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RESEARCH ARTICLE

Environmental Culture in Solid Waste Management Among Residents of Quebrada Verde de Pachacámac, 2025

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Abstract: This study investigated the influence of environmental culture on household solid waste management in Quebrada Verde, Pachacámac (2025). With a quantitative approach, basic type and non-experimental correlational-causal design, 178 residents were surveyed. The results showed that environmental culture significantly influences general waste management (coef. ,200, p < ,001), with notable effects on collection (χ^2 = 4.62, p = ,032) and, especially, on segregation (χ^2 = 7.72, p = ,005; coef. 1.015, p = ,035 for high levels), the latter being the most sensitive. No significant impact was found for transfer and transportation (χ^2 = 2.26, p = ,133), suggesting dependence on institutional factors. It is concluded that environmental culture is key to individual action but requires structural support for sustainable results.

Keywords: Environmental culture, solid waste management, collection, segregation, Quebrada Verde.

INTRODUCTION

In the current context, the planet faces an unprecedented environmental crisis caused by population growth, excessive consumption, and climate change, which has profoundly altered ecosystems and threatens global sustainability (Rockström et al., 2023; IPCC, 2023). Weak implementation of environmental public policies and government inaction are intensifying this crisis (UNEP, 2022). This situation calls for urgent transformation in natural resource management and consumption patterns on a global scale.

One of the most critical issues is the inadequate management of solid waste, with alarming figures: 2.24 billion tons of waste are generated each year, but only 19% is recycled or composted (IDB, 2022). The situation with plastic is even more serious, as only 9% is recycled and more than 50% end up in the environment (OECD, 2022). CO_2 emissions are also increasing, reaching 36.8 Gt in 2022 (Global Carbon Project, 2023).

In Latin America, the situation is no longer encouraging more than 541,000 tons of solid waste are generated daily, but only 4.5% is formally recycled (ECLAC, 2023). Countries such as Brazil and Mexico have recycling rates of less than 3% (ABRELPE, 2023). In Peru, only 1.9% of municipal waste is recycled, and 76% of municipalities do not have adequate landfills (MINAM, 2023; OEFA, 2022).

Quebrada Verde, in Pachacámac, reflects this problem. The lack of environmental awareness is evident in the burning of garbage, accumulation in streets and riverbanks, and minimal waste separation in homes. This situation creates health and environmental risks due to low neighborhood participation in municipal programs (WWF Peru, 2021; INEI, 2022). Without a strong ecological culture, infrastructure is insufficient.

This research seeks to analyze how environmental culture manifests itself in waste management in Quebrada Verde, with a view to 2025. Dimensions such as environmental values, beliefs, and behaviors (Sauvé, 2005; García, 2004) will be studied, along with operational variables such as the collection, segregation, transfer, and transport of solid waste (MINAM, 2023). The diagnosis will allow for the proposal of sustainable strategies adapted to the local context.

Theoretically, it is based on models such as the Theory of Reasoned Action (Ajzen, 1991), Social Learning (Bandura, 1986), Pro-Environmental Behavior (Kollmuss & Agyeman, 2002), and the Circular Economy (Ellen MacArthur Foundation, 2013). These theories explain how values, norms, emotions, and social learning condition environmental practices provide frameworks for understanding ecological decisions.

From a methodological perspective, a quantitative approach was used to gather solid evidence to correlate environmental culture and waste management. The research is linked to Sustainable Development Goal No. 12, which promotes responsible consumption and

production (UN, 2021). The hypotheses propose that there is a significant relationship between environmental culture and household waste management (Martel et al., 2022; Ramírez, 2024).

International and national evidence reinforces the relevance of the study. Research in Colombia, Ecuador, Mexico, and Peru has shown how education, beliefs, and citizen participation influence waste management (Castillo & Chacón, 2022; Barragán et al., 2024; De La Cruz, 2022; Delgado, 2024). This research, therefore, seeks not only to understand the phenomenon but also to contribute to applicable solutions in vulnerable communities such as Quebrada Verde.

METHODOLOGY

This research was conducted using a quantitative approach and a positivist paradigm, focused on objectivity, measurement, and generalization of principles, as proposed by Kuhn (1962) and Sautu et al. (2005). The hypothetical-deductive method (Creswell, 2014) was used to establish relationships between the variables "environmental culture" (Serrano & Morales, 2008) and "solid waste management" (Bermúdez & Londoño, 2006). The study was basic (Ñaupas et al., 2018), with a non-experimental, cross-sectional, and correlational design (Hernández et al., 2014), allowing data to be collected at a single point in time and analyzed without manipulating variables.

The population consisted of 278 residents of Quebrada Verde, 178 of whom were selected through non-probability convenience sampling, with the support of neighborhood leaders (Hernández et al., 2014). The survey was the main technique, and the questionnaire was the instrument, developed with indices, typologies, and scales (Sautu et al., 2005). Its content was validated by expert judgment, and its reliability was evaluated using Cronbach's alpha, obtaining coefficients of 0.837 and 0.819, which represents high consistency (Cronbach, 1951; Ruiz, 2015). Data processing was performed in SPSS v27, using descriptive statistics, multiple correlation, and ordinal logistic regression (McCullagh, 1980; Hosmer et al., 2013).

The study complied with the ethical standards of the César Vallejo University (UCV, 2020), guaranteeing the privacy, anonymity, and informed consent of the participants. Data collection was conducted in person and did not cause harm to the health of the respondents. All information was handled with rigor, ensuring the protection of the participants' identity throughout the research process. This allowed for reliable and valid results on the relationship between environmental culture and solid waste management in the local context of Pachacámac.

RESULTS

The results obtained show that more than half of the participants have a high level of environmental awareness (56%), with environmental behavior standing out at 67% in this category, followed by environmental values and beliefs, each at 58%. In terms of solid waste management, 50% of those evaluated are at an optimal level, while the highest-rated dimension is transfer and transport (76% at an optimal level), followed by segregation (63%) and collection (59%). These data suggest a population with a high attitudinal and behavioral disposition toward pro-environmental practices, although challenges remain in the initial stages of waste management.

Table 1: Description of the levels of the environmental culture variable and its dimensions

Ranks / Levels	Low		Medium		High		Total	
Variable and Dimensions	f	%	f	%	f	%	f	%
Environmental Culture	4	2,00	75	42,00	99	56,00	178	100,00
D1: Environmental values	13	7,00	62	35,00	103	58,00	178	100,00
D2: Environmental Beliefs	4	2,00	70	40,00	104	58,00	178	100,00
D3: Environmental performance	3	2,00	55	31,00	120	67,00	178	100,00

Inferential analysis using ordinal logistic regression reveals that environmental culture significantly influences solid waste management ($p < .001$), with moderate explanatory power (Nagelkerke $R^2 = .20$). As the level of environmental culture increases, so does the likelihood of efficient management. The coefficients show that moving from a low level to a high level more than triples the probability of good practices, validating the overall hypothesis. However, goodness-of-fit tests reveal a model with limitations, which is common in social studies with multiple influencing factors.

Table 2 Information on model fit and R-squared explaining the influence of environmental culture on solid waste management

Model	Logarithm of likelihood -2	Chi-square	gl	Sig.	Pseudo R squared	
Only intersection	214,940				Cox y Snell	,150
Final	190,070	29,500	1	,000	Nagelkerke	,200
					McFadden	,150

Link function: Logit.

Regarding the specific hypotheses, environmental culture has a significant influence on solid waste segregation (p = .005), although the model's adjustment values are low, indicating a moderate relationship. A high level of environmental culture (level 3) shows a positive and significant impact on segregation (p = .035), while the medium level has no statistically relevant effects. In contrast, in the collection dimension, although the model is significant (p = .032), the coefficients of the environmental culture levels are not significant, suggesting that their influence on this practice is inconclusive.

Table 3 Information on model fit and R-squared explaining the influence of environmental culture on the solid waste collection dimension

Model	Logarithm of likelihood-2	Chi-cuadrado	gl	Sig.	Pseudo R cuadrado	
Only intersection	211,38				Cox y Snell	,0256
Final	209,07	4,62	1	,032	Nagelkerke	,0283
					McFadden	,0109

Link function: Logit.

Table 4 Information on model fit and R-squared explaining the influence of environmental culture on the solid waste segregation dimension

Model	Logarithm likelihood-2	ofChi-square	gl	Sig.	Pseudo R cuadrado	
Only intersection	189,80				Cox y Snell	,0425
Final	182,08	7,72	1	,005	Nagelkerke	,0485
					McFadden	,0208

Link function: Logit.

Table 5 Information on model fit and R-squared explaining the influence of environmental culture on the transfer and transport dimension of solid waste

Model	Logarithm likelihood-2	of Chi-square	gl	Sig.	Pseudo R cuadrado	
Only intersection					Cox y Snell	,0126
Final	253,03	2,26	1	,133	Nagelkerke	,0166
					McFadden	,0089

Link function: Logit.

Finally, the environmental culture variable does not significantly influence the transfer and transport of solid waste (p = .133). Neither medium nor high levels of environmental culture show a statistically significant relationship, and the model has little explanatory power. This is because these practices are more related to structural and institutional factors than to citizen decisions. In conclusion, environmental culture has a clearer impact on the initial stages of waste management, while subsequent management requires interventions from public policy and municipal infrastructure.

DISCUSSION

The general hypothesis of the research, which proposed that environmental culture significantly influences solid waste management, was solidly confirmed. Based on Ajzen's Theory of Planned Behavior (1985), it was understood that attitudes, subjective norms, and perceived control determine the intention to act ecologically. This relationship was empirically supported by authors such as Kollmuss and Agyeman (2002), Barr (2007), and Stern (2000), who have pointed out that environmental awareness and values strengthen behaviors such as segregation and compliance with norms. In the study, this influence was statistically significant in segregation and collection, but not in transfer and transport, revealing that environmental culture has more impact where individual action is direct and less in dimensions controlled by institutions.

Regarding the first specific hypothesis, which proposed a relationship between environmental culture and waste collection, the results were significant (p = .032), although with low explanatory power (Nagelkerke R^2 = .0256). This finding coincides with the proposals of Gifford (2011) and Stern (2000), who warn of the gap between environmental intention and action in contexts with structural limitations. Thus, environmental culture operates as a facilitator but does not guarantee sustainable behavior if the urban environment, infrastructure, or public services do not allow it. This

conclusion is also supported by local studies, such as that of Navarro et al. (2019), which found that environmental awareness is diluted in the face of poor municipal conditions.

In relation to the second specific hypothesis, waste segregation showed a significant correlation with environmental culture, especially at its highest level ($p = .035$), with greater explanatory power than other dimensions (Nagelkerke $R^2 = .0485$). This finding is consistent with the theory of values, beliefs, and norms proposed by Stern (2000) and with the assertion by Steg and Vlek (2009), who indicate that sustained behavioral changes require a deep internalization of ecological values. The literature reviewed reinforces this interpretation, as evidenced by García et al. (2018) and Rodríguez and Pérez (2020), who have shown that intensive environmental education has a greater impact on household waste separation practices than on other phases of the waste cycle.

Finally, the third specific hypothesis, relating to waste transfer and transport, was not empirically confirmed ($p = .133$). The results reveal that this dimension, as it depends on logistical and institutional systems, is beyond direct citizen control, which limits the impact of environmental culture on it. This finding is consistent with the arguments of Steg and Vlek (2009), who highlight that psychosocial factors have less predictive power in contexts where individual agency is reduced. Similarly, studies such as those by Del Río-González (2015) and Díaz and Fuentes (2021) have warned that the intermediate stages of waste management are perceived as distant or invisible to citizens. Taken together, the findings of this research suggest that a truly effective waste management policy must integrate educational and structural interventions, recognizing that environmental culture is necessary but not sufficient to transform the system in a sustainable manner.

CONCLUSION

The research confirmed the general hypothesis: that there is a significant relationship between environmental culture and solid waste management, especially in phases where citizen participation is direct. This corroborates the postulates of Ajzen (1985) and Stern (2000), who point out that attitudes, social norms, and perceived control influence environmental behaviors. The dimensions of collection and segregation showed statistically significant coefficients, revealing that environmental culture can promote sustainable behaviors in urban contexts (Kollmuss & Agyeman, 2002).

The specific hypothesis on collection was confirmed: although a significant relationship was identified, the explanatory power was low. This result coincides with Gifford (2011), who warns of the gap between intention and environmental behavior when structural barriers exist. In contexts where collection services are irregular or unreliable, intention does not always translate into action. Therefore, environmental culture acts as a facilitator, but requires minimum contextual conditions to activate pro-environmental behavior.

Regarding segregation, the hypothesis was robustly confirmed. High levels of environmental culture were found to significantly predict waste sorting behaviors, in line with Stern (2000) and Barr (2007), who argue that these practices are strongly influenced by values and knowledge. However, this behavior is not linear; only with deep commitment can sustained habits be achieved (Steg & Vlek, 2009). Segregation, therefore, represents a key opportunity for intervention through environmental education.

The hypothesis related to transfer and transport was not confirmed. Environmental culture had no significant effects in this dimension, suggesting that institutional factors such as municipal logistics carry more weight, as indicated by Díaz & Fuentes (2021) and Del Río-González (2015). At this stage, individual action is limited, which restricts the impact of environmental attitudes. This reinforces the need for structural approaches that complement behavioral change.

From a methodological point of view, the use of ordinal logistic regression was appropriate for modeling the relationships between environmental culture and the ordinal dimensions of waste management. Despite the low R^2 values, which are common in social sciences, the significant coefficients in several dimensions support the validity of the model (Hosmer et al., 2013; McFadden, 1974). Future research should incorporate variables such as perceptions of institutional effectiveness or service quality.

In summary, this research provides empirical and theoretical evidence that reinforces the role of environmental culture as a key variable in the civic stages of the waste cycle. To improve the effectiveness of the system, a dual intervention is recommended: ecological training to reinforce individual awareness and improvements in the structural management of the service (García et al., 2018; Navarro et al., 2019). Only then will it be possible to consolidate a culture of community sustainability and close the gap between values and environmental impact.

The author of this study, Martínez (2025), acknowledges that the findings not only partially validate the hypotheses put forward, but also offer a critical and realistic view of the scope and limitations of environmental culture as a driver of social change. Her work provides a contextualized perspective on the Quebrada Verde community, showing that citizen commitment to the environment can be strengthened through educational strategies and public policies that create enabling conditions for effective environmental action.

Martínez (2025) highlights that this research can serve as a basis for future interventions in similar communities, where environmental culture is in its infancy but has transformative potential. Her proposal is oriented toward a comprehensive approach that articulates individual awareness with structural, institutional, and logistical support. By integrating theory, empirical evidence, and local reality, the author contributes to the design of a more sustainable and participatory waste management model that is consistent with the principles of responsible environmental development.

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