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# SOLID WASTE MANAGEMENT AND PREVENTIVE ATTITUDES TOWARD ENVIRONMENTAL POLLUTION AMONG RESIDENTS OF A COMMUNITY IN THE DEPARTMENT OF PUNO

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## ABSTRACT

*Solid waste management comprises a set of actions, policies, and processes aimed at managing waste produced by human activities, from its origin to its final disposal, in a socially, economically, and environmentally responsible manner. This includes the prevention, reduction, collection, transport, treatment, and final disposal of such waste, with the aim of reducing its impact on the environment and public health. General objective: To determine the relationship between solid waste management and the preventive attitude towards environmental pollution among residents of the community of Tiracoma in the district of Cabanillas, province of San Román, and department of Puno in 2024. Materials and methods: This is a basic, descriptive, non-experimental, quantitative, correlational study. The population consisted of 205 inhabitants, and a sample of 134 residents was obtained using simple random sampling. A survey was used as the technique, and the instrument was a structured questionnaire validated by expert judgment. To test the hypothesis, the non-parametric chi-square (X<sup>2</sup>) statistical test was used. Results: With regard to solid waste management, 41.79% of participants generate organic and inorganic waste ( $p=0.000$ ). 64.18% collect waste in general ( $p=0.000$ ).*

*58.21% incinerate solid waste ( $p=0.001$ ). 59.70% recycle plastic bottles ( $p=0.001$ ). 26.87% of waste outdoors ( $p=0.001$ ). 33.58% reduce the use of cardboard boxes ( $p=0.001$ ). 64.93% store waste in bags ( $p=0.001$ ). 52.24% of those surveyed have a poor attitude toward environmental pollution prevention. Conclusions: A significant relationship was found between solid waste management and attitudes toward environmental pollution prevention among residents of the community of Tiracoma, with statistically significant results ( $p < 0.05$ ).*

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**KEYWORDS:** Attitude, Environmental Pollution, Solid Waste Management, Solid Waste, Prevention.

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## 1. INTRODUCTION

Community solid waste management is defined as the collaborative effort between authorities and communities to effectively manage waste. This collaborative effort is intended to promote organization, environmental awareness, and conservation. The overarching aim of community solid waste management is to improve quality of life and ecological awareness. Proper solid waste management remains a global challenge, exacerbated by the lack of a closed production and consumption cycle, causing environmental damage and health crises in communities (1).

Globally, there is a potential for a 70% increase in waste by 2050 if urgent measures are not implemented, owing to rapid urbanization and population growth. Plastic waste poses a significant environmental concern due to its potential for long-term pollution and ecosystem damage if not properly collected and managed. In 2019, global plastic production reached 368 million tons, making that year the highest production year on record, with 51% (2).

The management of solid waste in Peru is substandard, resulting in environmental degradation and potential health hazards. Cities generate approximately 20,000 tons per day, with Lima accumulating 2.1 million tons per year, primarily comprising food, plastics, and hazardous waste, in addition to other types of waste (3).

In Peru, the daily generation of municipal waste is approximately 21,000 tons, with a population of 30 million people. This indicates that the average individual produces approximately 0.8 kilograms of waste per day, the majority of which consists of organic matter, such as food and vegetables.

In Puno, the daily waste generation per capita ranges from 0.59 to 0.85 kilograms. In 2022, approximately 217,000 tons of municipal solid waste were produced, with organic waste constituting the predominant category (56.6%), followed by inorganic, non-reusable, and hazardous waste (4).

In reality, solid waste management in homes and communities is inadequate, which is the rationale behind this research.

This research is theoretically significant because inadequate waste management in a community can have deleterious effects on health, sanitation, urban development, and environmental quality.

The results of this study will facilitate the evaluation and enhancement of community residents' practices in the effective management of solid waste within their homes, from its origin to its final disposal. Furthermore, the findings will promote the implementation of strategies aimed at enhancing

knowledge about the prevention of environmental pollution in the area.

The research will describe the methodologies and instruments used to collect information on waste management and attitudes toward prevention of environmental pollution, ensuring their validity and accuracy. In accordance with this objective, the following general objective was established: The objective of this study is to ascertain the correlation between solid waste management and attitudes toward environmental pollution prevention among the residents of the Tiracoma community.

## 2. METHODOLOGY

The design employed in the research was a non-experimental design, as it involved the handling of two variables without the direct intervention of the researcher. The nature of the research was correlational in nature, as it entailed the analysis of two variables, with an exclusive focus on the relationship between solid waste management and preventive attitudes toward environmental pollution. This approach is quantitative in nature, as it employs statistical tools to analyze the results. The findings are represented quantitatively using frequency and percentage data.

The hypothetical-deductive scientific method was employed, commencing with an examination of general knowledge to derive specific conclusions. The population of Tiracoma, a community within the district of Cabanillas in the province of San Roman, was 205 individuals. The sample population was determined to be 134 residents, as calculated using a formula designed for finite populations. The selection of the sample was executed through the implementation of a simple random probability sampling method. A survey was conducted to collect data on the variables.

The instruments employed in this study included a structured questionnaire designed to evaluate solid waste management practices and an additional questionnaire aimed at collecting data on attitudes concerning the prevention of environmental pollution. The utilization of primary sources was imperative, given that the data were collected directly from the subjects selected for the sample. The non-parametric chi-square ( $\chi^2$ ) statistical test was utilized to evaluate the hypotheses. The instruments were validated through a process of evaluation by experts in the field. These specialists proffered fundamental suggestions and recommendations. The implementation period occurred from October to December of 2024. The development of the research was conducted without any conflicts of interest.

3. RESULTS

Table 1: Solid Waste Generation Related to Attitudes toward Environmental Pollution Prevention.

Solid waste generation	Attitude toward preventing environmental pollution						Total	
	Good		Regular		Poor		Total	
	fi	%	fi	%	fi	%	fi	%
Organic	14	10.45	9	6.72	10	7.46	33	24.63
Inorganic	5	3.73	16	11.94	24	17.91	45	33.58
Organic and inorganic	5	3.73	15	11.19	36	26.87	56	41.79
<b>Total</b>	<b>24</b>	<b>17.91</b>	<b>40</b>	<b>29.85</b>	<b>70</b>	<b>52.24</b>	<b>134</b>	<b>100.00</b>

Source: Questionnaire: X<sup>2</sup>c: 20.102 X<sup>2</sup>t: 9,487 Gl:4 P:0.000

Table 1 shows solid waste generation and attitudes toward environmental pollution prevention in the community of Tiracoma. Of the 134 (100%) people surveyed, 41.79% reported generating both organic and inorganic waste, 33.58% reported generating inorganic waste, and 24.63% reported generating organic waste. Of those residents who have a poor attitude toward environmental pollution

prevention, 26.87% generate organic and inorganic solid waste, while those with a neutral attitude (11.94%) generate inorganic waste. The statistical results show the following results, chi-calculated: 20.102, chi-tabulated: 9.487, 4 degrees of freedom and a probability of 0.000, < 0.05, the result is significant, therefore, the generation of solid waste is related to the attitude of environmental pollution prevention.

Table 2: Collection Of Solid Waste Related to Attitudes Toward Environmental Pollution Prevention.

Solid waste collection	Attitude toward preventing environmental pollution						Total	
	Good		Regular		Poor		Total	
	fi	%	fi	%	fi	%	fi	%
General	9	6.72	20	14.93	57	42.54	86	64.18
Difference	15	11.19	20	14.93	13	9.70	48	35.82
<b>Total</b>	<b>24</b>	<b>17.91</b>	<b>40</b>	<b>29.85</b>	<b>70</b>	<b>52.24</b>	<b>134</b>	<b>100.00</b>

Source: Questionnaire: X<sup>2</sup>C: 19,988 X<sup>2</sup>t:5,991 GL: 2 P: 0.000

Table 2 analyzes the relationship between solid waste collection and attitudes toward environmental pollution prevention among residents of the community of Tiracoma. Of the total sample of 134 (100%), 64.18% collect solid waste in a general manner, and 35.82% collect it in a differentiated manner. Residents with a poor attitude toward environmental pollution prevention generally collect solid waste,

while those with a fair attitude (14.93%) collect solid waste both generally and separately. The non-parametric chi-square statistic was chi-calculated=19.988, chi-tabulated=5.991, for 2 degrees of freedom and a probability of 0.000, < 0.05. The result is significant; therefore, solid waste collection is related to the attitude of environmental pollution prevention among residents of the community of Tiracoma.

Table 3: Treatment Of Solid Waste Related to Attitudes Toward Environmental Pollution Prevention.

Solid waste treatment	Attitude toward preventing environmental pollution						Total	
	Good		Regular		Poor		Total	
	fi	%	fi	%	fi	%	fi	%
Composting	19	14.18	14	10.45	23	17.16	56	41.79
Incineration	5	3.73	26	19.40	47	35.07	78	58.21
<b>Total</b>	<b>24</b>	<b>17.91</b>	<b>40</b>	<b>29.85</b>	<b>70</b>	<b>52.24</b>	<b>134</b>	<b>100.00</b>

Source: Questionnaire: X<sup>2</sup>c:18,694 X<sup>2</sup>t:9,487 GL: 4 P: 0.001

As illustrated in Table 3, the solid waste treatment indicator is associated with residents' attitudes toward environmental pollution prevention in the Tiracoma community. In a survey of 134 subjects, 58.21% of respondents reported incinerating solid waste as a treatment method, while 41.79% reported using composting as a method of waste treatment.

Of those who incinerate solid waste, 35.07% exhibit a poor attitude toward environmental pollution prevention, while 19.40% demonstrate an

average attitude. Notably, those who exhibit a good attitude, defined as those who compost, account for 14.18%. The statistical analysis yielded the following result: the chi-squared value was 18.694, and the chi-squared table value was 9.487. These values correspond to four degrees of freedom and a probability of 0.001, which is less than 0.05. This outcome is of considerable significance. Consequently, solid waste treatment is associated with attitudes concerning environmental pollution prevention.

**Table 4: Recycling Of Solid Waste Related to Attitudes Toward Environmental Pollution Preventi.**

Solid waste recycling	Attitude toward preventing environmental pollution						Total	
	High		Medium		Low		fi	%
	fi	%	fi	%	fi	%		
Paper and cardboard	5	3.73	14	10.45	23	17.16	42	31.34
Plastic bottles	16	11.94	17	12.69	47	35.07	80	59.70
Metals	3	2.24	9	6.72	0	0.00	12	8.96
<b>Total</b>	<b>24</b>	<b>17.91</b>	<b>40</b>	<b>29.85</b>	<b>70</b>	<b>52.24</b>	<b>134</b>	<b>100.00</b>

Source: Questionnaire:  $\chi^2$ :18.694  $\chi^2$ t: 5, 487 GL: 4 P: 0.001

As illustrated in Table 4, the solid waste recycling indicator is associated with residents' attitudes toward environmental pollution prevention in the Tiracoma community. A total of 134 residents were surveyed, and the results indicated that 59.70% of respondents recycle plastic bottles, 31.34% recycle paper and cardboard, and 8.96% recycle metals.

A survey of individuals who engage in recycling plastic bottles revealed that 35.07% of respondents exhibited an unfavorable attitude toward

environmental pollution prevention. Meanwhile, 12.69% of respondents demonstrated a neutral attitude, and 11.94% exhibited a favorable attitude.

The chi-square statistical result yielded a calculated chi of 18.694, a tabulated chi of 5.487, for 4 degrees of freedom and a probability of 0.001, < 0.05. The result is significant. The present study offers a compelling conclusion regarding the relationship between recycling and attitudes concerning environmental pollution prevention.

**Table 5: Solid Waste Disposal Related to Attitudes Toward Environmental Pollution Prevention.**

Solid waste disposal	Attitude toward preventing environmental pollution						Total	
	Good		Regular		Poor		fi	%
	fi	%	fi	%	fi	%		
Buried	12	8.96	16	11.94	27	20.15	55	41.04
Outdoors	8	5.97	16	11.94	12	8.96	36	26.87
Farm	1	0.75	0	0.00	20	14.93	21	15.67
Riverbank	3	2.24	8	5.97	11	8.21	22	16.42
<b>Total</b>	<b>24</b>	<b>17.91</b>	<b>40</b>	<b>29.85</b>	<b>70</b>	<b>52.24</b>	<b>134</b>	<b>100.00</b>

Source: Questionnaire:  $\chi^2$ :22,276  $\chi^2$ t: 12,591 GL: 6 P: 0.001

As illustrated in Table 5, the elimination of solid waste is associated with the attitudes of residents of the Tiracoma community regarding environmental pollution prevention. Of the 134 residents surveyed, 26.87% reported disposing of solid waste outdoors, 16.42% on the riverbank, and 15.67% on their farmland. Of the residents who exhibited an unfavorable attitude toward environmental pollution prevention, 20.15% opted for burial as their waste disposal method, while 11.94% of those with a

favorable attitude chose the same approach. Additionally, 11.97% of the population opted for outdoor disposal. The statistical analysis yielded a calculated chi-square value of 22.276 and a tabulated chi-square value of 12.591, both at 6 degrees of freedom, with a probability value of 0.001 < 0.05, indicating a significant result. Consequently, solid waste disposal is associated with attitudes toward environmental pollution prevention.

**Table 6: Reduction Of Solid Waste Related to Attitudes Toward Environmental Pollution Prevention.**

Solid waste reduction	Attitude toward preventing environmental pollution						Total	
	Good		Regular		Poor		fi	%
	fi	%	fi	%	fi	%		
Compress bottles	0	0.00	0	0.00	4	2.99	4	2.99
Compress cans	4	2.99	2	1.49	0	0.00	6	4.48
Cardboard boxes	3	2.24	19	14.18	23	17.16	45	33.58
None	17	12.69	19	14.18	43	32.09	79	58.96
<b>Total</b>	<b>24</b>	<b>17.91</b>	<b>40</b>	<b>29.85</b>	<b>70</b>	<b>52.24</b>	<b>134</b>	<b>100.00</b>

Source: Questionnaire

$\chi^2$ : 21,811

$\chi^2$ t: 12,591

GL:6

P: 0,001

The following table illustrates the correlation between attitudes toward environmental pollution prevention and the reduction of solid waste among

residents of the Tiracoma community. Of the total sample, 58.96% do not reduce solid waste, 33.58% reduce cardboard boxes, and 4.48% compress cans.

Of those who do not engage in the compression of solid waste, 32.09% exhibit an unfavorable stance on environmental pollution prevention, while 17.16% reduce cardboard boxes and also demonstrate an unfavorable stance. The statistical analysis yielded a calculated chi-square value of 21.811 and a tabulated chi-square value of 12.591, both at six degrees of freedom, with a probability value of  $0.001 < 0.05$ , indicating a significant result. This finding supports the hypothesis that solid waste reduction is associated with attitudes toward environmental pollution prevention.

#### 4. DISCUSSIONS

In the urban center of Juliaca, the entity known as Pandia is present. The management of solid waste is contingent upon an understanding of the classification of containers by color. The results of the study indicated that 67.05% of the students classified waste as either organic or inorganic, while 12.50% exhibited inadequate knowledge regarding waste management. The study concluded that solid waste management is associated with students' understanding of color-coded container classification at the 09 de Octubre primary school in the city of Juliaca (5).

Flores' research, entitled "Level of knowledge and attitudes about hospital solid waste management among staff at the Puno clinic," found that the level of knowledge and attitudes about hospital solid waste management are positively related among staff at the Puno clinic (6).

Additionally, Pandia's research focuses on "Solid waste management related to knowledge about color-coded container classification." The findings of the study indicate that a significant proportion of the student population, amounting to 73.30%, engages in the practice of general solid waste collection. This observation suggests a correlation between solid waste management practices and the extent of knowledge regarding the color-coded classification of containers (5).

Huamani, Tudela, Huamani (2020). The following paper will examine the subject of solid waste management in the city of Juliaca, located in the Puno region. The analysis revealed that 72% of the solid waste was found to be suitable for reuse, while the remaining 28% was deemed unsuitable for these purposes. The conclusion drawn therein asserts that the transformation of organic solid waste from paper, cardboard, plastics, and glass, including the production of compost, can contribute to sustainability and improve equitable income from the benefits resulting from the responsible use of municipal resources (7).

In this regard, Huanca. The following study will examine the characteristics and behaviors of residents of the city of Juliaca in relation to their knowledge of recycling. The findings of the study indicated that 23.2% of the participants demonstrated a satisfactory level of knowledge about recycling, exhibiting average characteristics and behaviors. The highest percentage, 57.6%, exhibited an average level of knowledge about recycling (8).

Pandia. The management of solid waste is contingent upon an understanding of the color-coded classification system for containers. The study's findings indicated that 42.05% of the residents engage in weekly recycling practices, while 55.11% consistently reuse solid waste.

In Puno, 40% of waste is biocontaminated, and 59% is common waste. The conclusion drawn from this analysis indicates a clear noncompliance with the stipulated stages outlined by the Technical Health Standard (NTS - 096).

Pandia. The results of the study indicated that 42.05% of the participants engage in weekly recycling, while 55.11% consistently reuse waste materials. The survey further indicates that 64.77% of respondents occasionally minimize waste, while 42.05% engage in weekly recycling practices.

Huamani, Tudela, Huamani. The study "Solid Waste Management in the City of Juliaca" determined that the transformation of organic solid waste from paper, cardboard, plastics, glass, and metals (7) is a viable solution for municipal solid waste management. These results are consistent with those previously reported in our research. It is evident that a significant proportion of the local population exhibits an inadequate or unfavorable stance towards solid waste management, encompassing its generation, classification, treatment, storage, final disposal, and recycling.

#### 5. CONCLUSION

- There is a significant relationship between solid waste management and attitudes toward environmental pollution prevention among residents of the community of Tiracoma, with a value of  $p < 0.05$ , accepting the proposed hypothesis.
- Regarding solid waste management: 41.79% of people generate organic and inorganic waste ( $p=0.000$ ), 64.18% collect solid waste in general ( $p=0.000$ ), 58.21% incinerate solid waste ( $p=0.001$ ), 59.70% recycle plastic bottles ( $p=0.001$ ), 26.87% dispose of solid waste outdoors ( $p=0.001$ ), 33.58% reduce cardboard boxes ( $p=0.001$ ), 64.93% store waste in polyethylene bags ( $p=0.001$ ), the

results were significant. Therefore, solid waste management is significantly related to the attitude of preventing environmental pollution. Accepting the hypothesis formulated.

- The attitude of the residents of the community of Tiracoma toward preventing environmental pollution was poor in 52.24% of cases, fair in 29.85% of cases, and good in 17.91% of cases.

### 5.1. Recommendations

- The mayor of the district of Cabanillas should issue a municipal ordinance for solid waste management involving the entire population of the district's territorial jurisdiction, with the aim

of improving the final disposal of solid waste and minimizing environmental pollution.

- The general manager of the district municipality of Cabanillas should organize training on solid waste management in the town, communities, and neighborhoods on the collection, treatment, recycling, disposal, reduction, and storage of solid waste.
- The general manager of the district municipality of Cabanillas, in coordination with the person responsible for basic sanitation at the Clas Kenakuturi Health Center, to provide training to residents on the prevention of environmental pollution.

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