

ORIGINAL RESEARCH ARTICLE

Water situation in Las Vigas from a socioenvironmental perspective

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Abstract: Water is essential to life, yet scarcity and contamination remain persistent global challenges. This study analyzed the water situation in Las Vigas, a rural community in the Costa Chica region of Guerrero, Mexico, from a socioenvironmental perspective, focusing on three water sources: natural streams, artificial irrigation canals, and potable water from the community system. A mixed-methods approach was used, comprising participant observation, surveys, and interviews. The participant observation revealed that water issues are tied to economic marginalization, the presence of urban solid waste and agrochemical containers in water bodies, and insufficient institutional infrastructure. A structured questionnaire with 41 closed-ended questions was applied to 35 residents. In the socioeconomic dimension, 66% of respondents were women, 77% had stable jobs, and 60% lived in owned homes, although 43% had only a primary education, limiting access to technical knowledge. In the environmental dimension, 86% perceived stream contamination, 94% canal contamination, 97% recurrent droughts, and 83% a lack of water conservation culture. In the sociopolitical dimension, 89% perceived a lack of environmental education, and 86% attributed water shortages to institutional failures, especially in the pumping system (69%). Only 20% believed that wastewater treatment plants existed, although none currently do. Interviews with 42 key informants reinforced that water scarcity, contamination, and unequal access are interconnected challenges rooted in structural weaknesses. The findings highlight the urgent need for integrated strategies that promote water governance, environmental education, community participation, and infrastructure enhancement to ensure sustainable and equitable access to water in the Las Vigas community.

Keywords: Water; Socioenvironment; Contamination; Water supply; Community participation; Sustainability

1. Introduction

Water is essential for human survival, economic development, and the health of ecosystems worldwide. However, it is increasingly threatened by pollution resulting from various anthropogenic activities, and the lack of access to clean drinking water can have severe impacts on public health and socioeconomic development. While access to safe water is a global concern, rural communities such as Las Vigas, Guerrero, Mexico, face additional local challenges, including limited infrastructure, perceived water pollution, scarcity, and weak governance, making the situation more complex and demanding urgent, context-based solutions.

Poor water quality and contamination resulting from human activities, such as inadequate waste management and intensive use of agrochemicals, represent a global issue that also affects local communities, including Las Vigas. In addition, the lack of an adequate potable water supply results in environmental and social impacts in these areas. To address these issues, solutions including promoting environmental education, improving public water management, encouraging citizen participation, and enforcing environmental legislation are implemented to ensure the protection and sustainable use of water resources.

These global and local challenges are reflected in various studies conducted in Mexico and other regions of Latin America, highlighting the connection between water contamination, waste management, and the importance of strengthening environmental education and community governance. For example, a diagnosis of the generation and management of urban solid waste in five municipalities of the Ciénega region of Jalisco indicates that these wastes may contain contaminant materials, concluding that there is a latent risk of water source contamination due to leachate from hazardous waste.¹ Likewise, a study in Las Animas, Tecoaapa, Guerrero, analyzed community access, use, and management of water, identifying challenges such as water stress during the dry season, contamination from intensive agriculture, lack of wastewater treatment, and organizational weaknesses.² Autonomous governance forms based on community norms and social monitoring were also observed. The study concluded that strengthening this governance, along with public policies, environmental restoration, and water education, is key to the sustainability of the water system in vulnerable rural contexts. Meanwhile, a systematic review study analyzed the effects of

contaminated water on health and quality of life across studies based on laboratory analyses.³ The results revealed contamination by microorganisms, parasites, and toxic residues, mainly associated with acute diarrhea. The review concluded that the main sources of contamination are human and animal feces, as well as wastewater, with coliform bacteria being the most common contaminant. A study on knowledge, attitudes, and practices regarding water, conducted in three rural communities in Huetar Norte, Costa Rica, with 262 participants, showed that they had basic knowledge and a positive attitude toward water conservation, but with limited practical skills.⁴ This supported a proposal for environmental education focused on water care in households. Similarly, the current study took place in Las Vigas (located in the Costa Chica region of Guerrero, Mexico), the municipal seat of the newly established municipality of Las Vigas, which was created through Decree No. 864 published in the Official Government Gazette of the State of Guerrero on September 28, 2021.⁵ The study considered water from three different sources, natural streams, artificial irrigation canals, and potable water supplied through the community system.

As Fernandez-Cirelli⁶ highlighted, water is essential not only for human survival but also for the development of societies, possessing unique properties. The history of humanity is rife with conflicts over the scarcity of natural resources, including water, which until recently was not considered a cause of tension but has now emerged as a critical issue of international security. The management of water is a global concern, with poor governance and mismanagement leading to dire predictions: within two decades, one in every two households could experience some form of water stress (BBC Mundo, November 2005, cited by Peña-García⁷). Moreover, as Nieto-Nubia⁸ stated, the inequitable distribution of water and the political-economic decisions that govern access to it are among the most significant global issues today.

In medium-sized cities such as Las Vigas, the efficient provision of urban services, including water supply, waste collection, and public transportation, presents significant challenges. Many cities face difficulties in managing these services due to a lack of financial resources and limited infrastructure. According to Duran-Juarez and Torres-Rodriguez,⁹ issues, such as insufficient coverage, poor quality, and the negative environmental impacts of these services, hinder the development of sustainable urban communities. Water is central to sustainable development, being essential not only for socioeconomic development but also for food production, energy generation, and ecosystem

preservation.¹⁰ In this context, a study by Navarro-Chaparro¹¹ on the urban water management of Tijuana from 1991 to 2009 revealed unsustainable practices that led to water scarcity and sociospatial segregation in access to water services. A similar issue was identified in Las Vigas, where the community's socioenvironmental perception highlighted urban waste in water bodies and chemical pollution from agricultural activities. In addition, the community faces a lack of environmental awareness and an inefficient water supply system, further exacerbating environmental, socioeconomic, and governance issues.

Given these challenges, it is imperative for both the local community and authorities to collaborate in designing and implementing effective policies and actions aimed at improving the water quality and efficiency of the water supply system. Such collaboration is essential for enhancing the quality of life of residents in Las Vigas and ensuring the sustainable development of the area.

1.1. Theoretical and conceptual context

In socioenvironmental research, the concept of the “subject” plays a crucial role in understanding how individuals and communities interact with and perceive their environment. As Edgar Morin (1994, cited by Jaramillo-Echeverri¹²) explained, a subject is not just an isolated individual but someone who is actively engaged in the world, making sense of the surrounding contradictions and changes. This active engagement with the environment is also fundamental in understanding how people perceive social and environmental issues and how they can collectively contribute to solving them.

The concept of “social perception” refers to the influence of social and cultural factors on how individuals perceive the world around them. It is closely tied to the idea of “social cognition,” which encompasses the way individuals understand others and form impressions about them. This perception of the social environment is essential for understanding how individuals and communities react to socioenvironmental challenges, such as water contamination and scarcity. According to Santoro (2012, cited by Salazar *et al.*¹³), social cognition involves both the perception of the environment and the assessment of one's role within it.

In relation to environmental issues, as Alberto Conde (cited in Jimenez-Marce¹⁴) pointed out, humans are part of a single, interconnected natural system. This view aligns with Enrique Leff's (2005, as cited in Jimenez-Marce¹⁴) assertion that the rise of environmental

issues has reshaped our understanding of the world, development, and our relationship with nature. Leff emphasized the need for interdisciplinary approaches that bridge the gap between the natural and social sciences to address complex environmental issues.

1.2. Environmental education for sustainability: Water conservation and the new water culture

Environmental education is a key tool for fostering awareness and behavioral change concerning the use and conservation of water. The lack of awareness about the importance of preserving water is a widespread issue that affects both individual and collective actions. As Meira-Carrea¹⁵ noted, the role of environmental education is to provide people with a real understanding of their environment, enabling them to act responsibly. This type of education should not only be scientific but should also address the social and political aspects of environmental issues, as Martinez-Castillo¹⁶ argued.

A crucial aspect of environmental education is promoting a “new water culture,” one that emphasizes the importance of water conservation, equity, and justice. According to Benarroch *et al.* (2022, as cited by Balbuena-Hernandez *et al.*¹⁷), fostering a new culture of water, involve promoting sustainable practices and encouraging public participation in water management, as well as cooperation among governments, academia, and society. As Frausto (2015, as cited by Balbuena-Hernandez *et al.*¹⁷) warned, without such a culture, water will continue to be misused and wasted. In Las Vigas, there is a growing concern among the local population about the management and care of water resources. This concern presents a unique opportunity to promote educational campaigns and community participation aimed at improving water conservation practices and ensuring sustainable water use for future generations.

1.3. Context of Las Vigas: Normative, environmental, and social aspects

As stated in Decree No. 864, published in the Official Government Gazette of the State of Guerrero on September 28, 2021, Las Vigas—formerly part of the municipality of San Marcos—is now recognized as an independent municipality (Figure 1), with a population of 4,762 according to the 2020 census by the National Institute of Statistics and Geography.¹⁸ The municipality provides various essential services, including healthcare, water supply, sanitation, and waste management. It is rich in natural resources and supports agricultural, livestock, and fishing activities. The area is irrigated by water from the Mexican Revolution

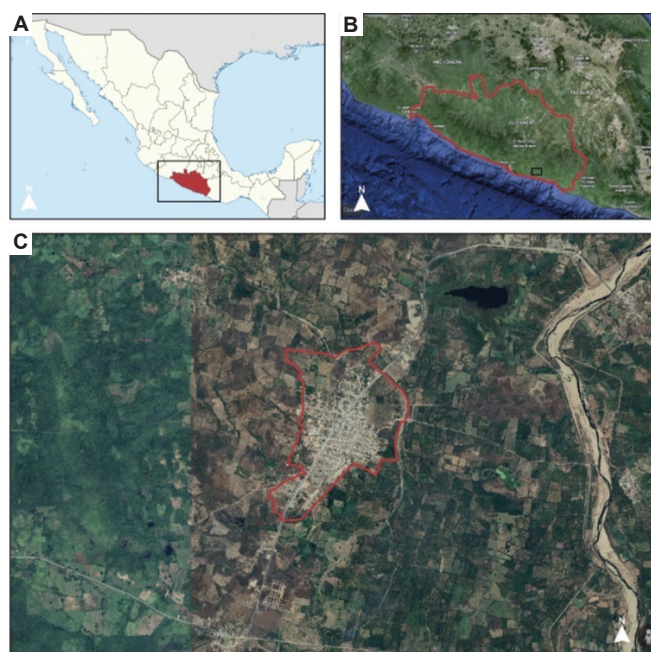


Figure 1. Geographical location of the community of Las Vigas in the state of Guerrero, Mexico. (A) Map showing Mexico as the national territory, highlighting the state of Guerrero and Las Vigas. (B) Map focusing on Guerrero, highlighting the area where Las Vigas is located. (C) The precise location of the community of Las Vigas within Guerrero. Panel A modified from Wikipedia²⁰; panel B modified from PueblosAmerica.com²¹; panel C modified from Google Earth^{22,23}

(*Revolución Mexicana*) Dam, the Nexpa River, and several streams that feed into the Ramaditas Lagoon, a vital water source for the region. The municipality's legal framework, as defined in the Constitution of the State of Guerrero, guarantees the right to a healthy environment and mandates the protection of natural resources. With Las Vigas now serving as a municipal seat, it is vital for local authorities and the community to collaborate in addressing water pollution and improving the efficiency of the water supply system.¹⁹

1.4. Objective

The main objective of this study was to assess the water situation in Las Vigas from a socioenvironmental perspective, focusing on water from three sources: natural streams, artificial irrigation canals, and potable water supplied through the community system. To achieve this, a mixed-methods approach, combining participant observation, surveys, and interviews, was employed to analyze socioeconomic, environmental,

and sociopolitical factors related to water issues. Observations revealed that water challenges are linked to economic marginalization, the presence of urban solid waste and agrochemical containers contaminating water bodies, and insufficient institutional infrastructure. A structured survey was conducted with 35 residents, showing that while a majority had stable employment and house ownership, limited education constrained access to technical knowledge. Most participants perceived significant contamination in local streams and canals, recurrent droughts, and a widespread lack of water conservation culture. In addition, many identified institutional shortcomings, particularly in water supply systems and environmental education, as key factors contributing to water scarcity and unequal access. Interviews with key informants further confirmed that these interconnected challenges stem from underlying structural weaknesses.

2. Materials and methods

2.1. Materials

This study employed a mixed-methods research approach, which, according to Mendizabal,²⁴ involves combining theoretical perspectives, epistemological standpoints, and both qualitative and quantitative methods in a single study conducted by one or more researchers. In this context, the research utilized observational techniques (Method 1), supported by surveys and key informant interviews (Method 2), to gain a comprehensive understanding of the socioenvironmental situation of water in the Las Vigas community (Figure 2).

2.2. Method 1

As part of the mixed-methods approach, the first methodological strategy employed in this study was participant observation. This technique directly recorded the water situation in the Las Vigas community using a structured observation format specifically designed to identify issues concerning water quality and the water supply system. The format included indicators organized around three key dimensions: socioeconomic, environmental, and sociopolitical aspects.

The objective of the participant observation was to systematically identify and record the practices, conditions, and socioenvironmental and sociopolitical factors related to the access, use, and quality of water in the community of Las Vigas. This technique aimed to generate contextual information to understand how

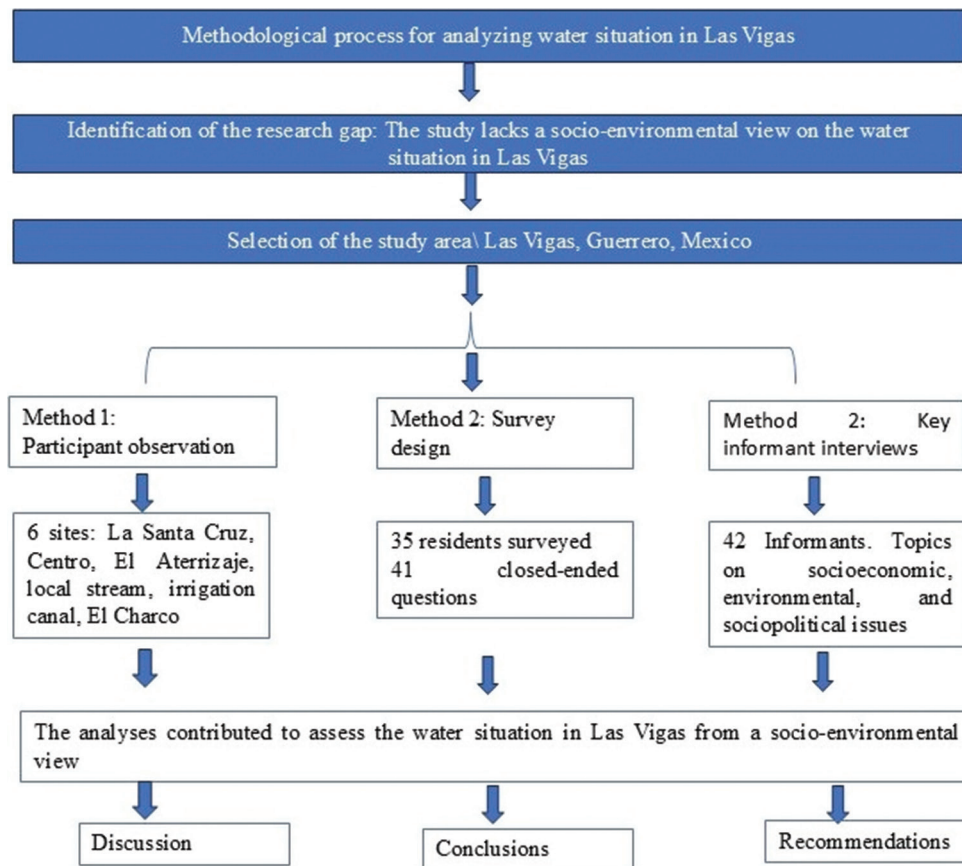


Figure 2. Flowchart of the methodological process for analyzing the water situation in Las Vigas. The process is structured around the identification of a research gap, specifically the lack of socioenvironmental studies on the topic. Based on this, the study area, Las Vigas, is selected. The research employs mixed methods comprising (i) participant observation across six strategic sites (La Santa Cruz, Centro, El Aterrizaje, a local stream, an irrigation canal, and El Charco), (ii) a survey of 35 residents using 41 closed-ended questions, and (iii) interviews with 42 key informants focused on socioeconomic, environmental, and sociopolitical issues. These combined approaches allowed for a comprehensive analysis of the water situation from a socioenvironmental perspective, informing the final discussion, conclusions, and recommendations.

water-related problems manifest and interact within the community’s daily spaces, considering aspects such as local management, existing infrastructure, and the interactions between the population and water resources.

The observation was conducted in six strategically selected locations within the community (La Santa Cruz, Centro, El Aterrizaje, the local stream, the irrigation canal, and El Charco), chosen for their relevance to the identified water-related challenges. These areas enabled the documentation of conditions such as improper waste disposal, potential sources of contamination, and deficiencies in water infrastructure. Through this method, valuable information was gathered about everyday practices, community organization, and the local context, contributing to a comprehensive understanding of the variables addressed in this study.

2.3. Method 2

2.3.1. Survey design and data collection

A descriptive study was conducted using a structured questionnaire composed of 41 closed-ended questions with response options: “Yes,” “No,” and “I don’t know.” The instrument was designed to explore community perceptions regarding the water problem in Las Vigas through three analytical dimensions: socioeconomic, environmental, and sociopolitical aspects. A total of 35 residents participated in the survey, selected through non-probabilistic sampling based on accessibility and willingness to respond. Data collection focused on obtaining quantitative insights into the population’s demographic characteristics, water access, perception of environmental contamination, and views on institutional management.

The results were analyzed through descriptive statistics to identify trends and highlight key socioenvironmental concerns affecting the community. As Hernández-González²⁵ noted, convenience sampling allows researchers to select participants based on their availability and relevance to a study, which in this case included individuals who were accessible within the community and willing to participate. The survey was administered both in-person and online, through a link shared on a local Facebook profile, enabling participation from community members who could not attend in person. The online survey platform, Microsoft Forms,²⁶ was used to process the responses, generating percentage-based data for subsequent analysis.

2.3.2. Interviews with key informants

To supplement the quantitative data, semi-structured interviews were conducted with 42 key informants from the community. These interviews aimed to gather in-depth, qualitative insights into socioeconomic, environmental, and sociopolitical aspects that influence water quality and management in Las Vigas. The informants were selected based on their involvement in local water management, environmental governance, or their general knowledge about community water issues.

The responses were analyzed and interpreted by the researchers, allowing for a richer understanding of the sociopolitical and environmental dynamics surrounding water in the community.

2.4. Data analysis

Data from participant observation and interviews were analyzed qualitatively, while survey data were analyzed quantitatively using descriptive statistics. The results from the survey were processed through Microsoft Forms, which generated percentage data reflecting the community's perceptions of water quality and management. The interview data were analyzed qualitatively using a thematic approach to identify key patterns and insights related to the socioeconomic, environmental, and sociopolitical dynamics of water in the community.

3. Results

3.1. Socioenvironmental perspective on the water situation in Las Vigas: Results from method 1

As part of the mixed-methods approach, participant observation was conducted on July 3–4, 2023, in six strategic areas of the community of Las Vigas, located

in the Costa Chica region of Guerrero, Mexico. The observation aimed to analyze the community's water situation from a socioenvironmental perspective. The goal was to document local practices, conditions, and perceptions that contribute to the ongoing water challenges in the community.

3.1.1. Socioeconomic dimension

The observation revealed that water-related problems in Las Vigas are closely connected to economic marginalization. In neighborhoods such as La Santa Cruz, Centro, and El Aterrizaje, the public water supply system failed to deliver water during the observation period. As a result, families had to rely on private water delivery services, which impose additional financial burdens, particularly on low-income households. This situation reinforces inequalities in access to a fundamental resource. Moreover, some daily practices—such as using water to clean streets or irrigate household gardens—demonstrated a limited culture of water conservation, despite the scarcity. These behaviors suggest not only the absence of adequate environmental education but also a lack of community programs aimed at promoting sustainable water use in everyday life.

3.1.2. Environmental dimension

From an environmental standpoint, the water bodies in Las Vigas are experiencing progressive degradation. The local stream, once a perennial water source, now only holds water during the rainy season. Although it is used for domestic and irrigation purposes, the presence of urban waste, detergents, and agrochemicals—resulting from activities such as clothes washing and improper waste disposal—contributes to the contamination of the water and the deterioration of its quality. These practices reflect a critical lack of environmental awareness and further compromise water quality. Similarly, the irrigation canal managed by the National Water Commission (CONAGUA) was observed to be misused by residents for bathing and washing. Although intended exclusively for agricultural irrigation, the presence of detergents and chemical residues in the canal water indicates widespread misuse, negatively affecting crop quality and soil health.

El Charco, a natural water body located to the north of the community, also showed signs of deterioration. Previously a stable water source year-round, it now functions only seasonally and has become a dumping site for urban solid waste and agrochemical containers. These environmental impacts are exacerbated by climate events, such as the 2017 flooding from Hurricane

Max, which spread contaminants and made visible the community's vulnerability to socioenvironmental risks.

3.1.3. Sociopolitical dimension

The sociopolitical analysis revealed structural problems in the governance of water resources. The drinking water system, although formally established, is highly deficient and unreliable, with no water delivery observed during the study period. The absence of preventive maintenance, planning, and regulatory oversight contributes to service failure and unequal distribution. In addition, no sanctions or community agreements were in place to discourage harmful practices, such as dumping waste in water bodies or misusing irrigation infrastructure. This regulatory vacuum reflects a fragmented institutional presence and a lack of coordination between the community and public authorities. The observation also revealed a limited sense of collective responsibility regarding water care, underscoring the need for inclusive strategies that link environmental sustainability with social justice. The situation in Las Vigas demonstrates that access to clean and sufficient water is not only a technical or infrastructural issue but also part of a broader socioenvironmental crisis rooted in poverty, lack of education, and weak institutional frameworks.

3.2. Socioenvironmental analysis of the water situation in Las Vigas: Results from method 2

3.2.1. Community survey

A structured questionnaire composed of 41 closed-ended questions with response options ("Yes," "No," and "I don't know") was administered to 35 residents of the community of Las Vigas, Guerrero, to assess their perceptions regarding water-related challenges from three socioenvironmental perspectives.

In the socioeconomic dimension, 66% of the respondents were women and 34% were men. Regarding marital status, 45.7% were married, 34.3% single, and 20.0% in a common-law relationship. Educational attainment showed that 43% had completed primary school, 14% secondary school, 20% high school, and 23% had a university or postgraduate degree. Furthermore, 77% of interviewees reported being employed. In terms of housing, 60% lived in their own houses, 20% in borrowed houses, and 20% in rented accommodations. Most houses (80%) were made of brick, while the rest were constructed from wood or adobe. Access to healthcare was reported by 63% of the participants. These data reflect the basic social conditions in the community and reveal both strengths and limitations for

responding to water-related challenges. For example, although the majority has employment and stable housing, low levels of formal education among many residents may hinder access to scientific or technical knowledge about water management. Furthermore, socioeconomic vulnerability may exacerbate the impacts of water scarcity and contamination, especially in households lacking access to health services.

In the environmental dimension, the majority of respondents perceived high levels of water contamination. Specifically, 86% identified solid waste or agrochemical containers in the local stream, and 94% stated that detergents and chemical products are used in the canal, contributing to its pollution. Furthermore, 83% perceived that water flow in the stream has diminished, attributing this to decreased rainfall, and 97% reported the presence of drought conditions. A total of 82% considered the community pond to be contaminated. While 46% believed that the water they use is polluted, 34% disagreed, and 20% were unsure. In addition, 77% associated water contamination with disease incidence in the community, and 83% indicated a lack of water conservation culture among the population. Although 74% stated they are aware of and apply water-saving practices, only 63% reported reusing or recycling water. Meanwhile, 69% knew where their household wastewater goes. Almost all respondents (94%) agreed that water is essential for life, and 86% emphasized the importance of avoiding environmental pollution to protect water resources. These results illustrate the strong perception among residents that the environmental degradation of water sources is both visible and concerning. From a socioenvironmental perspective, the data highlight not only the ecological risks associated with pollution and drought but also how local behaviors—such as improper waste disposal or limited water reuse—contribute to and are affected by these environmental issues. The connection between water contamination and perceived health problems further suggests that environmental risks are experienced as daily, tangible threats to community well-being.

In the sociopolitical dimension, 86% of respondents agreed that authorities, schools, civil society, and the community should work together to care for water. Moreover, 89% perceived a lack of environmental education among the population, and 71% believed that an environmental education program would help address water problems. Regarding public management, 83% thought that authorities should implement adequate waste management programs, and 86% linked the water supply issue to institutional failures by the municipal

government and the local water committee. In terms of infrastructure, 69% cited failures in the water pumping system as a key issue, while 46% mentioned the reduced water flow in the river. Only 23% believed that CONAGUA effectively monitors water contamination, and just 17% affirmed the existence of sanctions for polluters. Finally, only 20% stated that there are wastewater treatment plants in the community. These findings reflect a widespread perception of institutional weakness and disconnection between authorities and the community. In socioenvironmental terms, the absence of strong governance mechanisms, infrastructure investment, and environmental education has created a scenario in which local ecological degradation is not adequately addressed. The lack of regulation and community engagement prevents the development of collective solutions. Although there is a shared willingness to collaborate, residents feel unprepared and unsupported by public institutions to act effectively in the face of a worsening water crisis.

Table 1 summarizes the results of the community survey conducted in the current study. Respondents' answers reflect their views on water contamination, scarcity, and the role of societal and governmental factors in addressing these challenges. Although a formal correlation analysis was not conducted, a relationship among socioeconomic, environmental, and sociopolitical dimensions exists as economic and social conditions influence the community's environmental practices and perceptions. For example, employment and access to healthcare affect people's ability to address issues such as pollution and water scarcity. Failures in institutional management—including the lack of effective monitoring and sanctions—limit the resolution of these problems, worsening water quality and availability. Therefore, socioeconomic limitations combined with institutional weaknesses create a cycle that negatively impacts the environmental situation and the community's perception of the water resource.

3.2.2. *Key informants' interviews*

The responses obtained reflect a water-related issue deeply rooted in socioeconomic, environmental, and sociopolitical aspects. In the socioeconomic dimension, the community faces significant scarcity and unequal access to potable water, a situation that directly affects the inhabitants' quality of life. The limited distribution, often conditioned on timely payment, generates uncertainty, while the lack of community organization and institutional support hinders effective water resource management. From an environmental

perspective, respondents identified contamination of water bodies, mainly due to solid waste, detergents, and agrochemicals, contributing to the deterioration of the local ecosystem and posing risks to community health. Despite awareness of the need to keep water clean and avoid waste, a weak culture of environmental care persists, exacerbating the problem. The urgency to implement water treatment and conservation projects is a recurring demand to protect flora, fauna, and human well-being. In the sociopolitical dimension, there is a perceived lack of sufficient attention and action by authorities, limiting the capacity to resolve scarcity and contamination issues. The population calls for greater institutional commitment to design and implement programs addressing the water crisis. Furthermore, the importance of environmental education and awareness at the household and community levels is emphasized, alongside strict sanctions for polluters as mechanisms to promote water care and strengthen local governance. The absence of social organization represents a barrier to developing effective collective responses to this problem.

4. Discussion

In terms of the socioeconomic dimension, participant observation revealed significant inequality in access to water in areas such as La Santa Cruz and El Aterrizaje. There was no supply during the observation period, forcing families to pay for private water trucks, which represents a substantial financial burden for low-income households. This situation is supported by the survey results, where, although 77% of respondents reported being employed and 60% owned their houses, low educational levels (43% with only primary education) and limited access to healthcare (63%) indicate vulnerability conditions that hinder effective water resource management. In addition, interview results confirm this precariousness, pointing out that water distribution often depends on timely payment, which generates uncertainty and exclusion. They also highlight the lack of community organization as a barrier to collectively addressing the problem. Overall, the data show that water scarcity is closely tied to economic marginalization and the lack of educational tools for sustainable resource management.

In terms of the environmental dimension, environmental degradation is perceived in the local water bodies; the stream and El Charco show signs of contamination by solid waste, detergents, and agrochemicals, as observed during fieldwork. The

Table 1. Socioenvironmental analysis of the water in Las Vigas: Survey results

Dimension	Question/aspect	Main response	Percentage/details
Socioeconomic	Gender	Women, men	66% women, 34% men
	Marital status	Married, single, common-law relationship	45.7% married, 34.3% single, 20.0% in a common-law relationship
	Educational level	Primary, secondary, high school, university	43% primary, 14% secondary, 20% high school, 23% university/postgraduate
	Employment	Employed	77% employed
	Housing type	Own, borrowed, rented	60% own house, 20% borrowed, 20% rented
	Building material	Materials used in housing	80% brick, remainder wood or adobe
	Healthcare access	Access to medical care	63% have access to healthcare
Environmental	Water contamination	Pollution in water bodies	86% mention solid waste and agrochemical containers in the stream, 94% use detergents in the canal
	Perception of water scarcity	Reduced water flow	83% perceive reduced water flow due to lower rainfall
	Drought	Presence of drought	97% reported drought
	Perception of contamination in the community	Water contamination	82% perceive the community pond as contaminated
	Attitudes toward water use	Use of polluted water	46% believe water is polluted, 34% disagree, 20% unsure
	Link between contamination and disease	Connection to diseases	77% link contamination to disease incidence in the community
	Water conservation and reuse culture	Water saving and conservation practices	74% practice water saving, 63% reuse water, 83% lack a water conservation culture
	Awareness of the water cycle	Knowledge of wastewater disposal	69% know where their household wastewater goes
	Value of water	Water is essential for life	94% agree that water is essential for life, and 86% emphasize the importance of avoiding environmental pollution
	Sociopolitical	Collaboration among social actors	Collaboration for water care
Environmental education		Lack of environmental education	89% believe there is a lack of environmental education
Environmental education programs		Creation of educational programs	71% believe environmental education programs could help address the water problems
Public management		Need for waste management programs	83% think authorities should implement adequate waste management programs
Authorities and committees' performance		Failures in the management and monitoring of water	86% link water issues to institutional failures in management
Water infrastructure and management		Failures in infrastructure	69% mention failures in the water pumping system, 46% mention reduced river flow
Monitoring and sanctions for environmental pollution		Monitoring and sanctions exist for those who pollute water bodies	17% of respondents believe that monitoring and sanctions exist for those who pollute water bodies, 69% think they do not exist, 14% unsure

irrigation canal is used for bathing and laundry, even though it is designated exclusively for agricultural use. The survey results reinforce these observations: 94% of participants acknowledged chemical contamination in the canal, 86% reported waste in the stream, and 82% perceived contamination in the Charco. In addition, 83% noted a lack of water conservation culture, despite 74% claiming to apply water-saving practices. Interviews reflect this contradiction: although there is some awareness of contamination, harmful habits persist, and environmental education remains weak. There is also a perceived direct link between water degradation and health risks, along with a recurring demand for water treatment and conservation programs. Altogether, this reveals an environment where environmental damage is a daily reality, closely connected to community practices and the absence of effective regulation.

In terms of the sociopolitical dimension, at the institutional level, observation documented a formally established but non-operational drinking water system, with no water delivery during the days of fieldwork. No regulatory mechanisms, sanctions, or community programs were identified. This perception is supported by the survey, where 86% attributed the issue to failures by municipal authorities and the local water committee, and only 17% acknowledged the existence of sanctions for polluters. In addition, 71% believed that an environmental education program could help solve the problem. Interviews emphasize the lack of effective government action, insufficient monitoring by institutions such as CONAGUA, and the absence of strategies to foster participatory management. They also stress the need to strengthen local governance with legal, educational, and organizational tools. Thus, the sociopolitical dimension reflects a context of weak institutional capacity, with no planning or coordination to address the water crisis, and a community willing to act but lacking support.

These results are consistent with the findings of Arango-Ruiz²⁷ and Castro-Omar and Moncada-Rangel²⁸ that highlighted how water mismanagement and environmental degradation disproportionately affect marginalized communities. Pastrana-Miranda and González-Caamal²⁹ further argued that territorial marginalization leads to unequal water distribution, often privileging urban areas and intensifying scarcity and conflict in rural zones. This is evident in Las Vigas, where weak institutional presence and limited community organization worsen the crisis. As key informants pointed out, outdated infrastructure, pollution, and dependence on purchased water call for

not only technical solutions but also a new governance framework grounded in rights, equity, and citizen–state collaboration.³⁰ Another study related to the present one, conducted in 2024 in the same community of Las Vigas, established in its diagnosis that 80% of the respondents perceive that leachate from solid waste contaminates the soil and water bodies.³¹ In addition, another study, also conducted in 2024 in this community, highlighted that urban solid waste has a direct impact on both water quality and the increased damage caused by flooding during the rainy season.³²

According to Article 4 of the Constitution, everyone has the right to a healthy environment and access to sufficient, clean water. In the case of Las Vigas, sanctions must be applied to those causing environmental damage, ensuring the protection of this vital resource for the community's well-being.³³ Article 1 of the General Law on Ecological Balance and Environmental Protection establishes that the State must guarantee a healthy environment and prevent water pollution. Therefore, the authorities of Las Vigas must implement effective actions to prevent water contamination and ensure the well-being of the community.³⁴ Moreover, according to Article 1 of the National Water Law, the authorities of Las Vigas and the citizens must ensure the sustainable use, conservation, and quality of water, in line with the legal provisions regulating its use. Furthermore, according to Article 86 Bis 2, it is prohibited to discharge waste that contaminates water bodies, making it essential to implement preventive measures to avoid water pollution in the region.³⁵

The global water crisis, affecting over 2.5 billion people, appears to lack a rapid and efficient solution in the near future,³⁶ with human activity itself being a primary contributing factor.³⁷ This crisis is further exacerbated by the impacts of climate change.³⁸ In regions where water is not scarce, people often fail to recognize the importance of preserving this essential resource,³⁹ reflecting a general lack of environmental awareness.

The findings from this study highlight that environmental education plays a fundamental role in fostering awareness and promoting behavioral change. Small individual actions can significantly contribute to water conservation,⁴⁰ especially when cultivated from an early age.⁴¹ Therefore, environmental education must be integrated at all educational levels⁴² to promote not only water stewardship but also broader environmental responsibility and sustainability.⁴³ Moreover, the responsibility for water conservation should be shared across all sectors—social, business, educational, and

governmental sectors⁴⁴—as ensuring access to clean and safe water is among the most critical tasks for human survival.⁴⁵ The study results relate to several Sustainable Development Goals (SDGs), especially SDG 6, by assessing water quality and availability; SDG 11, by addressing challenges of sustainable community management; and SDG 15, by identifying environmental impacts on terrestrial ecosystems.⁴⁶

To address these water-related challenges, some recommendations are provided:

- (i) Socioeconomic dimension: Promote community workshops focused on water rights, hygiene, and basic water management practices, adapted to local educational levels, in order to empower residents with practical knowledge and reduce vulnerability to water scarcity.
- (ii) Environmental dimension: Implement local water conservation campaigns and community-led cleanup activities in streams and canals, alongside the promotion of responsible waste disposal and the reuse of water at the household level.
- (iii) Sociopolitical dimension: Establish a participatory water management committee that includes residents, local authorities, and educational institutions to strengthen governance, improve infrastructure oversight, and foster joint accountability for water quality and availability.

5. Conclusion

The socioenvironmental analysis of the three water sources in Las Vigas—natural streams, artificial irrigation canals, and community potable water—reveals a complex problem arising from the interaction among socioeconomic, environmental, and sociopolitical factors. Inequality in access to and quality of water, caused by economic marginalization and lack of adequate services, limits the community's capacity to manage its water resources sustainably. It is recommended that the municipal government of Las Vigas implement an effective community potable water system to address water scarcity and improve equitable access for all residents. Environmental contamination and the degradation of natural resources, worsened by improper practices and the absence of a conservation culture, highlight the urgent need to strengthen environmental actions. Likewise, insufficient infrastructure, weak governance, and low community participation constitute significant barriers to resolving the water crisis. This study emphasizes that effective water management in rural communities such as Las

Vigas requires an integral approach addressing social, environmental, and political dimensions simultaneously. Only through promoting equity, environmental education, and participatory governance can sustainable access to clean water be ensured, thus contributing to local well-being and development. These findings relate to the SDGs discussed in the study, reinforcing the importance of a multidimensional approach to water resource management.

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Conflict of interest

The authors declare that they have no competing interests.

Author contributions

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Availability of data

All relevant data are included in this paper.

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