America face many obstacles that directly and significantly impact the implementation of efficient environmental management. The lack of plans and policies, along with disinterest from authorities, among other factors, hinders the execution of mechanisms that promote the general progress of inhabitants in a healthy environment [17,18].

In Peru, environmental management represents a fundamental element within the national development process, and its effective implementation demands responsible and connected participation from the public and private sectors [19,20]. The Ministry of the Environment plays a leading role as the governing authority in environmental matters, being responsible for the preparation, design, management, organization, execution, monitoring, and analysis of the National Environmental Policy (PNA). However, to achieve the objectives set out in the PNA, it is crucial to have the active participation of the public sector. Furthermore, it is essential for the new management to take into account environmental management and eco-efficient sustainability, highlighting the importance of implementing policies that allow for the conservation and preservation of resources and their efficient use as a measure to combat global environmental decline [21].

According to [22], environmental management has acquired fundamental importance in the organizational environment and contemporary environmental behavior. Its main objective is to improve environmental efficiency to reduce the harmful impacts derived from environmental pollution, mainly caused by irresponsible practices in the use of natural resources by companies and citizens [23]. Therefore, protecting and conserving natural resources and the environmental surroundings is one of the most significant challenges for public authorities and citizens, in order to achieve better environmental quality and optimize natural resources to meet essential needs [24].

On the other hand, between 2021 and 2022, public institutions in Peru managed to reduce water, energy, and paper consumption, which decreased CO₂ emissions and preserved tree resources, with savings of S/ 15,392,975.96 [25]. However, the report indicates that savings could have been higher if all entities had adopted eco-efficiency measures since 2010. Thus, environmental protection remains a crucial challenge to ensure the well-being of future generations [26].

It is imperative to preserve our environment since, in a sustainable economy, both community well-being and environmental preservation are considered, in addition to financial viability. Therefore, environmental management, driven by various stakeholders, becomes a key tool for decision-making and continuous improvement to establish harmonious relationships between the organization, the natural environment, and society [27]. Likewise, [28] indicate that sensitivity to environmental issues is growing in the current context. Consequently, entities must commit to these matters due to the origins and outcomes of environmental challenges that affect global economic evolution.

Public institutions in Peru face budgetary restrictions that make it difficult to carry out awareness-raising activities directed at both public employees and the general community. This limitation negatively impacts the ability to achieve effective public environmental management and appropriate eco-efficiency in the use of resources in these entities. Therefore, it is necessary to promote the development of environmental awareness that is sustainable and efficient in the administration of available resources. Based on the aforementioned, the main objective arises of determining the

relationship between environmental management and eco-efficiency of workers in public institutions in Peru.

This research has made a significant contribution to future studies and scientific publications, opening new possibilities for knowledge and contributions in the field of environmental management. The results obtained provide a solid basis for the creation of more effective strategies and allow for a more sustainable approach to environmental challenges. Additionally, the research not only impacts the academic field but also the social and environmental ones, as its purpose aligns with fulfilling ecological responsibilities, optimizing resources and costs, improving the work environment, and strengthening a reputation committed to long-term sustainable development.

2. Literature Review

2.1. Environmental Management

It refers to the social components and the environment in which they interact with innovations in infrastructure. These modifications, known as environmental impacts, are the primary focus of Environmental Management [29]. Meanwhile, [30,31] highlight that, today, environmental management is recognized as a highly relevant strategy in organizational processes and environmental performance.

The main objective is to improve the eco-efficiency of readiness, in order to mitigate the adverse consequences resulting from environmental pollution and degradation, where these impacts are usually the result of irresponsible practices by companies and citizens, leading to excessive use of natural resources, and environmental management involves actions to safeguard and optimize the natural environment [32,33].

Similarly, environmental management is a systematic process that includes the standards, activities, and stages that allow an entity to condition actions to control and improve its environmental impact. This encompasses everything from the planning and design of products and processes to monitoring and evaluating environmental performance, ensuring that the organization's activities are sustainable and comply with current environmental regulations [34].

On the other hand, [35] consider environmental management as a key strategy in the organizational realm that seeks to improve eco-efficiency and reduce negative impacts on the natural environment caused by the excessive use of resources. This administration includes guidelines, measures, and procedures that must be executed in a planned and decentralized manner, promoting the participation of local actors so that decisions favor environmental protection and sustainable growth. Similarly, [36] indicate that environmental management involves the implementation of policies and practices that minimize the negative impact of activities on the environment.

Furthermore, environmental management is not only limited to regulatory compliance but also promotes innovation and continuous improvement in organizational processes. Companies that adopt proactive environmental management tend to develop cleaner technologies, optimize their resources, and improve their operational efficiency, which not only reduces environmental impacts but also allows them to gain competitive advantages [37,38]. This approach goes beyond mere damage mitigation by integrating sustainability into the organizational culture and fostering a long-term commitment to environmental protection. As a result, environmental management becomes a driver of sustainable development that drives balanced economic, social, and ecological growth [39,40].

2.2. Eco-Efficiency

It is a concept that combines economic efficiency and environmental sustainability, aiming to achieve a balance where economic benefits are maximized while minimizing environmental impact [41]. Eco-efficiency represents an important skill for sustainable institutional development, integrating both environmental and economic aspects. Similarly, eco-efficiency indicators are useful tools for business management [42].

On the other hand, it seeks a balance between increasing production and reducing the use of natural resources, ensuring that business operations do not have a negative impact on the environment [43,44]. Likewise, it is emphasized that eco-efficiency has gained great relevance as a key concept in business sustainability, as it integrates both economic and environmental aspects. In this context, eco-efficiency indicators have become essential tools for efficiently managing environmental impact within companies [45].

Moreover, eco-efficiency not only reduces environmental impact but also promotes the growth of human resources and the community, turning it into an innovative competitive asset. It is considered a principle of sustainability that ensures the efficient use of resources and the reduction of environmental impact [46,47].

Finally, it is pointed out as a tool for combining economic and environmental performance that has been widely analyzed. However, most previous research is conceptual in nature or focuses on the general relationship between both aspects, and there is little inquiry that explores its practical implementation in business operations [48]. For their part, [49] affirm that eco-efficiency integrates the efficient use of materials and energy, reducing environmental impacts while simultaneously improving economic competitiveness.

3. Methodology

This study adopts a quantitative approach, characterized by its methodological orientation towards data collection and analysis. This methodology focuses on the quantification of phenomena, allowing the rigorous examination of relationships between variables [50]. The use of this approach facilitates the identification of patterns and the generalization of results within the scientific framework [51].

Similarly, it is of a basic type, with the aim of enriching existing theory by exploring various situations. The design is non-experimental, cross-sectional, and correlational in scope. The sample consisted of 320 workers from public institutions in Peru selected through non-probabilistic, purposive sampling, as the goal was to obtain data from individuals directly involved in eco-efficiency and environmental management activities. For this purpose, two questionnaires of 18 and 24 items respectively were used with a Likert-type scale. The reliability of the questionnaires was verified using Cronbach's Alpha, and finally, SPSS 27 software was used to apply Spearman's coefficient and determine the level of association.

4. Results and Discussion

This section focuses on evaluating the existing correlation between Environmental Management and eco-efficiency in Public Institutions in Peru. For this, the Rho test was used to measure the strength and direction of the association.

Table 1
Degree of correlation between environmental management and eco-efficiency.

Criterion	Eco-efficiency		
	Spearman's Rho	df	Sig.
Environmental management	0.768	320	0.000

Source: SPSS V.27.

In Table 1, a Spearman's Rho value of 0.768 is shown between the variables. This coefficient indicates a high positive association, suggesting that as environmental management improves, eco-efficiency also tends to increase, indicating that there is a strong relationship where changes in environmental management practices have a significant impact on ecological efficiency.

This finding implies that institutions that implement more effective strategies in environmental management tend to achieve better results in terms of eco-efficiency, which could reflect a more effective integration of sustainable practices and more efficient use of resources. The high correlation observed

not only underscores the importance of optimizing environmental management but also highlights the potential of these practices to promote greater eco-efficiency in the public sector. Additionally, the analysis of this correlation can help identify specific areas where improvements in environmental management could generate significant benefits in terms of sustainability and operational efficiency.

Table 2.

Relationship of eco-efficiency dimensions and environmental management in public institutions of Peru.

Criterion	Environmental management		
	Spearman's	df	Sig.
Eco-efficiency	0.768	320	0.000
Resource optimization	0.731	320	0.000
Source segregation	0.713	320	0.000
Water conservation	0.651	320	0.000
Efficient energy use	0.526	320	0.000

Source: SPSS V.27.

In Table 2, analyzing each dimension of eco-efficiency, resource optimization shows a high positive correlation ($\rho=0.731$, $p=0.000$), source segregation also demonstrates a high positive correlation ($\rho=0.713$, $p=0.000$), while water conservation denotes a moderate positive correlation ($\rho=0.651$, $p=0.000$), and finally, efficient energy use has a moderate positive correlation ($\rho=0.526$, $p=0.000$) with environmental management.

These results imply that environmental management in public institutions benefits most directly from effective optimization and proper waste segregation, but is also influenced by water conservation and energy efficiency practices, albeit to a lesser extent. Altogether, to achieve optimal environmental management, it is essential not only to focus efforts on resource optimization and waste segregation but also to promote water conservation and energy efficiency. Adopting a comprehensive approach that encompasses all these practices will allow for a significant improvement in environmental management, leveraging the synergy between the various sustainable strategies.

Table 3.

Frequency of environmental management and its dimensions.

Variables and dimensions	Deficient		Regular		Efficient		Total	
	fi	%	fi	%	fi	%	fi	%
V: Environmental management	84	26.19	160	50.00	76	23.81	320	100.00
D ₁ : Environmental education and awareness	61	19.05	154	45.24	114	35.71	320	100.00
D ₂ : Environmental policies	114	35.71	122	38.10	84	26.19	320	100.00
D ₃ : Environmental strategies	84	26.19	145	45.24	91	28.57	320	100.00

Source: SPSS V.27.

Table 3 shows that environmental management in public institutions is predominantly in the regular category, with 50.00%, while 26.19% is classified as deficient, and 23.81% as efficient.

In the analysis of specific dimensions, environmental education and awareness have 35.71% in the efficient category, but still have 19.05% as deficient. Regarding environmental policies, 35.71% are deficient, indicating an urgent need to improve previously implemented policies. On the other hand,

environmental strategies show 28.57% as efficient and 26.19% as deficient, suggesting that although strategies are mostly regular, strengthening is still required.

Table 4.
Frequency of eco-efficiency and its dimensions.

Variables and dimensions	Deficient		Regular		Efficient		Total	
	fi	%	fi	%	fi	%	fi	%
V: Eco-efficiency	59	16.67	198	61.90	69	21.43	320	100.00
D ₁ : Resource optimization	99	30.95	145	45.24	76	23.81	320	100.00
D ₂ : Source segregation	46	14.29	168	52.38	107	33.33	320	100.00
D ₃ : Water conservation	30	09.52	168	52.38	122	38.10	320	100.00
D ₄ : Efficient energy use	53	16.67	145	45.24	122	38.10	320	100.00

Source: SPSS V.27.

Table 4 reveals that most public institutions present eco-efficiency considered regular with 61.90%, while only 16.67% have a deficient rating, and 21.43% achieve an efficient evaluation.

Analyzing specific dimensions, resource optimization stands out for having the highest percentage in deficient (30.95%) and only 23.81% in efficient, indicating that this area requires significant improvements. For its part, source segregation has a notable proportion in efficient (33.33%), although 14.29% is still in deficient, suggesting that although it is relatively strong, additional attention is needed. Also, water conservation shows good performance, with 38.10% in efficient and only 9.52% in deficient, indicating that this practice is mostly effective but can be improved. Lastly, efficient energy use shows a balance, with 38.10% in efficient and 16.67% in deficient, suggesting that although it is one of the strongest areas, there is still room for improvement.

5. Conclusions

It is established that there is a significant relationship between environmental management and eco-efficiency in public institutions of Peru, indicating that when environmental management improves, resource efficiency tends to increase, resulting in greater eco-efficiency. This is important as it demonstrates that environmental policies, education, and awareness within the organization have a direct impact on how natural resources are used sustainably.

Additionally, this study has identified a series of critical factors that directly influence the environmental performance of these entities. First, it is concluded that the adoption of eco-efficiency practices in the public sector is in an early stage, with limited progress in the implementation of measures that contribute to reducing environmental impact. However, there is a growing awareness among workers about the importance of adopting sustainable policies that promote the efficient use of resources and waste reduction.

Furthermore, it has been observed that continuous training and employee awareness are fundamental elements in consolidating an organizational culture oriented towards eco-efficiency. Therefore, it is crucial that these processes be consistently integrated within public institutions, fostering an organizational culture that prioritizes the responsible management of resources and the reduction of environmental impact.

Finally, the importance of creating an environment that allows for the effective implementation of eco-efficient strategies through improved planning, monitoring, and evaluation of current policies is emphasized. Only with a holistic approach and genuine institutional commitment will it be possible to advance toward more effective and sustainable environmental management in the public sector.

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