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Social Inequality and Access to Safe Water: Environmental Justice in Low-Resource Communities

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Abstract

Providing access to safe drinking water is an important environmental justice issue in low-resource communities. Social inequality, weak infrastructure, poverty, lack of formal housing, and limited political representational work together to create unequal exposures to unsafe water. This literature review aims to demonstrate the potential benefits of safe-water access through the lens of environmental justice, highlighting how various factors cause water insecurity and its invisible impacts. Unsafe water can cause infectious diseases, child morbidity, lower educational levels, loss of production, psychosocial stress and reinforcement of the cycle of poverty. The review stresses that inequality in water is an issue of rights, participation, affordability, accountability, and community empowerment, rather just a technical or infrastructure issue. Research from poorer countries suggests that disadvantaged households typically draw water from a dirty or unsafe source, and may not be able to treat or seek alternative supply. To respond effectively we require fair policy reform, participatory governance, community monitoring, better data disaggregation, and prioritization of the vulnerable. To achieve sustainable development, social justice, and upheld public health, the safe-water inequality must be addressed.

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Introduction

Access to safe drinking water is indispensable for individuals, public health, and community vitality (1). Many low-resource communities continue to experience chronic exposure to unsafe water, jeopardizing health and well-being (2). Unsafe water contributes to a staggering 2.2 million annual deaths from diarrhea-related diseases, exacerbates malnutrition for more than 800 million individuals, and inflicts major detriments to productivity and educational attainment, particularly among children (3). Risks differ across communities, influenced by factors such as climate, infrastructure, ecology, finance, geography, history, inequity, policy, poverty, regulation, subsidy, and treatment (4). This inquiry adopts an environmental justice lens to investigate the enduring challenges and prospects of safe drinking water access in low-resource communities (5). The investigation centers on questions that encompass the intertwined biophysical and societal determinants of access to safe water (6). The analysis reveals striking inequalities across wealth groups, gender, whether communities are rural or urban, the source of housing tenure, and the formal or informal nature of tenure, with occupied informal tenure communities experiencing the most severe deficiencies (7). Addressing these challenges requires a shared commitment to water as a right and empowerment of water-deficient communities to secure adequate treatment (8).

Conceptual Framework

Access to safe drinking water is a global concern that has long been recognized as critical for public health and well-being (9). The increasing urbanization of low-resource communities, often founded by excluded people who could not settle elsewhere, has historically occurred where the water supply is already limited and the infrastructure weak (10). Many such communities have informal, unplanned, or absent water supplies and related services (11). Staggering information and urgent questions arise in low-resource communities about the status of access to a safe supply of drinking water (12). People with secure and secure jobs can face issues about and sometimes lack access to a safe supply of drinking water (13). What is the accessibility to safe drinking water in the low-resource community? What elements affect the accessibility? (14). Taking a low-resource community, the construction of a conceptual model is developed taking into account environmental justice (15, 16).

Historical and Structural Drivers of Water Inequality

Inequitable access to water is neither a recent development nor one restricted to particular countries; colonial legacies, industrialization processes and wastewater treatment models—intertwined with multiple social vulnerabilities—have historically influenced access (17). Macro-factors determine where and when networks of supply can be developed, and public policies underpin water access governance (18). In addition to past patterns, historical socio-economic gradients remain in most post-colonial countries (19). In several contexts featuring infrastructure deeper than available checks and balances, utilities lack incentives to invest in low-resource residential connections (20). Macroeconomic instability encourages public investment in higher-income housing to recover water-system returns rapidly, while further development for lower-income residents, hampered by unpaid bills and economic stagnation effects, may be stalled even after a formal connection exists (21). Access persists unequally across socio-economic segments: among several monitored cities, ten upper-quartile consumers draw more than twenty times the median supply, while some lower-quartile residents in multiple post-colonial settings are fully disconnected (22, 23) (table 1).

Table 1. Multilevel determinants of inequitable access to safe drinking water in low-resource communities.

Level	Key determinants	Mechanism of inequality	Suggested indicators
Historical and structural	Colonial legacies, uneven urban development, settlement marginalization, informal tenure.	Creates long-term spatial exclusion and delays infrastructure investment.	Settlement type; tenure status; historical service coverage; distance from formal networks.
Economic	Poverty, inability to pay connection fees, high household water costs, unstable income.	Limits affordability of piped water, filters, bottled water, or household treatment.	Water expenditure as % of income; unpaid bills; coping costs; affordability thresholds.
Infrastructure and service delivery	Weak distribution networks, intermittent supply, pipe leakage, inadequate treatment.	Increases reliance on unsafe or irregular sources and reduces reliability.	Hours of supply/day; microbiological contamination; residual chlorine; pipe breaks; storage practices.
Governance and regulation	Limited accountability, weak enforcement, poor representation, insufficient monitoring.	Marginalized communities become less visible in service planning and regulatory action.	Complaints resolved; monitoring frequency; public reporting; inclusion in planning committees.
Social vulnerability	Gendered water collection, child dependency, disability, migration, low literacy, social exclusion.	Unequal burden of time, stress, disease risk, and reduced access to information.	Collection time; caregiver burden; school absenteeism; disability-sensitive access; language access.
Environmental and climate	Drought, floods, salinity intrusion, contamination, seasonal scarcity.	Amplifies scarcity and contamination risks in places already lacking resilience.	Seasonal source reliability; flood exposure; drought frequency; contamination after extreme events.

Note. This table is a synthesis of the manuscript sections on conceptual framework, structural drivers, governance, and research gaps.

Health and Socioeconomic Impacts of Unsafe Water

Unsafe water access causes direct and indirect health and socioeconomic impacts that reinforce and exacerbate inequalities in low-resource communities, thereby limiting their ability to escape poverty and advance towards broader wellbeing objectives (24). Water is a key livelihood necessity that shapes health, productivity, education, and, consequently, poverty throughout life (25). Limited access to safe water aggravates the risk of diseases such as cholera, typhoid, and hepatitis A, leading to high morbidity and child mortality rates, and hindering child development and educational performance (26). Hazard exposure, especially when combined with other shocks, diverts scarce resources away from preventive investments and enables the emergence of pernicious cycles that further entrench material disadvantage and vulnerability (27, 28). Poor governance interacting

with civil-society suppression aggravates status recognition and representation inequalities that compound the harmful effects of unsafe water through diminished access to publicly provided enriching services (29) (figure 1).

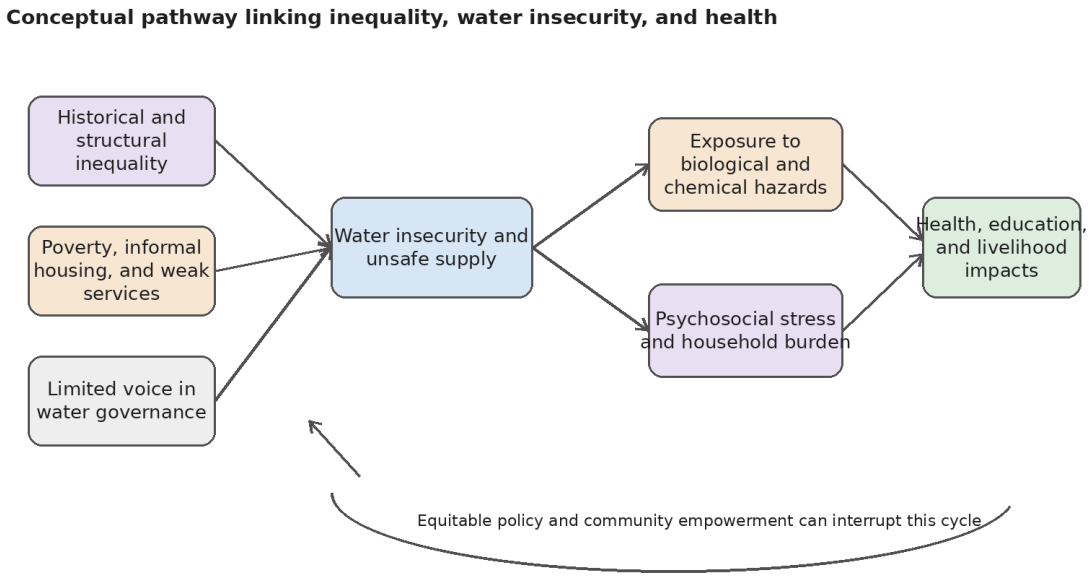

Figure 1: Conceptual pathway linking social inequality, water insecurity, unsafe exposure, psychosocial burden, and health-related outcomes.

Even low levels of pollution can deter investments and business activity, shifting focus towards simpler, low-value-adding activities and precluding entry into more profitable and productive ventures (30). Evaluation frameworks and procedures centred on universal wellbeing objectives provide the most comprehensive basis for guiding policy measures (31, 32). Water pollution hazards are pervasive yet highly heterogeneous in both exposure and consequence, requiring context-sensitive contextualisation of normative principles grounded either in individual or community attainment of common objectives (34). Indicators must clarify governance requirements and enable conditionality to mitigate adverse externalities (35) (table 2).

Table 2: Health, psychological, and socioeconomic consequences of unsafe or unreliable water access**.**

Domain	Main consequences	Likely pathway	Equity relevance
Infectious disease	Diarrheal disease, cholera, typhoid, hepatitis A, parasitic infections.	Microbial contamination, poor sanitation, unsafe storage, inadequate hygiene.	Burden is highest where treatment, sanitation, and clinical access are weakest.
Child health and development	Malnutrition, impaired growth, missed school, reduced learning performance.	Repeated infection, dehydration, caregiver time loss, school absenteeism.	Children in low-resource households experience cumulative developmental disadvantage.
Mental and psychosocial health	Stress, anxiety, reduced sense of safety, household conflict, loss of dignity.	Uncertainty of supply, fear of contamination, time pressure, financial strain.	Psychological harms are often invisible in standard water-service metrics.
Gender and household labor	Long collection time, caregiver burden, reduced work or education time.	Women and girls often manage water collection,	Water inequality becomes a gendered and

		storage, and household hygiene.	intergenerational form of social burden.
Economic productivity	Lost workdays, reduced business activity, medical expenses, low-value livelihood choices.	Illness, poor reliability, high coping costs, and pollution-related investment deterrence.	Unsafe water reinforces poverty cycles and lowers community resilience.
Public trust and governance	Distrust in utilities, low participation, community frustration, weak compliance.	Unresolved complaints, poor transparency, and repeated service failure.	Trust is essential for water safety planning, monitoring, and policy uptake.

Note. The categories combine biomedical, psychological, household, and governance consequences emphasized throughout the review.

Environmental Justice and Policy Responses

Water affects every aspect of health and well-being, including physical and mental health, and promotes healthy child development, educational attainment, productivity, and income generation (36). However, 884 million people worldwide lack access to safe water (37). Approximately 2 billion people rely on contaminated drinking-water sources (38). Surveys in Bhutan, Cambodia, and Nepal found that inadequate access to safe drinking water constitutes a serious problem for the majority of the populations (39, 40). The evidence indicates that the risk is strongly associated with socioeconomic status (41, 42). Low-income households are more likely to rely on contaminated sources of drinking water and to be unable to afford water treatment technologies, alternative sources, or bottled water (43-46) (figure 2, table 3).

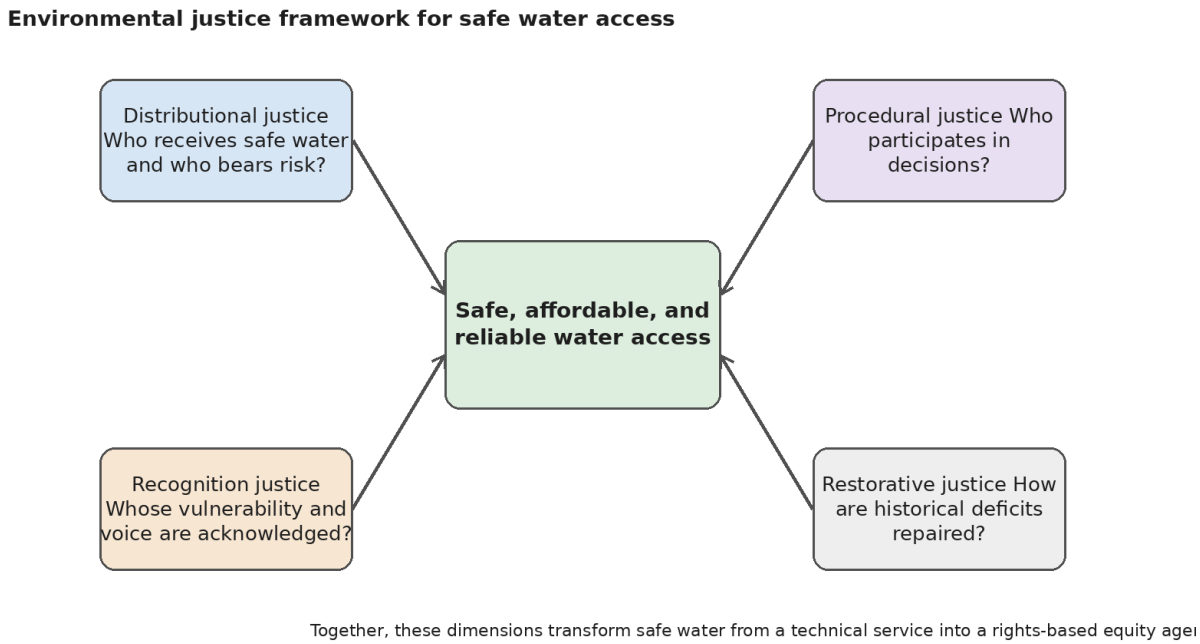

Figure 2: Environmental justice framework for interpreting safe-water access as a distributional, procedural, recognition-based, and restorative justice issue.

Table 3. Environmental justice dimensions and corresponding water-policy responses.

Justice dimension	Meaning in safe-water access	Policy or practice response	Expected contribution
Distributional justice	Fair allocation of safe, affordable, and reliable water services.	Prioritize underserved neighborhoods in infrastructure extension, repair, and treatment.	Reduces unequal exposure to unsafe water and narrows service gaps.
Procedural justice	Meaningful community participation in decisions affecting water services.	Create community water committees, public hearings, feedback channels, and transparent reporting.	Improves legitimacy, trust, and alignment of interventions with local needs.
Recognition justice	Acknowledgment of different vulnerabilities and lived experiences.	Disaggregate data by income, gender, tenure, disability, age, and location.	Makes hidden burdens visible and supports targeted policy action.
Restorative justice	Repair of accumulated historical and structural disadvantages.	Subsidies, compensation mechanisms, emergency supply, debt relief, and long-term investment.	Addresses inherited deficits rather than only treating immediate technical failures.
Intergenerational justice	Protection of children and future communities from water-related harm.	School WASH programs, climate-resilient water planning, and child-sensitive surveillance.	Reduces long-term developmental and educational consequences.

Note. These dimensions can be used as organizing principles in the discussion and recommendations sections

Disproportionate risks from unsafe drinking water tend to undermine social progress across a wide range of economic, developmental, and health priorities (47). The people without safe water access face a higher disease burden; greater in employment and productivity, education, and child development; and an escalated stress burden (48). Each of these further impoverishes already poor households, creating a diffusion effect through the system (49). When governments are involved at all, there is a widespread tendency to neglect communities with limited political and economic resources (50). Water plays a crucial role in enabling progress toward many other social goals, while lack of water often traps low-resource communities in chronic disadvantage (51).

Community Empowerment and Local Solutions

Participatory governance and co-management, combined with community-led water safety planning, monitoring, and capacity-building, foster trust-building and invigorate local solutions (52). Efforts to facilitate participatory governance, co-management, and ownership through Community-Led Total Sanitation (CLTS) and similar initiatives are ongoing in a variety of contexts (53). In some regions supportive legislation exists to empower communities to take the lead in water service provision (54). However, the effects of policies intended to empower communities do not always align with expectations; frequently, top-down governance structures remain and community input is restricted or disallowed entirely (55). Past experiences indicate that rapid unanticipated changes to established governance structures—such as rapid privatisation or the disbandment of an existing authority and the takeover of community-led approaches without empowerment of the community—can have disruptive and negative consequences (56, 57) (figure 3).

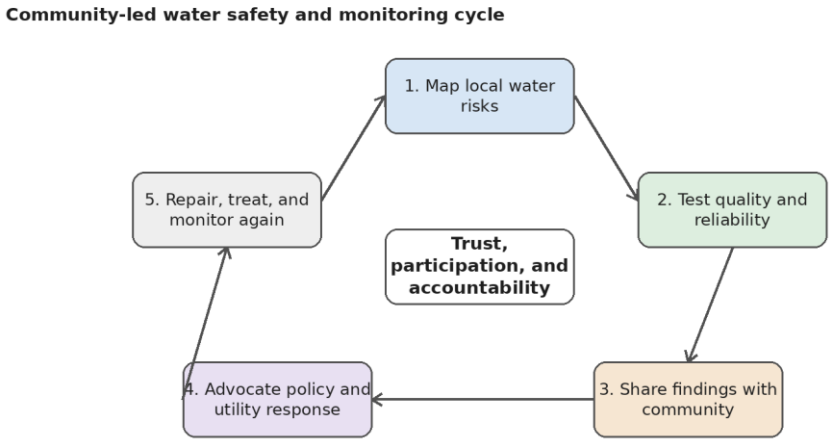

Figure 3: Community-led water safety and monitoring cycle emphasizing local risk mapping, testing, communication, policy response, and continuous follow-up

Case Studies: Illustrative Contexts of Low-Resource Communities

Although safe drinking water is fundamental to health and well-being, low-resource communities across the globe frequently lack affordable access to a sufficient quantity of water that is free from harmful contaminants (3). The problem affects vulnerable populations in both developing and industrialized countries, similar socio-economic and political conditions perpetuating inequalities in water security (6). Households in low-resource areas may obtain their water from unprotected wells, rivers, or other unsafe sources if piped connections are unavailable (8). As urbanization accelerates, peri-urban low-resource communities and informal settlements face the challenge of extended water distribution networks (58). Where access continues to fall below recommended standards, poor water quality due to inadequate treatment, contamination, or pipe leaks—often compounded by ineffective governance—undermines the effectiveness of supply improvements (59). Contaminated sources become attractive alternative supply options, and reliance on unsafe water increases in the face of rising costs (60).

By documenting a range of contexts across countries with dissimilar histories, geographies, and degrees of economic development, the case studies illustrate how structural factors, national development priorities, and an insufficiently explicit water security agenda subordinate low-resource community, regardless of political system (6). Clear access data remain scant. In buildings with piped water, high coverage can mask spatial inequities; sizeable minority groups in low-resource neighborhoods may depend on unsafe sources (61). The relative lack of disaggregation according to gender, ethnicity, or economic status further impedes identification of vulnerable sub-groups precisely, although broader regional inequalities can be discerned (62). Specifying these complementary dimensions of access remains crucial for building a comprehensive understanding of the safe-water challenge in low-resource communities, guiding the development of effective policy responses (63). Although partial information enables some inferences, improving the availability, comparability, and methodological rigour of related datasets constitutes an important priority for future research (64).

Measurement, Data, and Research Gaps

Access to safe drinking water remains a pressing public health issue for large swathes of the population across numerous low-resource communities (65). Literature in the field notes that safe is defined as access to drinking water that is free from microbiological,

chemical, and radiological contamination that threatens human health (66). This research addresses the questions of how inequality in access to safe drinking water affects health and socioeconomic outcomes and how these inequalities can be mitigated (43). A wealth of evidence establishes the importance of water, sanitation, health and hygiene for efficiency, productivity and economic growth and development (67). Safe, affordable and reliable access to safe drinking water is therefore necessary to empower marginalized and vulnerable individuals, communities and populations toward the goal of closing the inequality gap (68). Research across the field of environmental justice indicates that in large part these inequalities are inherited through structures, patterns, legacies and socio-political systems that favour certain individuals and communities at the expense of others (65). These factors build historical layers of inequity which are at odds with efforts and campaigns toward progress and change (69).

Water security is increasingly recognized as a requisite for human health, prosperity and well-being (70). Access to safe, affordable and reliable drinking water thus emerges as a global priority (71). Differential access to safe water is a widely acknowledged facet of inequality, and the concept of environmental justice serves to interrogate normative questions about the fairness of rights, access, governance, decision-making, and participation relative to the distribution of hazards and benefits (72, 73).

Governance refers to institutional arrangements for the development, implementation, and enforcement of rules, regulations, and decisions affecting the natural and built environment, including the distribution of formal or informal authority, power, influence, accountability, legitimacy, participation, and access to information; it shapes and constrains agency and the efficacy of vulnerability-reduction measures (74-77) (table 4).

Table 4: Recommended indicators for future research and monitoring of safe-water inequality.

Measurement area	**Core indicators**	**Possible data source**	**Equity disaggregation**
Access and reliability	Source type, distance, collection time, hours of supply, seasonal interruption.	Household surveys, utility records, community mapping.	Income, settlement type, rural/urban status, tenure, gender.
Water quality and safety	E. coli or thermotolerant coliforms, residual chlorine, turbidity, salinity, heavy metals where relevant.	Field testing, laboratory reports, public health monitoring.	Neighborhood, source type, school/household, informal settlements.
Affordability	Connection fee, monthly tariff, coping costs, bottled water spending, treatment cost.	Household expenditure surveys, utility billing data.	Income quintile, household size, employment status.
Health outcomes	Diarrhea, dehydration, skin infections, hepatitis A, school absenteeism, child growth indicators.	Clinic records, school records, caregiver surveys.	Age, sex, disability, locality, socioeconomic group.
Psychosocial burden	Water-related worry, perceived safety, household conflict, dignity, time stress.	Validated survey scales, interviews, focus groups.	Gender, caregiver status, household role, migration status.
Governance and participation	Complaint resolution, community representation, information access, meeting attendance.	Municipal records, utility feedback systems, participatory appraisal.	Neighborhood, language, literacy, civil-society participation.

Note. Disaggregated indicators are essential because overall coverage rates may hide severe inequality within specific communities.

Recommendations for Policy and Practice

People living in low-resource communities face significant obstacles in accessing safe water (78). This section recommends actionable steps for policymakers, utilities, and practitioners seeking to improve water access and safety in an equitable manner (79). Prioritizing access to safe water among marginalized and disadvantaged communities is crucial to ensure fairness in water management reforms (80). Certain interventions that promote affordable and safe access to water have proven effective in improving the situation in low-resource communities and can be scaled up to other contexts (81, 82). Disparities in safe-water access are generated through various social, political, economic, and infrastructural arrangements and are further compounded by the ongoing pandemic (83). Despite governmental efforts to increase water service provision, access remains unequal among diverse communities and population groups (84). Scalable models that explicitly target greater equity in water management have the potential to address these inequalities effectively (85, 86).

Ethical Considerations in Environmental Justice

There exist ethical obligations regarding data collection, consent, and stakeholder engagement for environmental justice research (87). Researchers must ensure that community representatives consent to the research process (88). They should avoid exploiting the community's suffering for personal gain or to further their own careers (89). Investigators should prioritize rigourous understanding of the issues faced and ensure that the views expressed align with the voices of the water- communities themselves rather than representing their own perspectives (90). Procedural and deliberative perspectives of environmental justice often emphasize the importance of affected communities being allowed to voice their own views and concerns within water and environmental decisions that could affect them (91).

Conclusion

Environmental justice highlights the fundamental human right to access safe water protected from human health risks, yet inequities persist in developing countries. Water-related infections kill approximately 800 children daily 1 while nineteen percent of the population remains unserved by improved drinking-water sources (92). The situation in low-resource communities matches social inequality determinants established in the contemporary context of COVID-19. Without sufficiently improved access to water for drinking and sanitation, efforts to address water-related infections fail. Access indicates the presence of at least basic water supply. Water supply must also occur through the use of safely managed exerted at household level, meaning that water from an improved source remains free from faecal or other contamination.

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