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BASIC SANITATION IN ENVIRONMENTAL IMPACT ON HOMES IN A POPULAR HOUSING DEVELOPMENT IN SULLANA, 2025

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ABSTRACT
The study sought to establish the relationship between basic sanitation and environmental impact in households in a low-income neighborhood in Sullana, 2025, contributing to SDGs No. 3: good health and well-being, and No. 6: clean water and sanitation. It has a quantitative, applied approach; the population is 11,000 inhabitants, and the objectives are: to contrast the relationship between basic sanitation and environmental health; to establish its relationship with the risk of disease; to verify its relationship with vector control; and to determine the relationship between basic sanitation and environmental impact. Pearson's correlations confirmed low and moderate but statistically significant positive associations between basic sanitation and environmental health ($r = 0.307$; $p = 0.000$), disease risk ($r = 0.310$; $p = 0.000$), vector control ($r = 0.454$; $p = 0.000$); and environmental impact ($r = 0.464$; $p = 0.000$), the latter being the main conclusion, meaning that improvements in basic sanitation services effectively contribute to mitigating negative environmental impacts and strengthening the sustainability of the urban environment; as a proposal, it is recommended to coordinate and establish a tripartite agreement between the Provincial Municipality of Sullana, the National University of Frontera, and the community.

KEYWORDS: basic sanitation, environmental impact, disease risk, vector control, waste management.

INTRODUCTION

Historically, Sullana has faced considerable challenges related to the lack of drinking water supply, the deterioration of its sewage systems, and poor wastewater management; the lack of adequate sanitation brought health and other problems to a popular neighborhood in Sullana that had already been around for more than 30 years. For the well-being of the residents, safeguarding the environment, and promoting sustainable growth, basic sanitation became a crucial foundation. This system could range from classic, centralized methods to more distributed options, like ecological systems or those using containers, and it covered a range of technical, management, and community participation strategies, aiming to ensure that citizens had effective services for wastewater disposal, proper treatment, and solid waste control.

The implementation of a sustainable sanitation model in popular neighborhoods of Sullana not only addressed an urgent local need but also aligned with the policies set by the United Nations in the Sustainable Development Goals (SDGs). Specifically, SDG 3 focuses on the Health and Well-being sector for everyone, a goal that considers the well-being and satisfaction of a healthy life. This meant reducing diseases caused by the lack of basic sanitation services (PAHO, 2024).

It's undeniable that having a sustainable sanitation system in the popular neighborhoods of Sullana goes beyond just solving a local infrastructure problem; it stands as a fundamental and tangible commitment to the global purpose of the 2030 Agenda, especially with SDG 3. Recognizing that the lack of basic sanitary services acts as a powerful and tragic social determinant, this effort aims to eliminate the source of various preventable diseases, from intestinal parasites to acute diarrhea, which disproportionately affect the most vulnerable members of the community, like children, pregnant mothers, and the elderly. Scientific evidence highlights that lacking access to decent hygienic conditions not only increases preventable morbidity and mortality but also traps these communities in a vicious cycle of poverty and exclusion, preventing their full realization. Therefore, dignifying sanitation is, in essence, a deep act of social justice that lays the essential foundations for true human and sustainable development (UNESCO, 2022).

The study also aligns with SDG 6: Clean Water and Sanitation, which aims to ensure universal and equitable access to safe drinking water and adequate sanitation and hygiene infrastructure, consequently improving water quality and reducing pollutants (Global Compact, 2025). On the other hand, SDG 11: Sustainable Cities and Communities promoted access for people to decent, safe, and affordable housing and basic services, encouraging a smaller environmental footprint and the improvement of vulnerable neighborhoods; thus, by addressing the sanitation issues in Sullana, the study directly contributed to achieving these goals, promoting healthier, more inclusive, and sustainable urban environments (PAHO, 2024).

The implementation of a sustainable sanitation system in Sullana is crucial; it goes beyond just solving local infrastructure issues, serving as a tangible commitment to the 2030 Agenda and directly contributing to Sustainable Development Goal (SDG) 3: Good Health and Well-being. This effort is based on recognizing that the lack of sanitation services is a social determinant of future diseases that the population may acquire. Its goal is to eliminate the source of preventable diseases like parasitic infections and acute diarrhea. These illnesses disproportionately affect the most vulnerable members: children, pregnant mothers, and the elderly. Science confirms that the lack of proper hygiene increases preventable morbidity and mortality. Additionally, the situation traps communities in a cycle of poverty and exclusion. Therefore, improving sanitation is an essential act of social justice that lays the foundation for true human and sustainable development (PMRE, 2025).

In this regard, we are not just talking about pipes, but about making sure that everyone, absolutely everyone, has safe drinking water and decent hygiene facilities, which is a fundamental human right, not a technical luxury. To achieve this, we have to clean the water of all harmful things (chemicals, viruses, bacteria) so that it is safe to drink. At the same time, this moves us towards SDG 11: Sustainable Cities and Communities, which emphasizes attention to sanitation, especially for the most neglected, so that they have decent and safe homes with access to basic quality services, as this requires giving beneficiaries a life with dignity. This involves improving vulnerable neighborhoods, like those in Sullana, recognizing that they have the right to the city and to environmental justice. By solving the sanitation problem in Sullana through science and culture, we help make these neighborhoods healthier, more equitable, and stronger (PMRE, 2025).

According to the Progress Report on the Sustainable Development Goals (WHO, 2025), it was estimated that around 2.2 billion people worldwide (which represented roughly 27% of the planet's population) still didn't have access to safe drinking water. Water pollution emerged as one of the biggest obstacles to achieving universal coverage, posing a key challenge for public health and environmental sustainability (Gonçalves et al., 2025).

The most recent WHO and UNICEF report confronts us with a harsh reality: a vast and painful global health inequality, which is truly shocking. Currently, around 2.2 billion people, almost one in four in the world, still don’t have access to safe treatment water in their homes. This number, which should embarrass us, shows that despite all technological progress, deep structural gaps persist, leaving millions of families in poor rural and urban areas to fend for themselves, where investment in infrastructure is sadly insufficient. At the heart of the problem is water pollution, a complex enemy that mercilessly hits our health and the environment. The sources are varied and hard to control, ranging from untreated wastewater to agricultural pesticide residues and garbage that leaks toxins (UN, 2024). The United Nations Children's Fund highlighted that a distributed urban purification system, implemented in Bolivia, managed to cut household water usage in half, as well as prevent diseases and ease the effects of climate change, which showed the potential of this approach to create a positive environmental and social impact (UNICEF, 2023).

The city of Sullana has historically faced structural challenges related to the shortage of drinking water, the gradual deterioration of sewer infrastructure, and poor wastewater management. This situation is particularly severe in popular neighborhoods, especially those over thirty years old, where the lack of proper sanitation systems has had direct consequences on public health, the environment, and the quality of life of its residents, the research arises from the urgent need to develop a comprehensive sanitation model that reduces the environmental impact in the households of a low-income neighborhood in Sullana. Basic sanitation is a key pillar to ensure community well-being, environmental preservation, and sustainable development. In this context, the study proposes analyzing technical and management alternatives that range from conventional centralized systems to decentralized ecological solutions, incorporating community participation strategies that guarantee the efficient disposal of wastewater, proper treatment, and adequate solid waste management, thus contributing to the creation of healthier and more sustainable urban environments.

According to the analysis, the proposed problem is: What is the relationship between basic sanitation and environmental impact in the homes of a popular neighborhood in Sullana, 2025? The theoretical perspective focused on understanding phenomena related to sanitation and provided a new approach to understanding the relationship between sanitation and public health in the homes of the Nueva Sullana popular neighborhood and its value as a technical input for reforming public policies at the local and regional government levels (Chaves & Costa, 2025).

In practical terms, the study is relevant because of its potential to directly influence the well-being of vulnerable populations, as it aims to reduce the prevalence of infectious diseases, decrease water and soil pollution, among other benefits.

Methodologically, it is justified using tools like surveys to find integrated sustainability indicators in sanitation and to present a proposed sanitation model that would mitigate environmental impact in low-income households in a popular neighborhood in Sullana. From a social perspective, this progress helped improve the health and living conditions of the community by providing access to high-quality water and helped reduce gastric illnesses caused by drinking water with low levels of coliforms.

Below are inquiries that show the relevance of the topic chosen for the research; in Afghanistan, specifically in the city of Kabul, the qualitative study conducted by Hamidi et al. (2025) through semi-structured interviews with residents found that one of the main obstacles identified is the separation of sustainable technical proposals by the government that respond to the particular characteristics of popular neighborhoods, since many interventions have wrongly focused on psychological aspects instead of addressing the context and the real needs of the residents. Therefore, it is essential that the government address these latent needs, as its inaction directly affects the health and overall well-being of the population.

The research conducted by Chaves & Costa (2025), which through an econometric study focused on analyzing the impact of privatization on morbidity rates from sanitation-related diseases in Brazilian municipalities between 1998 and 2021 using the Callaway-Sant'Anna Staggered DID methodology, based on the analysis of massive historical data; the authors determined that strong regulatory frameworks, continuous oversight, and sustained investment in sanitation infrastructure are key factors to ensure quality services that positively affect epidemiological and environmental indicators, regardless of the management model adopted. The government should stop debating whether water is managed by public or private entities; its goal should be focused on ensuring that the service reaches the population to protect their survival.

Research carried out in Indonesia on typhoid fever showed that poor sanitation conditions and inadequate hygiene practices directly affected the epidemiological vulnerability of marginalized communities. Risk behaviors such as skipping handwashing with soap, consuming unsafe food, and lacking access to drinking water and functional latrines were significantly correlated with the incidence of infectious diseases, as reflected in high odds ratios (Yushananta & Putri, 2024). They confirmed that, in addition to biological factors, environmental and social determinants shape the burden of illness in structurally impoverished settings. As a result, it becomes imperative to design comprehensive interventions that not only promote individual behavioral changes but also strengthen basic infrastructure and encourage a preventive culture from the home, incorporating elements of community management, sustainable administration, and operational durability to achieve lasting impacts on urban environmental quality.

In Mexico, marginalized urban areas through latent class analysis (LCA), being a multivariate statistical technique, Avilés et al. (2024) point out that in these contexts, due to their lack characteristics, they show high vulnerability to the consequences of climate change, especially in terms of water availability and increased vector-borne diseases linked to poor sanitary conditions. These areas show that the deterioration of sanitation networks not only directly compromises public health through waterborne pathogens but also amplifies indirect epidemiological risks by creating microenvironments favorable for the spread of vectors that transmit emerging and re-emerging diseases. There is an urgent need to implement resilient and adaptive sanitation models that consider regional climate projections and especially protect the populations most at risk.

The study conducted by Wang & Wang (2024) in the United States offered an innovative perspective by applying mathematical modeling based on ordinary differential equations to analyze the impact of impulsive sanitation on cholera control, highlighting the importance of periodic interventions as a strategic public health tool. By classifying sanitation into three types focused on preventing direct transmission, bacterial spread, and environmental disinfection, they found that not all sanitation actions had the same reach or long-term sustainability. The numerical results suggested that interventions focused on type 1 human hygiene could be more effective and sustainable if a high level of compliance was maintained, thus reducing the frequency of application needed. This approach highlighted the importance of designing comprehensive health strategies that combined operational efficiency, extended coverage, and suitability to the context, which turned out to be essential for containing infectious diseases and protecting vulnerable populations.

As happened in other contexts with deep structural gaps, in the United States at least two million people lived without access to basic water and sewage services, a situation that disproportionately affected historically marginalized groups. A model driven by community organizations proved to be a promising way to address these gaps from a contextual and participatory perspective, highlighting the importance of adapted and sustainable solutions. This experience confirms that even in developed countries, deep health inequities persist that require adapted, participatory, and sustainable solutions, recognizing the leading role of social organizations as agents of change and managers of sanitation improvement processes in marginalized areas where the state has limited coverage and effective action. (Ripkey et al., 2024).

The research presented by Ibrahim et al. (2024) used a Compartmental Mathematical Modeling approach, which is designed to be applicable to any high-risk region like sub-Saharan Africa and Southeast Asia. Globally, the researchers created a compartmental model to simulate the transmission dynamics of typhoid fever, which had occurred in regions of high health vulnerability, and this study highlighted the close relationship between sanitation conditions and public health, the mathematical modeling of these dynamics allowed for a better understanding of how the accumulation of bacteria in the environment and the lack of adequate infrastructure favored the spread of pathogens. The authors highlighted that multifaceted control measures are necessary, combining key interventions such as the impact of interventions that reduce cases through improved vaccination and sanitation practices in lowering infections. Likewise, it is necessary to consider a public policy recommendation for a comprehensive approach that covers vaccine coverage, sanitation compliance, and strengthening healthcare capacity to mitigate typhoid in high-risk regions. This evidence highlights the importance of developing holistic sanitation models that integrate not only physical infrastructure but also community practices and institutional strengthening as key elements to reduce environmental bacterial load, mitigate epidemiological risks, and break transmission cycles in degraded environments, making it an essential preventive approach to preserve public health.

The lack of basic sanitation and water treatment in rural and peri-urban areas of Indonesia continued to be key factors in exposure to environmental contaminants and the rise of waterborne diseases. The case analysis showed how the absence of adequate sanitation infrastructure, combined with the everyday use of untreated water sources, contributed to maternal health complications, stunted child growth, and high rates of infectious diarrhea, according to Wulandari et al., 2024. These findings reinforce the inseparable link between sanitation, public health, and social equity, showing the need to implement sustainable solutions that simultaneously address environmental contamination and household practices, as determined based on the systematic review conducted by the authors. It is important that efficient treatment systems are able to filter not only pathogens but also emerging contaminants, requiring comprehensive water and sanitation management as a structural priority for human development and well-being.

The local critical review carried out on greywater management in informal settlements in South Africa showed how the absence of a coherent legal framework adapted to the local reality could seriously hinder the development of sustainable sanitation solutions. The regulatory inconsistencies and weak oversight identified in the study reflected a common problem in many urban areas with high vulnerability, where public policies failed to adequately respond to the real needs of the population. The proposal to incorporate international best practices as a tool for regulatory improvement highlighted the importance of contextualizing regulation and combining it with participatory approaches at the local level, this type of analysis provided key elements for rethinking water governance and building regulatory frameworks that not only recognized the right to sanitation but also guaranteed it effectively, fairly, and sustainably (Vala and Malazaa, 2024). The proposal to incorporate international best practices as a tool for regulatory improvement highlighted the importance of contextualizing regulation and combining it with local participatory approaches. The relevant government sector must ensure effectiveness through enforceability mechanisms, distributive equity, and long-term operational sustainability.

In Mozambique, specifically in southern Africa, the research focused on integrating practical and replicable solutions. These solutions were designed to be adopted by local governments and organized communities, aiming to improve the quality of life for families. The study emphasized promoting environmental education, encouraging citizen participation, and implementing sustainable technologies. Methodologically, a capabilities-based approach was used, employing 19 in-depth interviews and 8 focus group sessions. They concluded that the five main attributes identified for such improvement were health, disgust, shame, safety, and privacy. This research confirms that successful sanitation interventions need to go beyond the technical side and include sociocultural, emotional, and human dignity aspects, recognizing that access to proper sanitation services not only prevents diseases but also restores community self-esteem and fundamental rights for vulnerable populations (Ross et al., 2021).

In Puno, Sánchez et al. (2025) published the territorial diagnosis on access to drinking water in the Piura region. The study used a structural documentary approach based on academic literature and validated institutional data to analyze spatial disparities in water coverage, continuity, and quality. It identifies structural and institutional barriers to universal access. The results highlighted the limitations and isolated innovation initiatives, like pilot projects led by universities and private companies, which often lack mechanisms for institutional integration and policy scaling.

In Huancayo, Hinostroza-Martínez et al. (2025) faced critical challenges related to the lack of urban planning, limited access to basic services, and high environmental vulnerability due to its location on slopes and risk areas. They applied a comprehensive assessment model to understand the complex relationship between environmental and urban sustainability in informal neighborhoods. The model was based on an ecosystem approach that combines geospatial analysis, Geographic Information Systems (GIS), and participatory tools to analyze how factors like migration, the market, and state policies impacted sustainability. The results reveal a significant correlation between the coverage of basic services and the reduction of environmental vulnerability, as well as between urban development policies and territorial occupation dynamics.

Particularly, Sullana, an urban center in the Piura region, witnessed the formation of various popular-origin housing developments as a result of the disorderly growth of the population and unplanned urbanization processes. Predominantly inhabited by low-income families, these areas faced considerable restrictions in accessing potable water, adequately managing wastewater, and handling solid waste. This issue not only endangered the health and well-being of its residents but also caused severe environmental consequences: contamination of surface and groundwater aquifers was observed, soil degradation occurred due to poor domestic waste management, disease-carrying agents spread, and there was an increase in harmful emissions resulting from the burning of waste.

The control and prevention of intestinal parasitic infections required a cross-sectoral approach. This involved coordinated actions between the health and education sectors. For the health sector, this meant mass and regular deworming for preschool and school-age children, focusing on geohelminthiasis, to mitigate its impact on health and reduce morbidity. Additionally, integration between key programs and areas was promoted to implement cost-effective interventions. This included the treatment of intestinal parasitic infections and, more broadly, all neglected tropical diseases. The goal was to reduce the disease burden, improve living conditions, and break the cycle of poverty as a crucial factor in disease determination. The education sector focused on improving hygiene

practices, encouraging the use of footwear, and expanding access to safe water and basic sanitation.
The general objective was: To determine the relationship between basic sanitation and environmental impact in the households of a popular neighborhood in Sullana, 2025, and the following specific objectives: a) To examine the relationship between basic sanitation and environmental health in the households of a popular neighborhood in Sullana, b) To establish the relationship between basic sanitation and the risk of diseases in the households of a popular neighborhood in Sullana, c) To verify the relationship between basic sanitation and vector control in the households of a popular neighborhood in Sullana.
In Lisbon, Portugal, De Paula et al. (2025) discussed studies on water supply and sanitation services (WSS) that faced challenges like high investment costs, contextual characteristics and limitations, and conflicting interests. The increase in access and demand makes the focus shift to specific requirements, which can divert AAS from their core purposes and functional needs for service delivery. Ensuring basic human needs in our interconnected and complex society has become a challenge. This study proposed a comprehensive approach to reveal the feedback loops related to the effects and dependencies of AAS. A Causal Loop Diagram (CLD) shows a new way to qualify decision-making processes and public policies by linking the feedback loops that connect the overall goal with sector-specific needs, promoting the (re)conciliation of the collective and individual values involved. Approaching financial dependence in relation to the role of AAS in health reveals critical connections with the environment and economic development, especially population growth, the consequences for ecosystems, and dependence on economic feedback.
In Spain, Huang et al. (2025) raised challenges for the setup and operation of infrastructure. Traditional centralized wastewater treatment models face issues with profitability, facility usage rates, and sustainable maintenance, which calls for exploring adaptive governance technologies under new demographic conditions. Using a governance approach based on a mixed method that integrates qualitative and quantitative approaches, they analyzed the correlation between the Population Decline Index (PDI) and the operational efficiency of facilities, investigated the impact of resident population dynamics on rural wastewater treatment patterns, and established a theoretical 'Source-Transmission-Sink' framework,
En Estados Unidos, Canova et al. (2025). Analizó el emprendimiento sostenible en comunidades marginadas más allá de los países occidentales de altos ingresos. Sin embargo, un área que ha recibido poca atención es el contexto altamente estigmatizado de los servicios de saneamiento sin alcantarillado y el consiguiente impacto social y ambiental perjudicial en las comunidades marginadas. Mediante análisis cualitativos de tres emprendimientos kenianos centrados en el saneamiento, examinamos el papel del estigma en la provisión de alternativas a los sistemas tradicionales de saneamiento con alcantarillado. Nuestro artículo presenta tres categorías de acciones relacionadas con el saneamiento: generación, recolección/transporte y procesamiento, cada una con su propio nivel de estigmatización. Este estudio contribuyó a vincular el emprendimiento sostenible con el estigma, con propuestas que sientan las bases para un mayor estudio del emprendimiento sostenible en el sector del saneamiento. They proposed a treatment system focused on resource use, adapted to population decline trends, which includes three technical components: source process reduction, transmission process interception, and sink process attenuation. This study focuses on adjusting the spatial layouts of green water infrastructure (GWI) according to village characteristics in productive, livable, and ecological spaces, creating a hierarchical attenuation mechanism through circular transmission paths. It made it easier to shift from gray infrastructure–dependent models to holistic pollution control systems with resource recovery capacity.
Other American findings introduced the tool QSDsan, an open-source Python tool focused on sustainable and quantitative design of sanitation systems, as well as resource recovery. The main goal was to bring together system design, simulation, techno-economic analysis (TEA), and life cycle assessment (LCA) under uncertainty, thus driving research and the development of new technologies. The methodological path involved creating the QSDsan platform using object-oriented programming, which enabled the modeling and simulation of sanitation processes, running sensitivity analyses, and visualizing results. The findings showed the platform's ability to assess complete sanitation chains, concluding that QSDsan was a robust and versatile tool that could be used by researchers and professionals to advance safe and accessible sanitation technologies. The study highlighted the importance of integrated and open-source tools for tackling sustainable sanitation challenges, promoting cooperation and transparency in research and technology development (Li et al., 2022)
In Venezuela, specifically in the community of Toro Muerto, Bolívar state, researchers set out to implement an environmental education plan for the sustainable management of water, given its shortage and degradation. The methodology combined different techniques, and following the Participatory Action Research approach, interviews were conducted with 310 neighbors and 18 local representatives. The results showed a noticeable improvement in theoretical understanding and attitudes; the authors concluded that environmental education could foster a common awareness, but constant support was needed to change deeply ingrained habits. This work stood out for its participatory nature and being adapted to the environment, although it highlighted the challenge of turning awareness into lasting actions, which reinforced what was learned in daily routines (Castro et al., 2022).

In a study carried out in Sicily and Emilia-Romagna, Italy, they evaluated the sustainability of constructed wetlands as green infrastructure for water management, integrating cost-benefit analysis with ecosystem services. Their goal was to analyze two full-scale treatment systems using economic and environmental data. The methodology included an expanded economic analysis with social and ecological variables. The results showed benefits exceeding costs in both cases (BCR > 1), especially in Emilia-Romagna, where the BCR reached 10. They concluded that constructed wetlands were viable and sustainable solutions. This study highlighted the value

of considering non-monetary benefits in water planning, although it also revealed that effectiveness varied depending on the geographic context, so they recommended designing strategies adapted to local conditions (García et al., 2022).

The proper provision of water, sanitation, and hygiene (WASH) services was essential for public health, as it played a crucial role in reducing morbidity and mortality associated with diarrheal diseases and childhood malnutrition, especially in low-resource settings. In this regard, a case-control study conducted by Hendricks et al. (2022) in a peri-urban community near Cape Town, South Africa, analyzed the relationship between diarrheal disease and hygiene factors in the home, environment, sociodemographics, and anthropometry in children under 2 years old. The methodology involved comparing 100 children with diarrhea and 100 controls without it, collecting information through surveys and anthropometric analysis, and using logistic regression to identify related predictors. The findings showed that rat infestations, maternal work, and childcare outside the home were important predictors of diarrhea. It was understood that effectively implementing policies on water, sanitation, and home hygiene could prevent diarrheal disease and lessen its impact on children's growth. (Hendrick et al., 2022).

Environmental sanitation was crucial for the health of both the family and the community, since its insufficient coverage worsened the quality of life and increased the spread of environmental diseases like diarrhea. In an observational analytical quantitative study in the city of Makassar, Indonesia, Nur et al. (2022) aimed to establish the correlation between environmental sanitation and the prevalence of diarrhea in children under five years old. The study, which used a cross-sectional design and examined a sample of 60 children through questionnaires and field observation (with Chi-square analysis), found a significant correlation between the physical quality of clean water and the prevalence of diarrhea ($p = 0.014$). They concluded that the physical quality of clean water had a significant correlation with the occurrence of diarrhea in the area studied. This finding was important for developing a sanitation model in a popular neighborhood of Sullana, as it provided empirical evidence from another urban setting (Indonesia) on how specific elements of environmental sanitation, especially water quality, were directly linked to health effects like diarrhea (Nur et al., 2022)

A study looked into the benefits of improving wastewater treatment and sanitation, for both people and the planet. Its goal was to show how that waste, which is normally thrown away, could be turned into useful resources if more sustainable approaches were applied. To do this, they reviewed successful projects from various places around the world, taking into account different economic and social situations, and paid special attention to resource recovery and the circular economy. The findings showed that the organic components of wastewater and human waste could be used to improve soil quality or generate biogas. They concluded that it was crucial for people to stop seeing waste as something useless and start valuing it, promoting sustainable sanitation systems that support the social, environmental, and economic goals of the 2030 Agenda. The study highlighted how valuable it was to integrate waste management into a circular economy model. (Andersson et al., 2021).

In the canton of San Pablo, located in the province of Heredia, Costa Rica, Sánchez et al. (2021) managed to detect several elements of the social and environmental surroundings that had an impact on water pollution. The main goal was to look at aspects like the residents' opinions, how the land was used, and the places where wastewater was dumped. To do this, they applied a descriptive methodology with a combined approach, gathering information through surveys, satellite photos, and municipal records. The findings showed that 27% of the 713 registered businesses were potential contamination sources, including restaurants, car workshops, and hair salons. On top of that, more than 230 points of wastewater discharge were discovered, whether direct or indirect, into water sources. They concluded that urban development and commercial activities without proper sewage management put a lot of pressure on water reserves. From this, it was determined that it was necessary to implement comprehensive management strategies and encourage community participation to reduce these impacts.

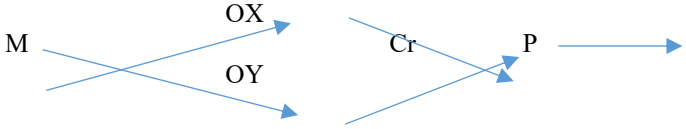
In a study in Porto Alegre, Brazil, Ziliotto, M (2024), based on the analysis of ecological and socioeconomic aspects that affect health and the risk of contamination and diseases, using socioeconomic indicators, found that even though the city has 80% of the capacity to treat its wastewater, it downplays environmental education with residents. Additionally, there is a lack of a policy that integrates spending on infrastructure with investment in environmental training for communities. From this, it appears that there is some similarity with the situation of the population studied in this research, since likewise, the local government is not implementing communication or training measures for the population to address the problem.

METHODOLOGY

The research has a quantitative approach. According to Sampiere et al. (2014), it is based on data collection to test hypotheses, uses numerical measurement and statistical analysis with the aim of establishing behavioral patterns and testing theories. It was applied research, which contributes to generating essential theoretical inputs for its practical application in this project. It was cross-sectional because the data were collected at a single point in time, with the goal of developing a basic sanitation model that allows us to minimize the environmental impact in households of a popular neighborhood in Sullana, 2025. Our design diagram is shown below:

Figure 1

Research design outline



Note: prepared by the autor

Where:

M = sample
OX = observation of variable X
OY = observation of variable Y
Cr = correlation between variables X and Y
P = proposal

Regarding the first variable related to basic sanitation, it is understood as a set of actions that can be applied to the environment to reduce health risks, prevent contamination, and consequently achieve better health levels; it has three main pillars: safe water, sanitary disposal of excreta, and sanitary waste management.

For the purposes of our research, the variable basic sanitation is operationalized through five dimensions: a) access to basic services, with its indicators being the number of households connected to the public water network and the number of households connected to the public sewer network; b) wastewater management, with its indicator being the method used by the household to dispose of wastewater; c) solid waste management, with the indicator being the method used to dispose of solid waste; d) public investment in sanitation, measured by the frequency of solid waste collection; and e) socioeconomic, measured by the indicators: the educational attainment level of the head of the household and the monthly income, in soles, of the head of the household. (Pan American Health Organization, 2022).

The second variable is environmental impact, also known as anthropogenic impact, which is the alteration or modification caused by human action on the environment. It is the effect or disturbance that a certain phenomenon produces on the environment and can be of human or natural origin, according to Pérez & Merino (2022). Another author states that the environmental basic sanitation model is essential for the health of the family and the community, since insufficient coverage deteriorates quality of life and promotes the spread of environmental diseases such as diarrhea (Nur et al. 2022). This variable is operationalized through three dimensions according to Nur et al. (2022): a) environmental health, whose indicators are: water quality at home and frequency of illnesses; b) disease risk, operationalized by the indicator frequency of illnesses; c) vector control, measured by the indicator: disinfection and rodent control.

The survey instrument was used, which included a total of 22 questions conveniently distributed across the five proposed dimensions. A questionnaire with a 22-item Likert scale was used, based on the categories: 1 never, 2 rarely, 3 sometimes, 4 frequently, and 5 always. The entire population living in a popular housing area in Sullana was included, with an approximate number of 11,000 people, as well as the population connected to the public water and sewer network and the adult population. All other popular housing areas around the study area and the population under legal age were excluded.

The instrument was validated through expert judgment, which was made up of professionals recognized in the National Registry of Science and Technology (Renacyt) and who hold a Doctorate degree; the reliability of the instruments applied to the target population was obtained using Cronbach's Alpha Coefficient, which ranges from 0 to 1. If a value above 0.8 is obtained, the instrument is generally considered acceptable; in our case, this value was 0.812, so the questionnaire is considered highly reliable.

Table 1. Reliability

Cronbach's Alpha	**Number of elements**
0,812	22

Homenaje.

According to Table 1, Cronbach’s alpha coefficient is 0.812 with 22 items on the survey applied to the pilot test conducted in 25 households, which according to the criteria indicates that it is good reliability.
In the data collection process, the collaboration of 18 young people was counted, who proceeded to carry out a pilot test of 25 surveys (approximately 7% of the sample) and refined the questionnaire, and then randomly conducted the 305 surveys (see Equation 1). The results were entered into an Excel sheet and then the SPSS statistical software was used, which allowed for obtaining the results of the descriptive, correlational, and propositional analysis. The sample size was obtained using the formula for finite populations, with the population of this study consisting of approximately 11,000 people located in a popular urban area in Sullana.

Equation 1. Sample size

$$n = \frac{N \times Z^2 \times p \times (1 - p)}{E^2 \times (N - 1) + Z^2 \times p \times (1 - p)} \quad (1)$$

Where: "n" represents the sample size; "N" is the population size (finite); "Z" is the Z value for the desired 95% confidence level (Z=1.96); "p" is the expected proportion of 0.5; and "E" is the margin of error of 5%.

Therefore:

$$n = \frac{1500 \times (1.96)^2 \times 0.5 \times (1 - 0.5)}{(0.05)^2 \times (4600 - 1) + (1.96)^2 \times 0.5 \times (1 - 0.5)}$$

Therefore, the sample consisted of 305 people, who participated through structured surveys.

According to Klinger (2024), sampling is the process of selecting a representative part of a population to make inferences about the whole. In this research, probabilistic sampling was applied, specifically simple random sampling, considering all the households in a Popular Urbanization in Sullana.

According to University Council Resolution No. 0470-2022/UCV, which promotes the non-disclosure of the results or findings of any research so that it does not affect the daily lives of the people involved in the popular urbanization sector in Sullana, it is ensured that the information will be kept confidential. It is worth mentioning that the ethical principles of the Graduate School of César Vallejo University will be taken into account, which should be considered in every research process to provide confidentiality, safeguarding the full rights of human beings. Therefore, the ethical principles established in University Council Resolution No. 0470-2022/UCV were applied, which promotes the non-disclosure of the results or findings of any research so that it does not affect the daily lives of the people involved in the popular urbanization sector in Sullana, It is ensured that the information will be treated as confidential, with the following principles: principle of integrity: from the start it allows building trust with participants and transparency regarding the purpose of the study; principle of human integrity: the participant will come before any research interest, regardless of their background, socioeconomic level, gender, or ethnicity; principle of justice: all participants have the right to be treated fairly, and no participant should be discriminated against; principle of autonomy: participants' decisions to take part in the study will be respected, answering the questionnaires is not mandatory; principle of equity: all study participants deserve to be treated equally, without any exceptions; principle of privacy: the integrity of all participants will be protected, all information must be kept confidential, safeguarding individuals' privacy; and principle of credibility: all necessary information about the study will be provided to ensure participants' safety and trust, allowing for clear and concise information to be obtained.

RESULTS

Specific objective 1: Compare the relationship between basic sanitation and environmental health in the homes of a popular neighborhood in Sullana

Table 2. Comparison of results between basic sanitation and environmental health

Elementos	Saneamiento básico		Salud Ambiental	
	Fi	%	Fi	%
Deficiente	95	31.15	182	59.67
Regular	204	66.89	106	34.75
Eficiente	6	1.97	17	5.57
Total	305	100.00	305	100.00

Note. Results of the questionnaire given to residents of a UP.

When comparing the results obtained between the variables basic sanitation and environmental health in the households of the popular urban area of Sullana, a direct and significant relationship between the two is evident. According to the data, 66.89% of respondents have a regular level of basic sanitation, while 31.15% are at a deficient level and only 1.97% reach an efficient level. This indicates that most homes have partial access to basic services like drinking water, sewage, and waste collection, reflecting limitations in infrastructure and maintenance or coverage of essential public services, which can affect exposure to communicable diseases.

Regarding environmental health, the results show a less favorable picture. 59.67% of households are in poor condition, 34.75% in average condition, and only 5.57% reach an efficient condition. This shows that there are environmental factors that deteriorate quality of life, such as the accumulation of waste, the presence of standing water, inadequate disposal of solid waste, and the proliferation of vectors, which directly affects the well-being and health of residents.

When comparing both results, it is noticeable that, even though most households have basic sanitation rated as "regular," the prevailing environmental health is "poor." This difference suggests that deficiencies in sanitation infrastructure, along with inadequate hygiene and environmental management practices, are negatively affecting

the home and community environment. In general, it can be said that the lower the level of basic sanitation, the greater the deterioration of environmental health, which shows a direct correlation between the two variables. Likewise, the small percentage of households with "efficient" sanitation and environmental health (1.97% and 5.57%, respectively) shows that sustainable practices and adequate services are scarce in the study area. These results confirm that poor coverage and quality of basic sanitation led to a negative environmental impact in households, affecting health conditions and creating risks for the population's health.

To establish the relationship between the basic sanitation variable and the environmental health dimension, the hypotheses were proposed Hi1: there is a significant relationship between basic sanitation and the environmental health of households in a popular neighborhood in Sullana, and H01: there is no significant relationship between basic sanitation and the environmental health of households in a popular neighborhood in Sullana

Table 3. Comparison between the relationship of basic sanitation and environmental health

Elemento	**Opción**	**1.1**	**V2**
Salud Ambiental	C. de Pearson	1	0,307**
	Sig. (bilateral)		0.000
Saneamiento básico	C. de Pearson	0,307**	1
	Sig. (bilateral)	0.000	

Note. Results of the questionnaire given to residents of a UP.

Table 4 shows the results of the Pearson correlation statistical test applied to determine the relationship between basic sanitation and environmental health in households in the popular neighborhood of Sullana. The correlation coefficient obtained was r = 0.307, with a two-tailed significance level of p = 0.000, which is lower than the critical value of 0.05. This result indicates the existence of a positive and statistically significant correlation between both variables.

The Pearson coefficient value (0.307) reflects a low to moderate relationship, which means that as basic sanitation conditions in homes improve, there is also an improvement in environmental health, although this relationship is not completely strong. In other words, the quality of basic sanitation positively affects environmental health, but there are other complementary factors like health education, municipal waste management, environmental awareness, and household hygiene practices that also play a role in the environmental condition of homes.

The statistical significance (p = 0.000) confirms that the result is not due to chance, so the research hypothesis that there is a significant relationship between basic sanitation and the environmental health of households in a popular neighborhood in Sullana is accepted. This finding supports the theoretical premise that proper access to drinking water, sewage systems, and correct solid waste disposal are essential components for maintaining healthy environments, preventing pollution, and reducing health risks.

In short, the correlation analysis shows that there is a direct and significant relationship between basic sanitation and environmental health in a popular neighborhood in Sullana. As sanitation services and practices improve, the environmental quality gets better and it helps protect the health of the population, highlighting the importance of public policies focused on sustainable development and comprehensive sanitation management.

Specific Objective 2: Establish the relationship between basic sanitation and the risk of diseases in households of a popular neighborhood in Sullana.

Table 4. Relationship of results between basic sanitation and the risk of diseases

Elementos	**Saneamiento básico**		**Riesgo de enfermedades**	
	Fi	**%**	**Fi**	**%**
Deficiente	95	31.15	157	51.48
Regular	204	66.89	105	34.42
Eficiente	6	1.97	43	14.10
Total	305	100.00	305	100.00

Note. Results of the questionnaire given to residents of a UP.

The results shown in Table 5 highlight the relationship between the level of basic sanitation and the risk of diseases in households in the popular urban area of Sullana; for basic sanitation, the same approach as before is applied when presenting the results of Table 4, adding that most households only have partial access to basic services, which leads to a high risk of getting sick.

On the other hand, regarding the risk of diseases, the results indicate that 51.48% of households have a high or poor risk, 34.42% a medium or average risk, and only 14.10% a low or safe risk. This pattern shows that more than half of the population is exposed to unhealthy conditions that promote the appearance of gastrointestinal, skin, and respiratory diseases, mainly associated with the lack of safe water and the improper disposal of excreta and solid waste.

When comparing both results, there is a clear link between the level of basic sanitation and the risk of diseases. In homes with poor sanitation, the highest proportion of households with a high risk of diseases is concentrated (51.48%), which confirms that lacking proper basic services increases health vulnerability. On the other hand, in households with efficient sanitation (1.97%), the risk of diseases drops significantly (14.10%), showing an inverse relationship between the two variables: better sanitation means lower disease risk.
These findings allow us to say that the level of basic sanitation directly affects the health of the population, since the insufficiency or poor quality of sanitary services creates favorable conditions for the spread of pathogens. Similarly, it is confirmed that deficiencies in infrastructure and in household hygiene practices are key factors in the incidence of infectious diseases in urban popular areas.

Table 5. Comparison between the relationship of basic sanitation and the risk of diseases

Elemento	**Opción**	**1.2**	**V2**
Riesgo de enfermedades	C. de Pearson	1	0,310**
	Sig. (bilateral)		0.000
Saneamiento básico	C. de Pearson	0,310**	1
	Sig. (bilateral)	0.000	

Note. Results of the questionnaire given to residents of a UP.

Table 6 shows the results of the Pearson correlation test applied to determine the relationship between basic sanitation and the risk of diseases in households in the popular neighborhood of Sullana. The coefficient obtained was r = 0.310, with a two-tailed significance level of p = 0.000, a value below the 0.05 threshold set for statistical significance. This shows that there is a positive and statistically significant correlation between both variables.
The Pearson coefficient (0.310) indicates a low to moderate relationship, suggesting that improvements in basic sanitation are linked to a reduced risk of diseases in households. In this sense, when drinking water, sewerage, and waste disposal services are adequate, people's exposure to pathogens that cause gastrointestinal, skin, or respiratory illnesses decreases.
The statistical significance (p = 0.000) confirms that the observed relationship is not due to chance, so the hypothesis that there is a direct and significant relationship between basic sanitation and the risk of diseases in households of a popular neighborhood in Sullana is accepted. In conclusion, this result is consistent with theoretical foundations and previous evidence highlighting the importance of sanitation in preventing waterborne and environmental diseases, allowing us to state that as basic sanitary conditions improve, the incidence of diseases related to water contamination, improper waste management, and inadequate solid waste disposal decreases.

Specific Objective 3: Check the relationship between basic sanitation and vector control in the households of a popular neighborhood in Sullana.

Table 6. Verification of the relationship of outcomes between Basic Sanitation and vector control

Elementos	**Saneamiento básico**		**Control de vectores**	
	Fi	**%**	**Fi**	**%**
Deficiente	95	31.15	47	15.41
Regular	204	66.89	108	35.41
Eficiente	6	1.97	150	49.18
Total	305	100.00	305	100.00

Note. Results of the questionnaire given to residents of a UP.

The information presented in Table 7 shows the relationship between the level of basic sanitation and vector control in the homes of the popular neighborhood of Sullana. The results for basic sanitation are the same as before, adding that, although most homes have some basic services, these are neither sufficient nor sustainable, which can influence the proliferation of disease-carrying insects and rodents.
Regarding vector control, the data shows the opposite trend. About 49.18% of households report effective control, 35.41% are at a regular level, and 15.41% have poor control. This distribution suggests that, despite limitations in sanitary infrastructure, a significant percentage of families are practicing preventive measures or getting support from local health programs focused on vector control.
When comparing both variables, there is a direct proportional relationship between the level of basic sanitation and the effectiveness of vector control. In households with efficient sanitation (1.97%), vector control reaches the highest level of efficiency (49.18%), which indicates that adequate sanitary conditions, such as access to drinking water, proper drainage, and correct waste disposal, help reduce vector breeding sites. On the other hand, in homes with poor sanitation (31.15%), vector control is also poor (15.41%), showing that the lack or insufficiency of basic services encourages the presence of mosquitoes, flies, rats, and other disease-carrying organisms.

Table 7. Comparison between the relationship of basic sanitation and vector control

Elemento	Opción	1.3	V2
Control de Vectores	C. de Pearson	1	0,454**
	Sig. (bilateral)		0.000
Saneamiento básico	C. de Pearson	0,454**	1
	Sig. (bilateral)	0.000	

Note. Results of the questionnaire given to residents of a UP.

Table 8 shows the results of the Pearson correlation test carried out to analyze the relationship between basic sanitation and vector control in households in the popular urban area of Sullana. The correlation coefficient obtained was r = 0.454, which indicates that there is a medium-strength relationship between the level of basic sanitation and the effectiveness of vector control. In other words, as basic sanitation conditions improve—meaning when there is access to safe water, functional sewer systems, and proper waste disposal—vector control is also optimized, reducing the presence of mosquitoes, rodents, and other disease-carrying organisms, showing a moderately positive and statistically significant correlation between the two.

General objective: To determine the relationship between basic sanitation and environmental impact in the households of a popular neighborhood in Sullana, 2025.

Table 8. Relationship of results between Basic Sanitation and environmental impact

Elementos	Saneamiento básico		Impacto Ambiental	
	Fi	%	Fi	%
Deficiente	95	31.15	71	23.28
Regular	204	66.89	198	64.92
Eficiente	6	1.97	36	11.8
Total	305	100.00	305	100.00

Note. Results of the questionnaire given to residents of a UP.

Table 9 shows the relationship between the level of basic sanitation and the environmental impact in homes in the popular neighborhood of Sullana. The results show that 66.89% of households have regular basic sanitation, 31.15% have a poor level, and only 1.97% reach an efficient level. This distribution shows that most households have partial or incomplete sanitation services, which limits the proper management of household waste and wastewater, affecting the environmental quality of the surroundings.

Regarding the environmental impact, the data shows that 64.92% of households are at a regular level, 23.28% are at a poor level, and only 11.8% reach an efficient level. This result suggests that, while a significant part of the population experiences a moderate environmental impact, there are still conditions that contribute to environmental degradation, such as wastewater dumping, solid waste accumulation, and improper land use.

When comparing both variables, a direct and proportional relationship is observed between the level of basic sanitation and the environmental impact. In households with efficient sanitation (1.97%), the environmental impact is significantly reduced, reaching an efficient level (11.8%). On the other hand, in homes with poor sanitation (31.15%), the environmental impact increases (23.28%), showing that deficiencies in basic services are closely linked to the deterioration of environmental quality.

These results show that the lack of an adequate basic sanitation system leads to visible environmental consequences, such as water, soil, and air pollution, as well as the spread of pests and landscape deterioration. On the other hand, when households have efficient sanitation—meaning they have permanent access to drinking water, a working sewage system, and responsible solid waste management, the negative environmental impact decreases significantly, promoting healthier and more sustainable surroundings.

Table 9. Comparison between the relationship of basic sanitation and environmental impact

Elemento	Opción	V1	V2
Impacto Ambiental	C. de Pearson	1	0,464**
	Sig. (bilateral)		0.000
Saneamiento básico	C. de Pearson	0,464**	1
	Sig. (bilateral)	0.000	

Note. Results of the questionnaire given to residents of a UP.

Table 10 shows the results of the Pearson correlation test applied to determine the relationship between basic sanitation and environmental impact in households in the popular urban area of Sullana. The statistical analysis shows a Pearson correlation coefficient of r = 0.464, with a two-tailed significance level of p = 0.000, which is

below the critical value of 0.05. This result shows the existence of a moderate and statistically significant positive correlation between the two variables.
The coefficient value (0.464) indicates that as basic sanitation conditions improve, the negative environmental impact on households decreases. In other words, when homes have drinking water services, functional sewage systems, and proper solid waste management, the surroundings stay cleaner and healthier, reducing the polluting effects on soil, water, and air. On the other hand, poor sanitation tends to increase adverse environmental impacts, such as waste buildup, improper waste disposal, and the spread of pollutants.

DISCUSSION

It is noted that the situation in the studied urban area reflects a pattern seen in many regions around the world, where poor sanitation infrastructure and limited environmental governance create ongoing cycles of epidemiological risk and environmental degradation. At the beginning of this research, it was highlighted that Sullana has historically faced critical deficiencies in drinking water supply, wastewater management, and sewer systems, problems that have persisted for more than three decades.

SPECIFIC OBJECTIVE 1: To compare the relationship between basic sanitation and environmental health in households of a working-class neighborhood in Sullana.

Regarding environmental health, the results indicate that 59.67% of households have “poor” environmental conditions, which is consistent with the literature cited in the introduction, particularly WHO and UNICEF (2024–2025), which stated that inadequate access to sanitation significantly increases childhood morbidity and the occurrence of diarrhea, dermatitis, and intestinal diseases. The correlation found between basic sanitation and environmental health ($r = 0.307$; $p = 0.000$) confirms this prediction, even though the relationship isn't strong; we also agree with (Yushananta & Putri, 2024) that the lack of access to drinking water and latrines is significantly linked to the increase of contagious diseases, since environmental determinants raise morbidity. Just like us, they suggest comprehensive strategies to strengthen infrastructure along with promoting a preventive culture that changes domestic users' behavior.
On the other hand, we found results very similar to the research by Castro et al. (2022) in a community in the state of Bolívar, Venezuela, regarding sustainable water management. They used a mixed methodology with interviews of 310 neighbors and 18 authorities, quite like our sample of 305 people, where they determined that constant support in environmental education was necessary to strengthen the limited infrastructure in basic sanitation services.

SPECIFIC OBJECTIVE 2: Establish the relationship between basic sanitation and the risk of diseases in households of a popular neighborhood in Sullana.
In Indonesia, Yushananta & Putri (2024), or South Africa, Hendricks et al. (2022), it was shown that the lack of safe water and the presence of vectors increase gastrointestinal and skin diseases. The correlation $r = 0.310$ ($p = 0.000$) between sanitation and disease risk shows that poor sanitation is a determining factor for local public health. This empirical evidence supports the Germ Theory of Disease and the Environmental Justice Theory, which emphasizes that poor groups bear a higher burden of disease due to the lack of adequate infrastructure.

One of the most significant findings was the relationship between basic sanitation and vector control, with a coefficient of $r = 0.454$ ($p = 0.000$), the highest in the study. This result strongly supports the theoretical and empirical arguments presented in the introduction. Studies in Mexico, Avilés et al. (2024), and in Mozambique, Ross et al. (2021), showed that the accumulation of waste, stagnant water, and deficiencies in community cleaning create microenvironments favorable for mosquitoes and rodents. The situation in Nueva Sullana reflects this same pattern: where sanitation is efficient, vector control improves by up to 49.18%; where it is poor, such control drops to 15.41%. This behavior shows that basic sanitation acts as a structural determinant for vector control.

SPECIFIC OBJECTIVE 3: To check the relationship between basic sanitation and vector control in the homes of a popular neighborhood in Sullana.
In a case study conducted by Hendricks et al. (2022) in a peri-urban community near Cape Town in South Africa, they analyzed the relationship between diarrheal diseases and environmental factors, focusing on children under 2 years old. They compared 100 children with diarrhea to 100 without diarrhea, collecting information through surveys and found that rat infestations and childcare outside the home were important predictors of diarrhea. This aligns with our results, as the comparison between basic sanitation and vector control shows that in households with poor sanitation (31.15%), vector control is also lacking by 15.41%, which leads us to conclude that basic sanitation is a key factor in the prevention and control of vectors. Additionally, the comparison between the two variables showed a coefficient of (0.454) and p (0.005), which shows that as basic sanitation improves, vector control also gets better, and when these basic services are lacking, it creates a breeding ground for rats, insects, and all kinds of disease-transmitting organisms.

GENERAL OBJECTIVE: To determine the relationship between basic sanitation and environmental impact in the households of a popular neighborhood in Sullana

Overall, the relationship between basic sanitation and environmental impact reached a coefficient of r = 0.464 (p = 0.000), the highest relationship found. This result confirms the general hypothesis and supports the relevance of the design of the Integrated Environmental Sanitation Model (MISA). The correlation is moderate but significant, showing that sanitation improvements like access to drinking water, sewer systems, and waste management proportionally reduce environmental pollution at home and in the community. This causal relationship is consistent with the international literature cited on green infrastructure, water governance, and decentralized sanitation models (Huang et al., 2025; García et al., 2022).

Overall, the results reveal that poor sanitation in a working-class neighborhood in Sullana is not just a technical problem, but a structural, social, and environmental one. The research confirms the existence of direct, positive, and significant relationships between basic sanitation and environmental health, disease risk, vector control, and environmental impact. It also shows that the historical precariousness of the local sanitation system has helped perpetuate vulnerable conditions, as highlighted by WHO reports (2024–2025) and SDGs 3, 6, and 11.

Finally, the empirical evidence fully justifies the need to implement a comprehensive model. The findings show that partial interventions, whether just infrastructure or just educational practices, are not enough.

CONCLUSIONS

According to the proposed objectives, the following conclusions were reached:

Regarding objective 1; comparing the relationship between basic sanitation and environmental health in households of a popular neighborhood in Sullana; the correlation analysis shows that there is a direct and significant relationship between basic sanitation and environmental health, which means that lower levels of basic sanitation lead to a greater environmental impact, in other words, it becomes negative; therefore, it is stated that as sanitation services and practices improve, environmental quality gets better and the health of the population is protected, highlighting the importance of public policies focused on sustainable development and comprehensive sanitation management.

The contrast between both is reflected by the Pearson correlation found of r = 0.307, with a two-tailed significance level of p = 0.000, which is positive and statistically significant; however, it is a low to moderate relationship, which means that as basic sanitation conditions in households improve, there is also an improvement in environmental health, although this relationship is not completely strong.

Regarding objective 2; establishing the relationship between basic sanitation and the risk of diseases in the households of a popular neighborhood in Sullana, when comparing both results, a clear correlation is observed between the level of basic sanitation and the risk of diseases; this is reflected in the fact that in homes with poor sanitation, the highest proportion of households with a high risk of diseases is concentrated (51.48%), which confirms that the lack of adequate basic services increases health vulnerability; in contrast, in households with efficient sanitation (1.97%), the risk of diseases decreases significantly (14.10%).

Then, we state that there is a direct and significant relationship between basic sanitation and the risk of diseases, supported by a correlation coefficient of r = 0.310 with a two-tailed significance level of p = 0.000, allowing us to affirm that as basic sanitary conditions improve, the incidence of diseases related to water contamination, improper waste handling, and poor solid waste disposal decreases. In this way, the need to strengthen sanitation infrastructure and promote hygiene practices and health education is reaffirmed as key strategies for protecting public health and environmental sustainability in the popular urban area of Sullana.

Regarding objective 3, which is to verify the relationship between basic sanitation and vector control in the households of a popular neighborhood in Sullana, the vector control dimension shows an inverse trend. 49.18% of households have effective control, 35.41% are at an average level, and 15.41% have poor control. This distribution suggests that, despite limitations in sanitation infrastructure, a significant percentage of families carry out preventive practices or receive support from local health programs focused on vector control.

Regarding objective 4: Comparing the relationship between basic sanitation and environmental impact according to the Pearson correlation applied to determine the relationship between basic sanitation and environmental impact in households in the popular urban area of Sullana, the statistical analysis shows a Pearson correlation coefficient of r = 0.464, with a two-tailed significance level of p = 0.000, which is below the critical value of 0.05. This result shows that there is a moderate and statistically significant positive correlation between the two variables.

It is concluded that there is a direct, positive, and significant relationship between basic sanitation and environmental impact, meaning that improvements in basic sanitation services effectively help to reduce negative environmental impacts and strengthen the sustainability of the urban environment. Therefore, the importance of implementing public policies and local programs aimed at improving sanitation infrastructure and promoting responsible environmental practices in the popular urban areas of Sullana is reaffirmed.

BIBLIOGRAPHIC REFERENCES

1. Andersson, K., Rosemarin, A., Dickin, S., & Trimmer, C. (2021). Sanitation, Wastewater Management and Sustainability: from Waste Disposal to Resource Recovery (2nd ed.) faltan páginas. https://www.sei.org/publications/sanitation-wastewater-management-and-sustainability/
2. Avilés, G., Beltrán, L., Miranda, A., y Troyo, E. (2024). Escasez de agua y riesgo de infecciones gastrointestinales agudas en hogares mexicanos: Un análisis de clases latentes. Water (Suiza), 16(13). Scopus. https://doi.org/10.3390/w16131884
3. Bain, R., Cronk, R., Wright, J., Yang, H., Slaymaker, T., & Bartram, J. (2014). Fecal Contamination of Drinking-Water in Low- and Middle-Income Countries: A Systematic Review and Meta-Analysis. PLOS Medicine, 11(5), e1001644. https://doi.org/10.1371/journal.pmed.1001644
4. Bronfenbrenner, U. (1979). The Ecology of Human Development. Harvard University Press. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://khoerulanwarbk.wordpress.com/wp-content/uploads/2015/08/urie_bronfenbrenner_the_ecology_of_human_developbokos-z1.pdf
5. Budge, S., Ambelu, A., Bartram, J., Brown, J., & Hutchings, P. (2022). Environmental sanitation and the evolution of water, sanitation and hygiene. ResearchGate. https://doi.org/10.2471/BLT.21.287137
6. Bullard, R. (2008). The quest for environmental justice: human rights and the politics of pollution. https://www.amazon.com/Quest-Environmental-Justice-Politics-Pollution/dp/1578051207
7. Canova, J., Nahar, S. & Moss, T.W. (2025) Del estigma a la solución: Saneamiento y emprendimiento sostenible en economías emergentes. Journal of Business Venturing Insights, 23, e00532, ISSN 2352-6734. https://doi.org/10.1016/j.jbvi.2025.e00532.
8. Castro, O., Moncada, J., Castro, O., & Moncada, J. (2022). Educación Ambiental Para El Manejo Sustentable Del Agua En La Comunidad Toro Muerto, Río Caroní. Areté, Revista Digital Del Doctorado En Educación, 8(15), 61–84. https://doi.org/10.55560/ARETE.2022.15.8.3
9. Chaves, R., y Costa, A.(2025). Propiedad privada de los sistemas de agua y aguas residuales: Evaluación de los impactos en la salud. Utilities Policy, 95. Scopus. https://doi.org/10.1016/j.jup.2025.101903
10. Concytec. (2020). Guía práctica para la formulación y ejecución de proyectos de investigación y desarrollo (I+D). chromextension://efaidnbmnnnibpcajpcglclefindmkaj/https://resoluciones.concytec.gob.pe/subidos/sintesis/RP%20097-2020-CONCYTEC-P.pdf
11. Costanza, R., & Daly, H. (1992). natural capital and sustainable development. conservation biology, 6(1), 37–46. https://doi.org/10.1046/J.1523-1739.1992.610037.X;PAGE:STRING:ARTICLE/CHAPTER
12. De Paula, J.M.P., Pinto, F.S., Amílcar Arantes & Rui C. Marques (2025) Cerrando el círculo del abastecimiento de agua y el saneamiento: Los vínculos dinámicos entre la población, los ecosistemas y las interacciones económicas, Sustainable Futures. 9, 100434, ISSN 2666-1888. https://doi.org/10.1016/j.sftr.2025.100434
13. Destinobles, A. (2000). El capital humano en las teorías del crecimiento económico. Juan Carlos Martínez Coll. https://books.google.es/books?hl=es&lr=&id=ATK3yacsIb8C&oi=fnd&pg=PA10&dq=Teor%C3%ADa+del+Crecimiento+Humano+explica&ots=KzU33CD7da&sig=dWxzZCJeDOfGUt7r4R5qvHB0iuk
14. Evans, B., Hueso, A., Johnston, R., Norman, G., Pérez, E., Slaymaker, T., & Trémolet, S. (2017). Limited services? The role of shared sanitation in the 2030 Agenda for Sustainable Development. Journal of Water Sanitation and Hygiene for Development, 7(3), 349-351.
15. García, L., Lavrnić, S., Guerrieri, V., Toscano, A., Milani, M., Cirelli, G. L., & Vittuari, M. (2022). Cost-benefit of green infrastructures for water management: A sustainability assessment of full-scale constructed wetlands in Northern and Southern Italy. Ecological Engineering, 185. https://doi.org/10.1016/j.ecoleng.2022.106797
16. Gonçalves, M., Nascentes, R., Ferreira, S., & Biondi, C. (2025). Análise do impacto ambiental na qualidade da água subterrânea de cemitérios – Caso do cemitério municipal localizado no município de Recife, Pernambuco – Brasil: Analysis of the Environmental Impact on the Groundwater Quality of Cemeteries – Case of the Municipal Cemetery Located in Recife, Pernambuco – Brazil. Revista de Geociências do Nordeste, 11(1), Article 1. https://doi.org/10.21680/2447-3359.2025v11n1ID38081
17. Hamidi, M., Haenssgen, M., y Greenwell, H. (2025). Explorando los determinantes del tratamiento del agua en los hogares de Kabul: Una perspectiva del modelo COM-B en un contexto de bajos ingresos. Desarrollo Mundial, 188. Scopus. https://doi.org/10.1016/j.worlddev.2024.106902
18. Hernández, R., Fernández, C, Baptista, L. (2020). Metodología de la investigación (7° ed.). México: McGraw Hill Interamericana Editores S.A. de C.V. https://apiperiodico.jalisco.gob.mx/api/sites/periodicooficial.jalisco.gob.mx/files/metodologia_de_la_investigacion_-_roberto_hernandez_sampieri.pdf
19. Hinostroza-Martínez, J., Custodio, M., y Chávez-Villarroel, J. (2025). Enfoque ecosistémico para barrios sostenibles: aplicabilidad de indicadores de sostenibilidad ambiental y urbana en barrios informales. Fronteras en Ciudades Sostenibles, 7, 1518694. https://www.frontiersin.org/journals/sustainable-cities/articles/10.3389/frsc.2025.1518694/full
20. Huang, M., Duan, D., Tan, S. y Huang, L. (2025). Tecnologías de tratamiento orientadas a los recursos para aguas residuales domésticas rurales en China en un contexto de disminución de la población: Un estudio de caso

del condado de Heyang en la región de Guanzhong, provincia de Shaanxi. Buildings, 15 (9), 1417. https://doi.org/10.3390/buildings15091417
21. Ibrahim, A., Humphries, U., Mohammed, I., & Zarin, R. (2024). Understanding the spread of typhoid fever: Combining vaccination and sanitation methods for better public health policies. AIP Advances, 14(4). https://doi.org/10.1063/5.0201916
22. Jiang, B., Li, P. (2024). Nonparametric Crosstalk evaluatión method using the Kolmorogov-Smirnov test https://doi.org/10.1109/EMCSIPI49824.2024.10705611
23. Li, Y., Zhang, X., Morgan, V., Lohman, H., Rowles, L., Mittal, S., Kogler, A., Cusick, R. D., Tarpeh, W. A., & Guest, J. S. (2022). QSDsan: An Integrated Platform for Quantitative Sustainable Design of Sanitation and Resource Recovery Systems. Environmental Science: Water Research and Technology, 8(10), 2289–2303. https://doi.org/10.1039/D2EW00455K
24. Martínez, J. (2011). El ecologismo de los pobres: conflictos ambientales y lenguajes de valoración. 416. https://icariaeditorial.com/antrazyt/4179-el-ecologismo-de-los-pobres-conflictos-ambientales-y-lenguajes-de-valoracion-6a-ed-ampliada.html
25. Maslow, A. H. (2021). Motivación y personalidad. Ediciones Díaz de Santos.
26. Ministerio del Ambiente [MINAM]. (2021). Propuesta de acciones para reducir la contaminación desde casa y promover la sostenibilidad ambiental en ciudades. Plataforma Digital Única del Estado Peruano. Recuperado de https://www.gob.pe/minam
27. Organización de las Naciones Unidas. (2024). Agua y saneamiento: Datos y cifras. Objetivos de Desarrollo Sostenible. . Recuperado de https://www.un.org/sustainabledevelopment/es/water-and-sanitation/
28. Organización Panamericana de la Salud. (2024, junio 18). https://www.paho.org/es/documentos/actualizacion-epidemiologica-aumento-casos-dengue-region-americas-18-junio-2024
29. OPS. (2024). Objetivos de Desarrollo Sostenible—OPS/OMS | Organización Panamericana de la Salud. https://www.paho.org/es/temas/objetivos-desarrollo-sostenible
30. Ostrom, E. (2009). A general framework for analyzing sustainability of social-ecological systems. Science, 325(5939), 419–422. https://doi.org/10.1126/SCIENCE.1172133/SUPPL_FILE/OSTROM.SOM.PDF
31. Pigou, A. (2013). The Economics of Welfare | SpringerLink (Vol. 1). https://link.springer.com/book/9780230249318
32. Plan Nacional de Saneamiento 2022-2026. (s. f.). Recuperado 8 de https://www.gob.pe/institucion/vivienda/informes-publicaciones/2586305-plan-nacional-de-saneamiento-2022-2026
33. PMRE. (2025). ODS 6 Agua limpia y saneamiento | Pacto Mundial ONU. Pacto Mundial Red España. https://www.pactomundial.org/ods/6-agua-limpia-y-saneamiento/
34. Prüss-Ustün, A., Wolf, J., Bartram, J., Clasen, T., Cumming, O., Freeman, M. C., Gordon, B., Hunter, P. R., Medlicott, K., & Johnston, R. (2019). Burden of disease from inadequate water, sanitation and hygiene for selected adverse health outcomes: An updated analysis with a focus on low- and middle-income countries. International Journal of Hygiene and Environmental Health, 222(5), 765-777. https://doi.org/10.1016/j.ijheh.2019.05.004
35. Ripkey, C., Waller, L., & Thompson, A. (2024). Partnering with community-based organizations to provide contextualized approaches to WaSH inequities in the United States. Journal of Water Sanitation and Hygiene for Development, 14(9), 873-885. https://doi.org/10.2166/washdev.2024.161
36. Ross, I., Cumming, O., Dreibelbis, R., Adriano, Z., Nala, R. y Greco, G. (2021). ¿Cómo influye el saneamiento en la calidad de vida de las personas? Investigación cualitativa en zonas de bajos ingresos de Maputo, Mozambique. Ciencias Sociales y Medicina, 272. Scopus. https://doi.org/10.1016/j.socscimed.2021.113709
37. Sánchez, R., & Aguilar, N. (2023). Bases teóricas de la conciencia ambiental como estrategia para el desarrollo sostenible. Alfa Revista de Investigación en Ciencias Agronómicas y Veterinaria, 7(21), 619-629. https://doi.org/10.33996/revistaalfa.v7i21.242
38. Sánchez-Lera, R. M., & Pérez-Vázquez, I. A. (2022). Pasteur y Koch: los padres de la microbiología. Revista 16 De Abril, 61(283), e1183. https://rev16deabril.sld.cu/index.php/16_04/article/view/1183
39. Sánchez, R., Alfaro, C., Ledezma, K., Hernando, L., Mora, C., Pérez, R. (2021). Aspectos del contexto socioambiental que inciden en la contaminación del recurso hídrico en un cantón urbano. Uniciencia, 35(2), 308–327. https://doi.org/10.15359/RU.35-2.20
40. Sánchez Ruiz, EA, Cremades, LV, y Villanueva Benites, S. (2025). Desigualdades en el acceso al agua potable en Piura (Perú): Diagnóstico territorial y desafíos de gobernanza. Sustainability, 17 (16), 7542. https://doi.org/10.3390/su17167542
41. Sclar, E. D., Garau, P., & Carolini, G. (2005). The 21st century health challenge of slums and cities. The Lancet, 365(9462), 901-903. https://doi.org/10.1016/S0140-6736(05)71049-7
42. UNESCO. (2022). Aprender por el planeta: Revisión mundial de cómo los temas relacionados con el medioambiente están integrados en la educación. Organización de las Naciones Unidas para la Educación, la Ciencia y la Cultura. https://unesdoc.unesco.org/ark:/48223/pf0000380480
43. UNICEF (2021, julio 1). Progress on household drinking water, sanitation and hygiene, 2000-2020: Five years into the SDGs. UNICEF DATA. https://data.unicef.org/resources/progress-on-household-drinking-water-sanitation-and-hygiene-2000-2020/
44. Wang, X., & Wang, F. (2024). Epidemic dynamics of cholera with impulsive sanitation. Nonlinear Analysis: Hybrid Systems, 53. https://doi.org/10.1016/j.nahs.2024.101502

45. Wang, X., & Wang, F. (2024). Epidemic dynamics of cholera with impulsive sanitation. Nonlinear Analysis: Hybrid Systems, 53. https://doi.org/10.1016/j.nahs.2024.101502
46. WHO. (2025). Water supply, sanitation, and hygiene monitoring. World Health Organization https://www.who.int/teams/environment-climate-change-and-health/water-sanitation-and-health/monitoring-and-evidence/wash-monitoring
47. Wulandari, R., Iswara, A., Qadafi, M., Prayogo, W., Astuti, R., Utami, R., Jayanti, M., Awfa, D., Suryawan, I., Fitria, L., & Andhikaputra, G. (2024). Water pollution and sanitation in Indonesia: A review on water quality, health and environmental impacts, management, and future challenges. Environmental Science and Pollution Research, 31(58), 65967-65992. https://doi.org/10.1007/s11356-024-35567-x
48. Yushananta, P., & Putri, M. (2024). Household and Environmental Typhoid Fever Transmission in Bandar Lampung City, Indonesia: A Case-Control Study. Journal of the Nepal Medical Association, 62(277), 564-569. https://doi.org/10.31729/jnma.8744
49. Ziliotto, M., Chies, J. A. B., & Ellwanger, J. H. (2024). Environmental Sanitation in Porto Alegre City, Brazil: A Basic Step towards Sustainable Development. Sustainability, 16(7), 2672. https://doi.org/10.3390/su16072672