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Community Perceptions of Non-Municipal Drinking Water Safety in the Blue and John Crow Mountains, Jamaica: Policy Gaps and Implications for Sustainable Development

Karlene Atkinson[1*], Abdallah Ahmed Adam Belal[2]
[1]*School of Public Health and Health Technology, University of Technology, Kingston, Jamaica*
[2]*Department of Public Health, College of Health Sciences, Saudi Electronic University, Riyadh, Saudi Arabia*

Abstract

This research explored community perceptions of non-municipal drinking water safety and quality in the Blue and John Crow Mountains, Jamaica, and examined policy gaps in water quality management. A census survey was conducted among fifty-six households in Bottom Dublin Castle and Pear Tree two rural localities that relies exclusively on entombed springs and tributaries domestic water use. The study aimed to assess residents' perceptions of the safety of these sources and to identify implications for public health and sustainable development. A total of 56 household interviews were included, targeting heads of households as respondents, data were collected using interviews with participants then rresponses were recorded on structured questionnaires and analysed quantitatively using descriptive statistics. The mains findings are widespread reliance on untreated water, with households expressing concerns about contamination, inconsistent supply, and inadequate government support. Although most households attempted disinfection, primarily through chlorine bleach, incorrect dosing and reliance on visual cues limited effectiveness. Reported illnesses, including gastrointestinal and dermatological conditions, highlighted epidemiological risks associated with unsafe practices. Perceptions of safety were mixed, with half of respondents believing their water was safe despite evidence of contamination risks. Policy awareness was low, with only 18% of respondents familiar with national water frameworks, underscoring governance gaps. Despite Jamaica's Water Resource Act 1995 and Water Sector Policy 2002, rural non-municipal supplies remain excluded from surveillance and regulation. According to the results the study provides baseline data for policymakers and stakeholders like emphasizing the need for intersectoral policies, improved monitoring, and community education, sstrengthening rural water governance is essential to reduce health risks, ensure equity in access, and align Jamaica's water management strategies with Sustainable Development Goal 6, which calls for universal access to safe and affordable drinking water by 2030.

Keywords: *Non-Municipal Potable, Water Governance, Water Insecurity.*

Introduction

Globally, water insecurity affects over 2.2 billion people, making it one of the most pressing public health and development challenges of the 21st century [1]. In Jamaica, despite the country's abundant freshwater resources, rural communities often lack access to safe municipal supplies due to uneven distribution, infrastructural limitations, and policy gaps [2]. The Blue and John Crow Mountains, spanning three parishes and

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****Corresponding Author: karleneatkinson77@gmail.com***

housing over 30,000 residents, rely heavily on non-municipal entombed springs and tributaries for domestic water use [3]. These sources, some dating back to pre-emancipation, have served generations without systematic cleaning, maintenance, or regulatory oversight.

Agricultural practices, including animal waste recycling, fertilizer application, and pit latrine disposal, contribute significantly to contamination risks in these catchments [4, 5]. Residents often attempt disinfection with chlorine bleach, but incorrect concentrations are widely used, reducing effectiveness and sometimes introducing secondary health risks [6]. While Jamaica has enacted the Water Resource Act 1995 and the Water Sector Policy 2002, these frameworks primarily address municipal supplies and overlook rural non-municipal systems [7, 8]. Surveillance systems remain inadequate, and rural water sources are frequently excluded from routine monitoring.

This policy neglect has serious implications. Untreated water is a vehicle for numerous pathogens and parasites known to transmit waterborne diseases, posing risks not only for food safety but also for individuals with chronic illnesses such as renal disease. Despite these risks, many residents perceive their sources as safe, reflecting a disconnect between lived experience and scientific evidence.

This study therefore investigates residents' perceptions of water safety in the Blue and John Crow Mountains and identifies policy gaps that hinder Jamaica's progress toward Sustainable Development Goal 6. By providing baseline data, the research aims to strengthen rural water governance, inform intersectoral collaboration, and highlight the urgent need for improved surveillance, community education, and equitable access to safe drinking water.

Materials and Methods

Study Design

A descriptive quantitative survey design was employed to assess community perceptions toward water safety and identify policy gaps in rural Jamaica. This design was chosen because it allows for systematic collection of numerical data on household practices, perceptions, and reported health outcomes, while also providing baseline information for policy analysis.

Study Duration

The study was conducted over a six-month period due the fact that a census approach was used to collect the data, all households in the localities that uses non municipal water was therefore included in the research.

Sampling and Participants

The study population consisted of households in parts of Dublin Castle community in particular Bottom Dublin Castle and Pear Tree locality within the Blue and John Crow Mountains. This site was selected because residents rely exclusively on non-municipal water sources, making it representative of rural water insecurity. A total of 56 household interviews were conducted, targeting heads of households as respondents. Inclusion criteria required that participants be permanent residents of the community and primary decision-makers regarding domestic water use. An interviewer administered questionnaire was used to collect the data. The instrument covered both quantitative and qualitative dimensions of water use and perceptions. Key areas included**:** perceptions of water safety and quality**, r**eported health effects linked to water consumption household practices for water collection, storage, and disinfection and awareness of government policies and interventions related to water safety and sanitation.

Data Collection Procedures

Interviews were conducted face-to-face by trained enumerators familiar with the community and cultural context. Each interview lasted 30–45 minutes. Responses were recorded on structured questionnaires and later digitized for analysis.

Data Analysis

Survey responses were coded and analysed quantitatively using descriptive statistics to identify trends in perceptions, practices, and reported health outcomes. Frequencies and percentages were calculated for categorical variables, while cross-tabulations were used to explore relationships between perceptions of water safety and reported health effects. Data were compared against national water quality standards and policy frameworks to identify gaps in governance and regulation.

Results

The survey captured responses from 56 households in Bottom Dublin Castle and Pear Tree, with an equal distribution of male and female participants. This gender balance ensured that perspectives from both men and women were represented. Men were more often identified as long-term residents, reflecting the dominance of farming as a male occupation in the Blue and John Crow Mountains.

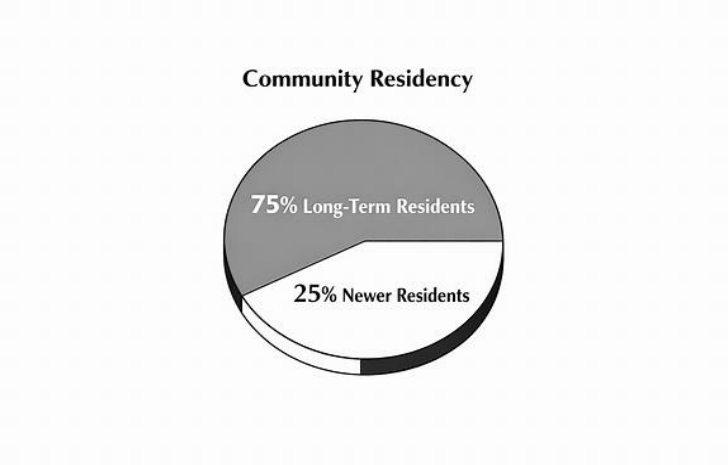

Figure 1. Tenure of Residency

Figure 1 shows that tenure in the community was notably high: 75% of respondents had lived there for more than 20 years, underscoring generational reliance on entombed springs and tributaries. The remaining 25% were newer residents, yet they too depended exclusively on non-municipal sources, highlighting the absence of viable alternatives regardless of length of stay. Long-term residents tended to express confidence in traditional sources, even while acknowledging contamination risks, whereas newer residents were more likely.

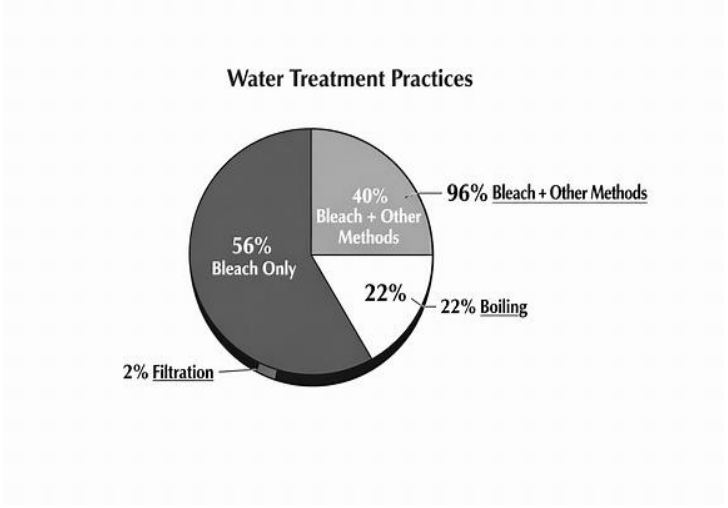

Figure 2. Water Treatment Practices

Figure 2 shows that water treatment practices were widespread but inconsistent. All households reported using some form of disinfection, with chlorine bleach being the most common method. Over half (56%) relied solely on bleach, while nearly all (96%) combined bleach with other practices. Filtration was rare (2%), and boiling, though globally common, was not dominant in this Jamaican sample.

Despite these efforts, epidemiological findings revealed that 14% of households experienced illnesses linked to water consumption, primarily gastrointestinal disorders such as diarrheal disease and dermatological conditions. Perceptions of safety correlated with health outcomes: households that expressed uncertainty or believed their water was unsafe were more likely to report illness. Conversely, those who believed their water was safe were less likely to report illness, though this confidence was not always supported by objective risk factors. Monitoring practices were informal. Nearly all households (96%) relied on organoleptic cues such as taste, smell, and appearance, with 70% equating visual clarity to safety. Only 4% reported testing water before use, and just 26% linked safety to microbial contamination. This reliance on visual cues contributed to epidemiological vulnerability, as pathogens cannot be detected by appearance alone.

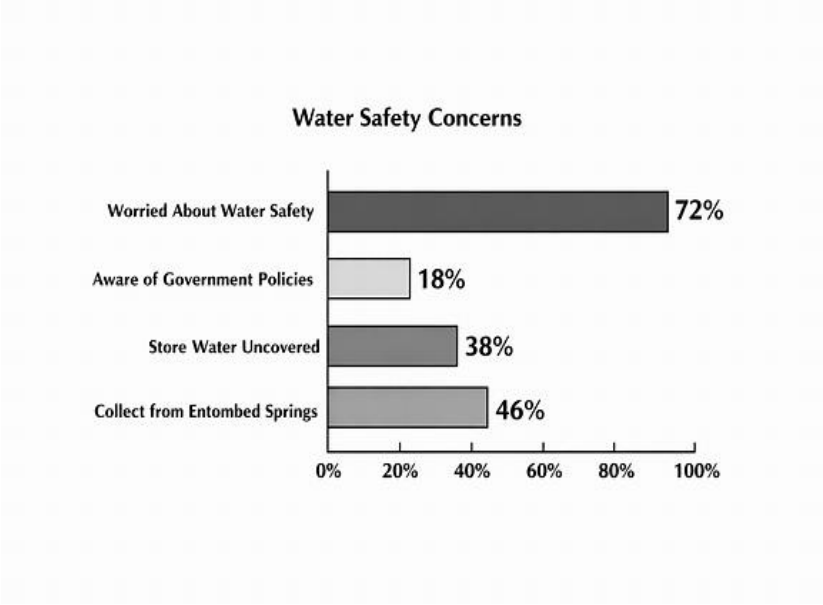

Figure 3. Water Safety Concerns

Figure 3 illustrates that concerns about water safety were widespread, with 72% of households expressing worry. However, reliance on non-municipal sources remained universal due to lack of alternatives. Awareness of government water policies was very low (18%), and none reported routine monitoring of their sources. Household practices further highlighted vulnerabilities these practices illustrate both resilience and risk, as households attempt to safeguard water quality without standardized guidance. Overall, the epidemiological profile of the community reflects low but significant levels of waterborne illness, underpinned by structural inequities in water governance and inadequate surveillance. The modest percentage of reported illness underestimates the true burden, given gaps in healthcare-seeking behaviour and the absence of systematic monitoring.

Discussion

The results of this study highlight how rural households in the Blue and John Crow Mountains navigate water safety with limited options, balancing awareness of risks against

structural constraints. Residents expressed concern about contamination, yet reliance on untreated sources remained universal, reflecting both cultural dependence on entombed springs and tributaries and the absence of viable alternatives [1, 2]. While awareness of contamination risks demonstrates a degree of health literacy, the continued reliance on unsafe sources underscores inequities in water distribution.

The widespread but incorrect use of chlorine bleach illustrates the gap between knowledge and effective practice. Although bleach is accessible and affordable, improper dosing and lack of standardized guidance reduce its effectiveness and may introduce secondary health risks [6-8]. Policy frameworks such as Jamaica's Water Resource Act 1995 and Water Sector Policy 2002 have not adequately addressed rural non-municipal supplies, which remain unregulated and excluded from routine monitoring [9, 10]. Only 18% of respondents reported awareness of government policies, and none reported direct engagement with regulatory agencies. This disconnect reflects a governance challenge where national frameworks prioritize municipal supplies, leaving rural communities outside the scope of surveillance and intervention. Inadequate maintenance of communal catchments, and lack of community-based monitoring systems further illustrate policy neglect [11, 15].

Several correlations emerged between household practices, perceptions, and health outcomes. Male respondents were more likely to be long-term residents, reflecting the dominance of farming as a male occupation in the Blue and John Crow Mountains. Despite 100% of households reporting some form of disinfection, 14% still experienced gastrointestinal or dermatological illnesses. Perceptions of safety also aligned with health outcomes: while 47% believed the water was safe, 53% expressed doubt, and illness reporting was more common among those uncertain about safety. Monitoring practices reinforced this pattern, as 96% relied on organoleptic cues, which cannot detect microbial contamination, leading to widespread uncertainty (68% unsure or believing water unsafe). These correlations demonstrate that while awareness of risk exists, reliance on unsafe practices and limited monitoring capacity perpetuate vulnerability to waterborne illness, underscoring the need for stronger community-based monitoring and standardized treatment guidance [12, 16, 19].

These findings have direct relevance to Jamaica's progress toward Sustainable Development Goal 6, which calls for universal access to safe water and improved water quality by 2030 [12, 18]. Without targeted interventions, rural communities will remain excluded from national progress indicators. Similar challenges have been documented across the Caribbean and Latin America, where more than 25% of the population lacks access to safe water and sanitation [2, 17]. Globally, rural populations are disproportionately affected by unsafe water due to environmental conditions, climate change, and infrastructural limitations [13, 14, 20]. These communities in the Blue and John Crow Mountains exemplify this global pattern, where abundant natural water sources coexist with unsafe practices and inadequate policy frameworks [3, 10, 15].

This study provides critical insight into the intersection of household practices, perceptions, and policy gaps shaping rural water insecurity in the Blue and John Crow Mountains. By documenting both the resilience of communities and the vulnerabilities created by reliance on untreated sources, the findings establish a clear evidence base for reform. The results emphasize that technical guidance, community-based monitoring, and inclusive governance are not optional but essential for safeguarding public health and achieving equity in water access. Positioned within Jamaica's broader development agenda, these outcomes underscore the urgency of integrating rural non-municipal supplies into national water

strategies to ensure meaningful progress toward Sustainable Development Goal 6.

Conclusion

The study underscores the persistent vulnerabilities faced by rural communities in Jamaica, where perceptions of water safety are shaped by lived experiences, yet constrained by structural inequities in access and governance. The reliance on untreated sources, despite awareness of contamination risks, reflects both cultural dependence and the absence of viable alternatives. The reported burden of gastrointestinal and dermatological illnesses, though modest in percentage, signals a deeper epidemiological challenge that is underreported due to gaps in surveillance and healthcare-seeking behaviour.

These findings highlight the urgent need to bridge the gap between household-level practices and national policy frameworks. While residents demonstrate health literacy and attempt disinfection methods, the widespread misuse of chlorine bleach illustrates how awareness without technical guidance can perpetuate risk. The absence of community-based monitoring systems and the exclusion of non-municipal supplies from regulatory oversight further compound these vulnerabilities, leaving rural populations outside the scope of Jamaica's water safety agenda.

At a global level, the study situates Jamaica's rural water challenges within a broader pattern of inequity, where marginalized populations remain disproportionately exposed to unsafe water due to climate variability, infrastructural neglect, and policy blind spots. Without targeted interventions, these communities will continue to be excluded from national progress toward Sustainable Development Goal 6, undermining Jamaica's ability to demonstrate universal access to safe water by 2030.

The conclusion therefore calls for a multi-pronged response: strengthening community-based monitoring, standardizing household treatment practices, integrating intersectoral collaboration across health, environment, and agriculture, and expanding policy frameworks to explicitly regulate rural non-municipal supplies. By addressing these gaps, Jamaica can not only reduce the burden of waterborne illness but also advance equity in water governance, ensuring that rural communities are included in national and global progress indicators. Ultimately, safe water is not only a matter of public health but also of social justice, resilience, and sustainable development.

Recommendations

Based on findings of this study to effectively address the identified challenges relating to non-municipal water insecurity and water safety the Ministry of Health and Wellness, the Water Resources Authority, and other stakeholders should implement coordinated actions at three levels as listed below:

1. **Household Level**
    - Provide clear dosing guidelines for chlorine bleach use in water disinfection to prevent misuse and minimize public health risks.
    - Promote boiling and filtration as complementary or alternative treatment methods for water disinfection.
    - Expand community education campaigns to strengthen health literacy and correct misconceptions about water safety.
2. **Community Level**
    - Establish community-based monitoring systems using water testing kits.
    - Encourage the establishment of community water monitoring committees and train committee members to conduct routine surveillance of water sources and report contamination risks.
    - Install signage at communal catchments to warn residents of contamination.

- Raise seasonal risk awareness, highlighting increased contamination during dry months (pollutant concentration) and rainy seasons (runoff).

3. **Policy and Governance**

- Review Jamaica's Water Resource Act 1995 and Water Sector Policy 2002 to regulate non-municipal rural supplies.
- Integrate health, environment, and agriculture agencies to address contamination from farming runoff and pit latrines.
- Include rural communities in national water quality monitoring frameworks to ensure they are counted in SDG 6 progress indicators.
- Allocate resources for maintenance of communal catchments and infrastructure upgrades in rural areas.
- Develop climate adaptation strategies for rural water systems, including catchment protection and drought resilience planning.
- Establish monitoring programs for rural water sources, including entombments and communal catchments.
- Promote safe disinfection practices and awareness of contamination risks.
- Support maintenance of entombed springs and improve sanitation facilities to reduce contamination.
- Engage health, environment, and agriculture agencies in rural water governance.

Conflict of Interest

The authors declare no conflict of interest.

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Ethical Approval

Ethical approval was obtained from the relevant institutional review board. Informed consent was secured from all participants prior to interviews.

Data Availability

The datasets generated and analysed during this study are available from the corresponding author upon reasonable request.

Artificial Intelligence Use

Artificial intelligence tools were used to support the preparation of this manuscript, specifically for language refinement and formatting assistance. No AI systems were involved in data collection, analysis, or interpretation of results. The author reviewed and verified all AI-assisted outputs to ensure accuracy, integrity, and compliance with ethical standards for academic writing.

Author Contributions

- **Dr. Karlene Atkinson Conceptualization**: Lead researcher.
- **Abdallah Ahmed Adam Belal-** Researcher.

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