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# Potable water distribution by tanker trucks and monetary poverty in Peru, 2020-2023

Distribución de agua potable mediante camiones cisterna y pobreza monetaria en el Perú, 2020-2023

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## Resumen

El acceso discontinuo al agua potable constituye una brecha social y sanitaria que afecta con mayor intensidad a territorios vulnerables. El objetivo del artículo fue determinar la relación entre la distribución de agua potable mediante camiones cisterna y la pobreza monetaria en el Perú durante 2020-2023. Se desarrolló un estudio cuantitativo, aplicado, no experimental y descriptivo-correlacional, basado en análisis documental de información secundaria de OTASS e INEI. La unidad de análisis estuvo constituida por 12 departamentos beneficiarios: Amazonas, Cajamarca, Huánuco, Ica, Junín, Lambayeque, Lima, Loreto, Piura, San Martín, Tumbes y Ucayali. Se aplicaron estadísticos descriptivos y correlación de Pearson, con un nivel de significancia de 5 %, interpretando los resultados como asociaciones y no como relaciones causales. Entre 2020 y 2023 se distribuyeron 594 462 m³ de agua potable mediante 21 camiones cisterna, con beneficio directo para 45 753 familias y un costo estatal acumulado de S/ 5 478 232. Los resultados muestran una relación positiva moderada entre volumen distribuido y pobreza monetaria ($r = 0.432$; $p = 0.010$) y una relación positiva muy alta entre volumen distribuido y costo estatal ($r = 0.970$; $p < 0.001$). Se concluye que el abastecimiento por cisternas es una respuesta necesaria ante emergencias y déficit de infraestructura, pero no sustituye la inversión permanente en redes de agua potable.

**Palabras clave:** Agua potable; pobreza monetaria; camiones cisterna; OTASS; saneamiento.

## Abstract

Intermittent access to drinking water is a social and public-health gap that mainly affects vulnerable territories. This article aimed to determine the relationship between potable water distribution by tanker trucks and monetary poverty in Peru during 2020-2023. A quantitative, applied, non-experimental and descriptive-correlational study was conducted using secondary documentary data from OTASS and INEI. The unit of analysis comprised 12 beneficiary departments: Amazonas, Cajamarca, Huánuco, Ica, Junín, Lambayeque, Lima, Loreto, Piura, San Martín, Tumbes and Ucayali. Descriptive statistics and Pearson correlation were applied at a 5% significance level; therefore, the findings are interpreted as associations rather than causal relationships. Between 2020 and 2023, 594,462 m³ of drinking water were distributed through 21 tanker trucks, directly benefiting 45,753 families at an accumulated public cost of S/ 5,478,232. The results show a moderate positive relationship between distributed volume and monetary poverty ($r = 0.432$; $p = 0.010$), and a very high positive relationship between distributed volume and public cost ($r = 0.970$; $p < 0.001$). The study concludes that tanker-truck supply is a necessary response to emergencies and infrastructure deficits, but it should not replace permanent investment in drinking-water networks.

**Keywords:** Drinking water; monetary poverty; tanker trucks; OTASS; sanitation.

## Introduction

Access to safe drinking water is a basic condition for the health, productivity, and well-being of households. The literature on water resources warns that water security requires planning, infrastructure, and sustainable management (Gleick, 2000; World Health Organization & United Nations Children's Fund, 2023). In Peru, although coverage by the public network has increased in recent years, gaps in continuity, quality, and safety of service persist, especially in peri-urban and rural areas, and territories exposed to droughts, heavy rains, floods, and other adverse events (National Institute of Statistics and Informatics, 2021, 2023). In this context, distribution by tanker trucks serves as a temporary solution for populations without regular supply.

This problem has economic and social relevance because the lack of drinking water not only reflects an infrastructure deficiency but also a deprivation that limits human capabilities. From Sen's (1999) perspective and that of welfare economics, poverty is not simply about income, but also includes restrictions on living with health, security, and dignity (Stiglitz, 2012). Similarly, the 2030 Agenda, through SDG 6, aims to ensure the availability and sustainable management of water and sanitation, while SDG 1 emphasizes poverty reduction (United Nations, 2015). Therefore, analyzing the link between alternative water supply and monetary poverty allows us to identify areas where public intervention must shift from emergency responses to structural solutions.

The Technical Agency for the Administration of Sanitation Services (OTASS) has intervened in departments with critical deficiencies by providing free drinking water via tanker trucks. This measure reduces immediate health risks, but also generates recurring fiscal costs and can reveal persistent territorial inequalities. Studies on water supply by tanker truck show that this method often appears in scenarios of water crisis and territorial inequality, as is the case in comparable Latin American experiences (Fragkou et al., 2022).

The research problem is formulated as follows: What is the relationship between the distribution of drinking water by tanker truck and monetary poverty in Peru during 2020–2023? The general objective was to determine this relationship in the departments served by OTASS. Specific objectives included describing the volume distributed and the state cost of the service, as well as estimating the association between the volume distributed, monetary poverty, and the cost of distribution.

The article's contribution lies in organizing official secondary evidence and correcting the statistical interpretation of the phenomenon: the correlation coefficient (r) measures the magnitude and direction of the association, while the p-value indicates statistical significance. Consequently, the results are presented separately for each relationship analyzed, and causal conclusions are not drawn.

## Materials and Methods

This research adopted a quantitative, applied, non-experimental, and descriptive-correlational approach. The analysis was conducted using secondary documentary information corresponding to the period 2020–2023.

The unit of analysis consisted of the 12 departments benefiting from the distribution of potable water by tanker trucks, as reported by OTASS: Amazonas, Cajamarca, Huánuco, Ica, Junín, Lambayeque, Lima, Loreto, Piura, San Martín, Tumbes, and Ucayali. The sample was a census of these departments; therefore, probabilistic sampling was not applied. Information on beneficiary families, volume of water distributed, number of tankers, and costs was obtained from OTASS records (Technical Agency for the Administration of Sanitation Services, 2023). Monetary poverty data were obtained from INEI statistical sources, including the National Household Survey (ENAHO) and poverty reports (National Institute of Statistics and Informatics, 2023, 2024).

The variables analyzed were: a) distribution of drinking water by tanker trucks, measured by volume distributed in cubic meters and the state cost of distribution; and b) monetary poverty, measured using official INEI poverty indicators. Frequencies, cumulative totals, percentages, and Pearson correlation were used, in accordance with the use of correlational statistics in non-experimental studies (Wooldridge, 2016). A significance level of 5% was used. Given the sample size ($n = 12$), the coefficients were interpreted as exploratory evidence of association and not as proof of causality. Regression models, panel data, and cluster analysis were not used to maintain consistency between method, results, and conclusions.

## Results

Between 2020 and 2023, OTASS distributed 594,462 $m^3$ of drinking water via tanker trucks in 12 departments of the country. This intervention directly benefited 45,753 families and entailed a cumulative state cost of S/ 5,478,232. The results are presented in accordance with the objectives of this article.

.**Table 1**

*Cost of water distribution by tanker trucks to beneficiaries, 2020-2023 (soles)*

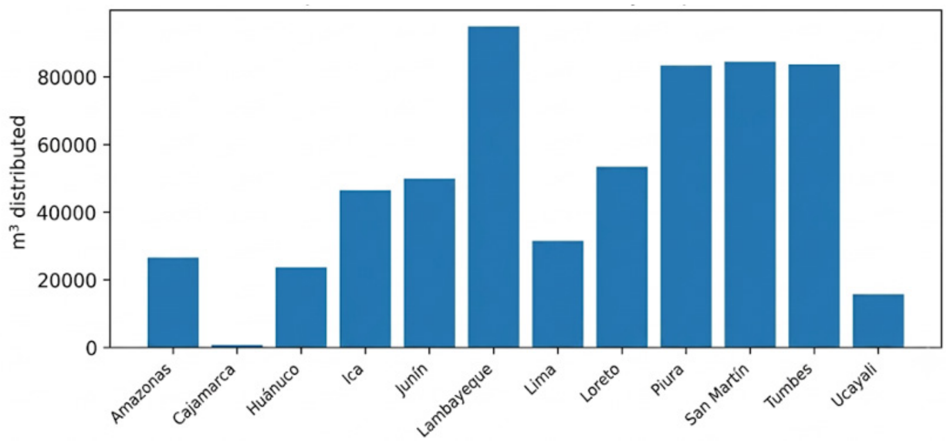
| DEPARTMENT | 2020 | 2021 | 2022 | 2023 | TOTAL |
|---|---|---|---|---|---|
| AMAZONAS | 94,702 | 80,691 | 35,379 | 37,591 | 248,363 |
| CAJAMARCA | 0 | 2,069 | 3,085 | 0 | 5,154 |
| HUÁNUCO | 27,021 | 95,247 | 69,283 | 28,506 | 220,057 |
| ICA | 163,177 | 140,034 | 86,463 | 40,977 | 430,651 |
| JUNÍN | 100,164 | 188,229 | 61,593 | 126,252 | 476,238 |
| LAMBAYEQUE | 150,339 | 325,635 | 186,483 | 221,760 | 884,217 |
| LIMA | 107,911 | 114,269 | 64,264 | 9,925 | 296,370 |
| LORETO | 92,129 | 180,830 | 100,389 | 125,108 | 498,456 |
| PIURA | 0 | 164,692 | 148,366 | 426,490 | 739,548 |
| SAN MARTÍN | 151,528 | 278,583 | 170,210 | 182,708 | 783,029 |
| TUMBES | 153,823 | 218,072 | 176,040 | 210,438 | 757,374 |
| UCAYALI | 20,942 | 44,812 | 62,309 | 10,713 | 138,776 |
| **TOTAL** | **1,060,738** | **1,833,162** | **1,163,862** | **1,420,469** | **5,478,232** |

*Note: Based on OTASS statistics (2020-2023).*

Table 1 shows that the highest accumulated cost corresponded to Lambayeque (S/ 884,217), followed by San Martín (S/ 783,029), Tumbes (S/ 757,374), and Piura (S/ 739,548). The lowest expenditure was recorded in Cajamarca (S/ 5,154). On an annual basis, the highest cost was observed in 2021, at S/ 1,833,162, while 2022 registered the lowest amount for the period, at S/ 1,163,862.

**Figure 1**

*Total volume of drinking water distributed by department, 2020-2023*




*Note: Based on OTASS statistics (2020-2023).*

Figure 1 shows that Lambayeque accounted for the largest volume distributed (94,963 m³), followed by San Martín (84,471 m³), Tumbes (83,671 m³), and Piura (83,397 m³). These departments combine high demand for temporary water supply with exposure to operational or weather-related emergencies that affect service continuity.


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**Table 2**

*Statistical results of the analyzed relationships*

| *Analyzed Relation* | *Test* | *n* | *Result* | *Interpretation* |
|---|---|---|---|---|
| Distributed volume - monetary poverty | Pearson | 12 | $r = 0.432$; $p = 0.010$ | Moderate and significant positive relation |
| Distributed volume - state cost | Pearson | 12 | $r = 0.970$; $p < 0.001$ | Very high and significant positive relation |

*Note: r expresses the magnitude and direction of the association; p expresses statistical significance. The results do not imply causality.*

Table 2 allows for a correct interpretation of the results. The association between distributed volume and monetary poverty was moderately positive (r = 0.432; p = 0.010), indicating that departments with higher poverty levels tend to have a greater need for alternative water supply. Additionally, the relationship between distributed volume and state cost was very strongly positive (r = 0.970; p < 0.001), showing that the increase in delivered volume raises public spending on the service almost proportionally.

## Discussion

The results confirm that the distribution of drinking water by tanker trucks serves as an immediate response to infrastructure deficiencies, weather events, and operational emergencies. The moderately positive relationship between distributed volume and monetary poverty suggests that the service is concentrated in economically vulnerable areas, although it is not limited exclusively to poor households. This distinction is important because water scarcity can also affect non-poor families when there are failures in the continuity, quality, or coverage of the water network.

From Sen's (1999) capabilities perspective, access to water is not just a domestic resource, but a condition that expands or restricts opportunities for health, education, and employment. Therefore, when the water supply depends on temporary solutions, the population faces deprivation that can intensify territorial inequalities. Similarly, poverty and well-being approaches posit that basic infrastructure is a central component of reducing deprivation and territorial poverty (Aparicio et al., 2011; Inter-American Development Bank, 2021; World Bank, 2018, 2023; Foster et al., 1984, 2010).

The study's strongest finding is the association between distributed volume and state costs. The r-value of 0.970 shows that the water truck supply model, while necessary in emergencies, generates a high and recurring tax burden. This result aligns with Latin American studies on water trucks, which indicate that water distribution can address urgent needs but also reveals institutional dependence when not accompanied by structural investment (Fragkou et al., 2022).

Consequently, the results should not be interpreted as evidence that monetary poverty directly causes water truck supply, nor that water trucks themselves increase or reduce poverty. The evidence supports a territorial association: where poverty, network deficits, and water vulnerability converge, the need for temporary distribution increases. The main public policy implication is to prioritize investments in networks, reservoirs, reliable water sources, and preventative management, especially in departments with high volumes delivered and high accumulated costs.

## Conclusions

Between 2020 and 2023, the distribution of drinking water by tanker truck served 45,753 families in 12 departments, with a cumulative volume of 594,462 m³ and a state cost of S/ 5,478,232. The intervention was relevant in addressing areas with water shortages and infrastructure deficiencies.

There is a moderate and significant positive correlation between the volume of water distributed by tanker truck and monetary poverty (r = 0.432; p = 0.010). This result indicates a territorial association, not causality; therefore, tanker truck delivery should be understood as an indicator of access gaps and vulnerability.

There is a very high and significant positive correlation between the volume distributed and the state cost (r = 0.970; p < 0.001). This demonstrates that the tanker truck mechanism is financially sensitive to increases in demand and does not constitute a sustainable long-term solution.

Fourth. Evidence supports the need for a gradual transition from temporary water tanker services to permanent water infrastructure solutions, prioritizing departments with the highest delivery volumes, the greatest accumulated costs, and persistent levels of monetary poverty.

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