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# The Impact of Water Supply on the Tourist Experience in Del Carmen, Surigao Del Norte

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## Abstract

This study assessed water supply conditions and their relationship with tourist experience in Del Carmen, Surigao del Norte, Philippines, and identified existing water scarcity mitigation strategies. A convergent parallel mixed-methods design was employed, involving 200 tourists selected through criterion sampling and 20 purposively selected tourism stakeholders and local government personnel. Data were collected using a researcher-developed questionnaire and semi-structured interviews and analyzed through descriptive statistics, Pearson correlation, and thematic analysis. Findings revealed satisfactory water supply conditions ($M = 3.01$, $SD = 0.50$) and a high positive perceived impact on tourist experience ($M = 3.02$, $SD = 0.50$). A very strong, statistically significant positive correlation ($r = 0.899$, $p < .001$) indicated that favorable water supply perceptions were associated with better tourist experiences. Qualitative findings identified infrastructure improvement, water source protection, wastewater management, conservation, and collaborative governance as key mitigation strategies. The study concluded that reliable water services are essential to satisfactory tourism experiences and sustainable destination management. It recommends implementing the proposed AQUA-CARE Del Carmen Program to strengthen water quality monitoring, infrastructure maintenance, conservation, and stakeholder coordination. Limitations included reliance on self-reported perceptions, the absence of laboratory water-quality testing, and the inability to establish causality. The findings contribute localized evidence supporting Sustainable Development Goals 6, 8, 11, 12, and 17 by informing responsible water management, resilient tourism services, environmental protection, and collaborative sustainable tourism planning.

**Keywords:** Collaborative Governance; Del Carmen; Sustainable Tourism; Tourist Experience; Water Conservation; Water Supply; Water Sustainability

## 1. Introduction

Water supply is a fundamental resource supporting human health, sanitation, tourism operations, and visitor satisfaction. Tourists depend on adequate and reliable water for drinking, bathing, food preparation, accommodation services, and recreational activities. The World Health Organization (WHO, 2022) emphasizes the importance of sufficient water for health and well-being, while tourism research recognizes water as an essential resource for maintaining hospitality services and destination operations (Becken & Hay, 2022; United

Nations World Tourism Organization [UN Tourism], 2021). Water adequacy extends beyond physical availability to include accessibility, frequency, duration, continuity, and quality (Howard et al., 2022). The World Health Organization (2023) further emphasizes that safely managed drinking-water services must be available when needed and free from contamination. Consequently, reliable water supply is essential for maintaining tourism services, protecting visitor welfare, and supporting sustainable destination development.

Existing literature establishes that tourism destinations depend heavily on freshwater resources, particularly for accommodation, sanitation, food services, and recreation. Hadinejad et al. (2022) explained that tourism-related water consumption becomes particularly significant where visitor demand is concentrated geographically and seasonally. UN Tourism (2021) similarly emphasized monitoring water availability, quality, conservation, and wastewater management as components of sustainable tourism. Water-service reliability involves both frequency and duration, as interruptions may interfere with tourists' personal needs and establishment operations. Vásquez et al. (2026) documented water-service interruptions in a tourism-dependent island destination, while Nguyen et al. (2024) identified dissatisfaction associated with inconsistent water availability in accommodation facilities. Water quality also influences visitor perceptions, with the WHO (2022) recognizing appearance, taste, and odor as important characteristics of water acceptability. World Health Organization (2022) demonstrated that observable water-quality conditions were associated with tourists' satisfaction. However, perceived clearness and safety must be distinguished from laboratory-confirmed water quality.

Tourist experience encompasses access to essential services, participation in recreational activities, accommodation comfort, and overall satisfaction. Emuy et al. (2024) examined tourist satisfaction and destination loyalty in beach resorts, while Ledesma et al. (2022) considered accommodation-related determinants of tourist satisfaction. Philippine research similarly emphasized the importance of accommodation services in shaping tourists' evaluations (Ledesma et al., 2022). Water supply contributes to these experiences by supporting access to clean drinking water, personal hygiene, sanitation, and planned activities. The Philippine Statistics Authority (PSA, 2024) identified accommodation services as a major contributor to tourism-related water consumption, demonstrating the sector's dependence on reliable water resources. Moreover, Ledesma et al. (2022) associated vacation duration with differences in perceived service quality and satisfaction, suggesting that basic service conditions may be relevant to tourists' experiences during their visits. Nevertheless, water availability should be examined as a potentially associated service condition rather than an isolated determinant of tourist behavior.

Globally, sustainable tourism research emphasizes the need to balance tourism development with freshwater availability, environmental protection, and community welfare. Hadinejad et al. (2022) highlighted the importance of efficient water management in island tourism destinations, while Calderon et al. (2025) examined concerns regarding water-resource equity and competing demands between tourism and local communities. Water conservation, wastewater treatment, appropriate reuse, and resource monitoring are therefore important components of sustainable destination management. In the Philippines, the Philippine Statistics Authority (PSA, 2026) reported that tourism consumed approximately 208.74 million cubic meters of water in 2025, with accommodation services accounting for 88.93 million cubic meters, or 42.6%. These figures demonstrate the importance of integrating water management into tourism planning. Philippine coastal tourism studies further emphasize the relationship between tourism development and environmental conditions. Tiu (2023) examined coastal environmental pressures in General Luna, while the Tourism Infrastructure and Enterprise Zone Authority (TIEZA, 2022) identified water and wastewater infrastructure concerns in Boracay. Department of Science and Technology–Philippine Council for Industry, Energy and Emerging Technology Research and Development (2019) documented wastewater-management initiatives in Siargao, demonstrating the relevance of technological interventions to environmental protection. Additional studies emphasized integrated coastal management, stakeholder participation, and groundwater conservation (Musico and Pelmin (2025); Calderon et al. (2025)). These perspectives reinforce the importance of managing tourism-related water demand without compromising community access and ecological sustainability.

The study is guided by three complementary perspectives: sustainable tourism development, environmental carrying capacity, and community-based tourism. Sustainable tourism development emphasizes balancing visitor needs, community welfare, and protection of limited natural resources, including freshwater (United Nations World Tourism Organization, 2021; Hadinejad et al., 2022). The carrying-capacity perspective considers whether tourism demand remains compatible with environmental and infrastructure resources, including water supply and wastewater services (Howard et al., 2022; Calderon et al., 2025). Community-based tourism emphasizes local participation and shared responsibility for resource planning and destination management (Roxas et al., 2023; Musico & Pelmin, 2025). These perspectives are integrated through an Input–Process–Output framework connecting tourists' demographic characteristics, perceived water-supply conditions, tourism experiences, and proposed recommendations.

Despite extensive research on tourism water consumption, environmental quality, wastewater management, and visitor satisfaction, limited destination-specific evidence examines how tourists perceive water-supply conditions and their relationship with tourism experiences in Del Carmen, Surigao del Norte. Existing Philippine studies

have primarily addressed environmental management, coastal-resource protection, and tourism infrastructure rather than directly examining tourists' assessments of water availability and service adequacy. Del Carmen, a developing coastal tourism municipality in Siargao Island, provides a relevant setting because its accommodations, tourism establishments, and nature-based attractions depend on reliable water services. This study therefore aims to assess the current status of water supply in terms of frequency, duration, and safety and clearness; examine its perceived impact on access to clean drinking water, participation in planned tourism activities, accommodation comfort and overall quality of stay, and length of stay at tourism sites; and determine whether a significant correlation exists between water-supply conditions and tourists' experiences. It also considers existing mitigation strategies and recommendations for improving water-related tourism services. By emphasizing tourists' perceptions rather than technical measurements of water quality, the study addresses a localized research gap while providing information relevant to tourism management and water-service planning.

The study aligns with Sustainable Development Goal 6 (Clean Water and Sanitation) through its focus on water availability, perceived quality, and responsible resource management; SDG 8 (Decent Work and Economic Growth) through the sustainability of tourism services; SDG 11 (Sustainable Cities and Communities) through resilient tourism infrastructure and community resource management; SDG 12 (Responsible Consumption and Production) through efficient water use and conservation; and SDG 17 (Partnerships for the Goals) through coordination among local government units, tourism establishments, communities, and environmental agencies. Its multidisciplinary sustainability contribution lies in connecting water-resource management, tourism service quality, public well-being, environmental protection, and local governance. By examining tourists' experiences alongside water-supply conditions, the study may provide evidence to guide infrastructure improvements, responsible water consumption, community participation, and sustainable tourism planning in Del Carmen, Surigao del Norte.

## 2. Material and methods

### 2.1 Research Design

The study utilized a convergent parallel mixed-methods design integrating descriptive-correlational and narrative approaches. The quantitative component assessed water supply conditions in terms of frequency, duration, and safety and clearness, and their perceived impact on access to clean drinking water, participation in planned tourism activities, accommodation comfort and overall quality of stay, and length of stay at tourism sites. It also determined the statistical relationship between water supply conditions and tourist experience without establishing causality. The qualitative component documented the experiences of tourism stakeholders and local government personnel regarding water scarcity, mitigation strategies, and management challenges. Both datasets were analyzed separately and integrated during interpretation to provide complementary statistical and contextual findings.

### 2.2 Locale of the Study

The study was conducted in Del Carmen, a coastal municipality on the western side of Siargao Island, Surigao del Norte, Caraga Region, Philippines. Located approximately 33 nautical miles from Surigao City, the municipality covers about 20,189 hectares and is bounded by San Benito, Pilar, Hinatuan Passage, Dapa, and Bucas Grande. Del Carmen is characterized by coastal communities, small islands, extensive mangrove forests, and marine resources. Its major ecotourism attractions include Sugba Lagoon, Del Carmen Mangrove Forest, Hali-an White Sand, Sugba Oval, and San Jose Cave. The municipality's geographical setting and dependence on water services for accommodation, sanitation, and recreational activities make it an appropriate location for examining water supply conditions and tourist experience.

### 2.3 Respondents of the Study

The quantitative component involved 200 domestic and international tourists who had firsthand experience with tourism facilities, accommodations, services, or attractions in Del Carmen. Of these respondents, 105 (52.50%) were female, 91 (45.50%) were male, and four (2.00%) preferred not to disclose their sex. The qualitative component included 20 key informants comprising five local government and tourism officers (25.00%) and 15 tourism establishment owners (75.00%). These participants possessed relevant knowledge or experience in tourism operations, water resource management, and mitigation practices. Both groups provided complementary information on tourists' perceptions and existing responses to water-related challenges.

### 2.4 Sample and Sampling Procedure

Criterion sampling was employed to select 200 tourist respondents who were at least 18 years old, had visited Del Carmen during the designated data-collection period, had personally experienced tourism-related facilities or services, and could provide informed assessments of water supply conditions. Participation was voluntary and required informed consent, while official tourism registration was not required. Individuals who failed to meet these criteria or submitted substantially incomplete questionnaires were excluded. For the qualitative component,

20 key informants were purposively selected based on their direct involvement or relevant knowledge of tourism operations, water supply management, and existing mitigation strategies.

### 2.5 Research Instrument

The study utilized a researcher-made questionnaire and a semi-structured interview guide. The questionnaire contained 35 substantive items organized into three parts: respondents' demographic and tourism-related profiles; 15 items assessing water supply frequency, duration, and safety and clearness; and 20 items evaluating the perceived impact of water supply on drinking-water access, participation in planned activities, accommodation comfort and overall quality of stay, and length of stay at tourism sites. Safety and clearness measured perceived water quality rather than laboratory-confirmed potability. Responses were measured using a four-point Likert scale, with mean scores interpreted as Strongly Agree (3.26–4.00), Agree (2.51–3.25), Disagree (1.76–2.50), and Strongly Disagree (1.00–1.75). The semi-structured interview guide explored water-related challenges, mitigation strategies, management practices, and stakeholder experiences. Both instruments underwent expert validation, while the questionnaire was pilot-tested among individuals outside the actual sample. Necessary revisions were incorporated before administration, with internal consistency assessed where applicable.

### 2.6 Data Gathering Procedure

The researchers secured institutional authorization from the Siargao Island Institute of Technology and permission from the Municipal Government of Del Carmen before data collection. Following expert validation and questionnaire pilot testing, qualified tourists were approached at selected tourism sites, accommodation establishments, and related facilities. After obtaining informed consent, the questionnaire was administered to 200 respondents. Completed questionnaires were checked for completeness, coded, and encoded using Microsoft Excel. For the qualitative component, semi-structured interviews were conducted with 20 purposively selected tourism stakeholders and local government personnel. Participants described water supply challenges, existing mitigation strategies, and management practices. Follow-up questions clarified their responses. Quantitative and qualitative data were analyzed separately and integrated during interpretation. All research records were securely stored and handled confidentially.

### 2.7 Data Analysis Techniques

Frequency counts and percentages were used to describe respondents' demographic and tourism-related profiles, including age, sex, civil status, nationality, and frequency of visits. Means and standard deviations summarized perceptions of water supply conditions and their perceived impact on tourist experience. Pearson's Product-Moment Correlation Coefficient (Pearson's r) determined the direction, strength, and statistical significance of the relationship between the two quantitative variables at the 0.05 significance level. A p-value below 0.05 indicated a statistically significant correlation, while a p-value greater than 0.05 indicated insufficient evidence to reject the null hypothesis. Findings were interpreted as associations rather than causal relationships. Qualitative responses were analyzed thematically by identifying significant statements, recurring experiences, and common management practices. Similar responses were grouped into categories and broader themes representing existing water supply mitigation strategies. These findings provided contextual explanations that complemented the quantitative results.

### 2.8 Ethical Considerations

The study observed informed consent, voluntary participation, confidentiality, privacy, beneficence, and research integrity. Institutional and local government permissions were obtained before data collection. Participants were informed of their rights, including the freedom to decline questions or withdraw without penalty. Personal information was protected through confidential data handling and participant codes, while research records were securely stored. The researchers minimized potential risks and ensured accurate data collection, analysis, and reporting without fabrication, falsification, or manipulation.

## 3. Results and Discussion

### 3.1 Profile of the Respondents

#### 3.1.1 Demographic and Tourism-Related Characteristics

Among the 200 respondents, the largest groups were aged 18–25 years (29.5%), female (52.5%), single (52.0%), Filipino (68.5%), and first-time visitors (45.0%). Male respondents comprised 45.5%, while 2.0% preferred not to disclose their sex. These findings indicate that the study primarily reflects the experiences of domestic, younger, and first-time tourists. Their characteristics provide context for understanding perceptions of water availability and tourism services.

### 3.2 Status of Water Supply

#### 3.2.1 Frequency of Water Supply

Water supply frequency was rated satisfactory (M = 3.02, SD = 0.56). Regular availability received the highest rating (M = 3.07), while limited interruptions and sufficient supply frequency received the lowest ratings (M =

2.95). The findings indicate generally dependable water availability, although occasional interruptions remain a concern. Reliable supply supports accommodation, sanitation, and tourism activities, consistent with the importance of water-service continuity emphasized by the World Health Organization [WHO] (2020, 2024) and UN Tourism (2021).

#### 3.2.2 Duration of Water Supply

Water supply duration was satisfactory (M = 3.03, SD = 0.53). Availability for sufficient hours and reliability throughout most of the day received the highest ratings (M = 3.06), while adequacy for personal needs and activities received the lowest (M = 2.99). These findings suggest that water was generally available long enough to support tourists' daily needs. Maintaining service continuity remains essential, particularly during periods of increased demand (WHO, 2022, 2024).

#### 3.2.3 Safety and Clearness of Water Supply

Safety and clearness were rated satisfactory (M = 2.99, SD = 0.55). Clean and clear water appearance received the highest rating (M = 3.04), while meeting tourists' water-quality expectations received the lowest (M = 2.90). The findings indicate acceptable perceived water quality but suggest room for improvement. World Health Organization (2022) emphasized the influence of sensory characteristics on water-quality perceptions. However, perceived cleanliness does not establish drinking-water safety, which requires appropriate monitoring and testing (WHO, 2024).

#### 3.2.4 Overall Water Supply Status

Overall water supply conditions were satisfactory (M = 3.01, SD = 0.50). Duration ranked highest (M = 3.03), followed by frequency (M = 3.02) and safety and clearness (M = 2.99). These findings indicate generally acceptable water services, with safety and clearness requiring greater attention. Continuous monitoring and maintenance support sustainable tourism operations (WHO, 2024; UN Tourism, 2021; Philippine Statistics Authority, 2022).

### 3.3 Impact of Water Supply on Tourist Experience

#### 3.3.1 Access to Clean Drinking Water

Access to clean drinking water received a high positive impact rating (M = 3.02, SD = 0.54). Drinking-water availability when needed ranked highest (M = 3.05), while its contribution to overall tourist experience ranked lowest (M = 2.99). The findings suggest that accessible drinking water supports tourists' convenience and basic needs. Reliable availability and water-quality monitoring remain important for maintaining confidence in tourism services.

#### 3.3.2 Participation in Planned Tourism Activities

Water supply positively influenced participation in planned tourism activities (M = 3.04, SD = 0.57). The absence of water-related interruptions received the highest rating (M = 3.08), while convenient use of water-dependent facilities received the lowest (M = 3.01). These findings indicate that adequate water availability supports uninterrupted tourism activities. Hadinejad et al. (2022) emphasized water's importance as a tourism resource, reinforcing the need for dependable services.

#### 3.3.3 Comfort and Overall Quality of Accommodation

Water supply positively influenced accommodation comfort and quality (M = 2.98, SD = 0.55). Its contribution to accommodation quality ranked highest (M = 3.05), while its direct contribution to comfort ranked lowest (M = 2.92). The findings suggest that water availability supports accommodation services, hygiene, and convenience. Reliable water management remains essential for maintaining satisfactory visitor experiences.

#### 3.3.4 Length of Stay at Tourism Sites

Water supply positively influenced tourists' length of stay (M = 3.04, SD = 0.54). Willingness to explore additional sites received the highest rating (M = 3.10), while avoiding shortened visits due to water-related problems received the lowest (M = 3.00). These findings suggest that dependable water services support continued tourism participation and exploration. This is consistent with the importance of water availability in tourism operations (Howard et al., 2022; Hadinejad et al., 2022; UN Tourism, 2021).

#### 3.3.5 Overall Impact on Tourist Experience

Water supply had a high positive perceived impact on tourist experience (M = 3.02, SD = 0.50). Participation in activities and length of stay ranked highest (M = 3.04), followed by drinking-water access (M = 3.02) and accommodation comfort (M = 2.98). These findings indicate that water availability contributes to different aspects of tourist experience, particularly recreational participation. Reliable services remain important for sustainable tourism management (Hadinejad et al., 2022; UN Tourism, 2021).

### 3.4 Relationship Between Water Supply and Tourist Experience

Pearson correlation analysis revealed a very strong, statistically significant positive relationship between water supply status and its perceived impact on tourist experience ($r = 0.899$, $p < .001$). The null hypothesis was rejected at the 0.05 significance level. This indicates that favorable perceptions of water supply were strongly associated with favorable tourist experiences, although causation cannot be established. The finding supports the importance of water reliability, accessibility, and quality in tourism development (Calderon et al., 2025; WHO, 2023; Howard et al., 2022; Hadinejad et al., 2022).

### 3.5 Water Scarcity Mitigation Strategies

#### 3.5.1 Strengthening Water Supply Infrastructure

Participants identified improvements in water supply systems, storage, and distribution networks as important responses to recurring shortages. Infrastructure limitations and uneven distribution were among the concerns raised. These findings suggest that improving infrastructure can strengthen water reliability and accommodate increasing tourism demand.

#### 3.5.2 Protecting and Diversifying Water Sources

Participants emphasized watershed conservation, spring protection, forest preservation, and alternative water sources as strategies for sustaining water availability. These findings highlight the importance of environmental protection and diversified water sources in reducing vulnerability to shortages.

#### 3.5.3 Wastewater Treatment and Reuse

Participants identified wastewater treatment, pollution prevention, and appropriate water reuse as strategies for protecting coastal and marine environments. The findings suggest that wastewater management can complement freshwater conservation while reducing environmental risks associated with tourism activities.

#### 3.5.4 Water Conservation and Environmental Management

Participants emphasized responsible water consumption, tourist awareness, and conservation practices among tourism establishments, particularly during periods of limited supply. These findings indicate that conservation measures can reduce unnecessary water demand and support sustainable tourism operations.

#### 3.5.5 Collaborative Governance and Tourism Planning

Participants highlighted cooperation among local government units, tourism establishments, communities, and water-service providers in addressing water scarcity. These findings emphasize shared responsibility and coordinated planning. Roxas et al. (2023) similarly highlighted stakeholder participation as an important component of sustainable tourism governance.

### 3.6 Integration of Quantitative and Qualitative Findings

The quantitative findings revealed satisfactory water supply conditions ($M = 3.01$, $SD = 0.50$), a high positive perceived impact on tourist experience ($M = 3.02$, $SD = 0.50$), and a very strong positive correlation between the variables ($r = 0.899$, $p < .001$). Qualitative findings identified five mitigation strategies involving infrastructure, source protection, wastewater management, conservation, and collaborative governance. Together, these findings indicate that maintaining satisfactory tourist experiences requires reliable water services and sustainable resource management. Strengthening the identified mitigation strategies may help address water-related challenges while supporting tourism development (Hadinejad et al., 2022; Calderon et al., 2025; UN Tourism, 2021).

## 4. Conclusion & Recommendations

The study concluded that water supply in Del Carmen, Surigao del Norte, was generally satisfactory and positively associated with tourist experience. The respondents, predominantly young, single, Filipino, and first-time visitors, reported favorable water supply conditions in terms of frequency, duration, safety, and clearness. Among these dimensions, duration received the highest assessment, while safety and clearness received the lowest. Water supply also contributed positively to tourists' participation in planned activities, access to clean drinking water, accommodation comfort, and length of stay. A statistically significant, very strong positive correlation ($r = 0.899$, $p < .001$) indicated that favorable perceptions of water supply were strongly associated with favorable tourist experiences. Furthermore, tourism establishments and local authorities implemented water storage, conservation, monitoring, alternative water sources, and facility maintenance strategies. Overall, the findings highlight the importance of reliable water services and coordinated management in supporting sustainable tourism development.

The Local Government Unit of Del Carmen, in coordination with tourism establishments and water-service providers, should strengthen water supply monitoring, infrastructure maintenance, and contingency planning, particularly during periods of increased tourist demand. Priority should be given to improving water safety and clearness and ensuring reliable services in accommodation establishments. The proposed AQUA-CARE Del

Carmen Program (Aqua Quality, Availability, and Resilience Action for Tourist Experience) may be implemented to institutionalize regular water-quality monitoring, facility inspections, adequate storage, alternative water sources, and conservation practices. Tourism operators should establish procedures for managing temporary interruptions and informing visitors about service conditions. Environmental agencies and local communities should support water source protection, wastewater management, and responsible consumption. Regular coordination and evaluation should assess the effectiveness of existing mitigation strategies. Future researchers should examine actual water quality, seasonal supply variations, and water management practices across other tourism destinations.

The study was limited to 200 tourists and 20 purposively selected tourism stakeholders and local government personnel in Del Carmen, Surigao del Norte. Its quantitative findings were based on self-reported perceptions collected through a researcher-developed questionnaire rather than objective measurements of water supply conditions. Consequently, perceived water safety and clearness cannot establish actual compliance with drinking-water quality standards. The descriptive-correlational design also limits causal interpretation of the significant relationship between water supply and tourist experience. Furthermore, the findings are specific to the study setting and respondents. Future studies may incorporate laboratory water-quality testing, seasonal assessments, and broader samples from other tourism destinations.

## 5. Compliance with ethical standards

The authors affirm that no conflicts of interest exist in relation to this study. The research was conducted in accordance with accepted ethical principles for human-participant research, involving 200 tourist respondents and 20 tourism stakeholders and local government personnel in Del Carmen, Surigao del Norte, Philippines, with the necessary institutional and local permissions secured before data collection. Participation was voluntary, informed consent was obtained, and participants were informed of their right to decline questions or withdraw without penalty; data collection involved non-invasive questionnaires and semi-structured interviews. Privacy and confidentiality were maintained by limiting personally identifiable information, using participant codes for interview findings, securely storing research records, and restricting data access to authorized individuals.

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