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Water Insecurity and Rights Erosion: A Comprehensive Analysis of Rohingya Refugee Camps in New Delhi

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Abstract: This study presents a comprehensive analysis of the critical issue of water insecurity and its multifaceted impact on and relationship to the human rights and environmental justice conditions within Rohingya refugee camps located in New Delhi, India. A comprehensive mixed-methods approach was employed to investigate water-related challenges within a refugee camp in Madanpur Khadar, region in Delhi. Qualitative methods including focused group discussions and one-on-one household interviews were conducted to allow residents' perceptions from diverse groups and examine their experiences. Structured surveys were administered to gather quantitative data on water access, sanitation, health, and socio-economic factors. Additionally,, literature surveys and document archival research provided contextual insights. This study underscores the pressing water, sanitation, and hygiene (WaSH) challenges faced by Rohingya refugees in the area, revealing irregular water supply, impacting residents' daily lives and hygiene practices. The majority of families in the camp, with an average of 6 members in each family, can only collect 30–40 L of water to meet all their needs, from consumption to personal hygiene, which is significantly insufficient. This situation has resulted in severe health consequences for the camp residents. Alarmingly, over 90% of the female respondents reported experiencing issues such as urinary infections. This paper gives a comprehensive analysis of the multidimensionality of rights that intersect with and are affected by WaSH issues. The poor WaSH conditions in the camp directly hinder the fulfillment of fundamental human rights. It not only disrupts the basic sanitation need but has negative economic repercussions and causes mental distress. This study concludes by targeted recommendations aimed at improving the conditions prevailing within the camp.

Keywords: Rohingya refugees; water access; environmental justice; human rights violations; New Delhi refugee camps

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1. Introduction

Water resource availability is fundamentally intertwined with human society, serving as the foundation for human existence. However, the accessibility of water is not solely determined by its geographical presence in a region but is also shaped by complex factors such as geo-physical, socio-economic, and political considerations. In many instances, the burden of water-related challenges falls disproportionately on marginalized communities, who often find themselves socially and economically excluded within their regions [1,2].

Extensive literature has highlighted the connection between access to clean water and sanitation and marginalized communities across the globe, with a particular focus on Southeast Asia [3] and Sub-Saharan Africa [4]. The concept of water, sanitation, and

hygiene (WaSH) has emerged as a crucial framework underpinning the right to water, encompassing not only the availability and accessibility of safe drinking water but also the maintenance of proper sanitation facilities and the promotion of hygienic practices, as recognized by international human rights frameworks [5,6].

While the right to water explicitly pertains to the access to safe, adequate, and affordable water for personal consumption and domestic use [7], it is complemented by the right to WaSH, which encompasses safe water, appropriate sanitation, and effective hygiene behaviors [8]. Therefore, WaSH services are not only essential for realizing the right to water but also for upholding the overall well-being and dignity of individuals and communities.

Over the past two decades, there has been a significant evolution in the global recognition of water as an inherent human right, supported by the core principles of international human rights law (Table 1). This momentum gained traction from the 1970s to the 1990s, culminating in the UN Committee on Economic, Social, and Cultural Rights affirming the significance of water as a fundamental aspect of life and all other human rights. In 2010, the UN General Assembly officially acknowledged the right to water and sanitation, cementing its role in advancing sustainable development objectives [9,10]. It has transitioned from soft law to hard law, firmly establishing itself as a composite human right in international legal frameworks.

Table 1. Evolution of water as human right in international law regime.

Sl. No.	Key Milestones in the Recognition of the Right to Water and Sanitation	Year
1	The Stockholm Conference of the UN on the Human Environment: the human right to a healthy environment and access to clean water were both recognized at this summit, which was a significant turning point.	1972
2	The Mar del Plata Water Conference Organized by the UN and the WHO addressed difficulties with worldwide water management. It emphasized the importance of equitable access to water resources, particularly for developing countries.	1977
3	The Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW) sets out an agenda to end discrimination against women, and explicitly references both water and sanitation within its Article 14(2)(h)	1979
4	The Convention on the Rights of the Child explicitly mentions water, environmental sanitation and hygiene under Article 24(2)(c)(e)	1989
5	The UN Conference on Environment and Development (UNCED) in Rio de Janeiro, Brazil, led to the adoption of Agenda 21. International Conference on Water and Sustainable Development. Dublin Conference	1992
6	The Water Governance Programme was started by the UNDP with the intention of assisting nations in strengthening water governance at various levels. The UN International Conference on Population and Development in 1994 affirms right to water for living standard.	1993
7	The UN General Assembly Resolution A/Res/54/175 "The Right to Development": Article 12 of the Resolution affirms that the right to clean water is inter alia with the right to development.	1999
8	MDG 7.C specifically targeting access to safe drinking water and basic sanitation. In 2002, in General Comment No. 15, published by CESCR, the right to water was acknowledged as a component of the right to an adequate standard of living.	2000
9	Draft Guidelines for the Realization of the Right to Drinking Water and Sanitation. E/CN.4/Sub.2/2005/25/ Human Rights Council Decision 2/104	2005
10	In 2006, Human Rights Council Decision 2/104, requesting the UNHRC to conduct a study on relevant human rights obligations related to equitable access to safe drinking water and sanitation. The Convention on the Rights of Persons with Disabilities, in Article 28(2)(a), ensures the right to water.	2006

Table 1. *Cont.*

Sl. No.	Key Milestones in the Recognition of the Right to Water and Sanitation	Year
11	Human Rights Council Resolution 7/22 "To appoint, for a period of three years, an independent expert on the issue of human rights obligations related to access to safe drinking water and sanitation".	2008
12	In Resolution 64/292, the UN General Assembly formally recognized the right to hygienic conditions, including access to safe and clean drinking water. Through Resolution A/HRC/RES/15/9, the UNHRC affirms that the rights to water and sanitation are part of existing international human rights law, recognizing them as essential components for the enjoyment of all human rights.	2010
13	The SDGs were included in the 2030 Agenda for Sustainable Development, which was adopted by the UN. The SDGs' Goal 6 focuses primarily on providing everyone with access to clean water and sanitation systems and managing them sustainably.	2015

In India, access to clean drinking water and adequate sanitary facilities is explicitly linked to the right to life under Article 21 of the Constitution and the right to a means of livelihood (Article 39(a)) in the Indian Constitution. The Supreme Court of India has upheld this principle in various judgments. In the case of Narmada Bachao Andolan v. Union of India (2000), the Court observed that "Water is the basic need for the survival of human beings and is part of the right to life and human rights as enshrined in Article 21 of the Constitution of India. . . and the right to a healthy environment and to sustainable development are fundamental human rights implicit in the right to life." Additionally, in State of Karnataka v. State of Andhra Pradesh (2000), the Court held that "the right to water is a right to life, and thus a fundamental right." Article 21, applicable to all individuals within India's territory, regardless of nationality or citizenship status, guarantees the right to clean drinking water and sanitation. The National Water Policy of 2012 further emphasizes the importance of viewing water as a common resource held in public trust, affirming that all residents have a constitutionally guaranteed right to sufficient and clean water. Indigenous communities' rights to water resources in their natural habitats are recognized under the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act of 2006. The Water (Prevention and Control of Pollution) Act of 1974, while indirectly supporting the right to clean and safe water for all, also seeks to combat water pollution.

However, the lack of access to clean water and adequate sanitation for billions of people in the twenty-first century presents a serious obstacle to human development. According to the Composite Water Management Index (CWMI) report by NITI Aayog in 2018, 600 million people in India face severe water stress. India, as the world's largest consumer of groundwater [11] relies on it for over 60% of irrigated farmland and 85% of drinking water supplies. This over-extraction has led to the depletion of this vital resource, exacerbated by a constant rise in water demand due to population growth [12,13]. Vulnerable groups bear the brunt of water scarcity, compounding their existing challenges [14–16]. Water shortages hinder access to safe drinking water, functional sanitation facilities, and adequate irrigation for agriculture, further straining livelihoods, health, and general well-being, especially for marginalized groups who lack the resources to cope with such hardships.

To ensure that the most vulnerable populations do not fall behind in accessing this vital resource, addressing water scarcity with an equity-focused approach is crucial. Refugees, often considered one of the most vulnerable groups due to their forced displacement and associated challenges, have received limited attention in terms of their access to water, sanitation, and hygiene (WaSH) services. While numerous studies have addressed the vulnerabilities of marginalized communities, such as slums and squatter colonies [1,2] or gender-specific groups [17–19], there is a notable research gap regarding the state of WaSH facilities in refugee settlements, colloquially known as camp in India. Little consideration

has been given to the challenges and impacts experienced by refugees when attempting to access WaSH provisions.

Delhi, as the capital of India, experiences a rapid urbanization and hosts a concentration of major industrial and service sectors [20]. The city's water supply relies on the Yamuna and Ganga rivers, as well as the Bhakra storage dam. Despite efforts by the Delhi Jal Board (DLB) to supply water to every household, it falls short of meeting the demand. Out of a total water demand of 1200 MGD (million gallons per day), the DLB supplies only around 950 MGD. The deteriorating condition of the Yamuna River, which supplies approximately 70% of Delhi's water, is a major contributing factor to this water scarcity. The rampant discharge of domestic wastewater, heavy metals from industrial plants, and the untreated sewage of approximately 800 million liters per day have transformed the Yamuna into one of the world's most polluted rivers. Consequently, water treatment plants like Wazirabad, Okhla, and Chandrawal have struggled to provide clean water. In this context, where the availability of this vital resource is inherently scarce, ensuring equitable distribution among all communities becomes a formidable challenge. The Rohingya refugee communities in Delhi are struggling to access clean water and sanitation facilities, with each family in the Madanpur Khadar neighborhood receiving only 1–3 buckets of water per day when the water tank arrives. Moreover, a significant portion of the inhabitants' resorts to open defecation, with women above the age of 10 to 12 using the same space for bathing and sanitation purposes. The Rohingya, who fled persecution in Myanmar, have sought refuge in various parts of the world, including India. New Delhi, hosting a significant Rohingya population, grapples with the complex issue of providing adequate water resources to meet their needs.

Objectives of the Study

Numerous studies have highlighted the political situation and dire living conditions of Rohingya refugees in host countries, especially India [21] and Bangladesh [22,23]. They live in constant fear of eviction or deportation in their host countries [24], contributing to their precarious living situation. These circumstances increase their already high levels of vulnerability that are due to congestion and lack of essential amenities, such as adequate sanitation [25]. Poor and congested living conditions without access to clean water and sanitation significantly increase the risk of waterborne diseases, further deteriorating their health and quality of life [22,26].

There is a notable scarcity of academic literature addressing the conditions of water, sanitation, and hygiene among the Rohingya community settled in Delhi. Addressing the lack of water supply and sanitation among the Rohingya community is of paramount importance due to its direct impact on their health and overall well-being.

Thus, this study aims to fill this knowledge gap by examining the water security challenges faced by Rohingya refugees, with a specific focus on refugee camps in New Delhi, India. It comprehensively analyses the factors influencing water security in these camps, shedding light on the multifaceted nature of the problem.

The study-objectives are as follows:

1. Highlight the connection between access to clean and safe water and sanitation among the Rohingya refugees in Delhi, providing valuable insights that can inform policymakers in developing robust water-related policies that ensure equitable access to proper water and sanitation facilities for all.
2. Fill the existing knowledge gap by examining the water security challenges faced by Rohingya refugees, with a specific focus on refugee camps in New Delhi, India.
3. Comprehensively analyse the factors influencing water security in these camps, shedding light on the multifaceted nature of the problem.

This study is specifically conducted in the Madanpur Khadar neighborhood, located in the southeast portion of Delhi, primarily inhabited by Rohingya refugees who have migrated from Myanmar, in order to compare the study-objectives and novel approach

with relevant international literature, highlighting its contributions to the existing body of knowledge.

2. Literature Review

2.1. Linking WaSH with Human Rights and the Right to Water

The interconnection between the right to water and the right to water, sanitation, and hygiene (WaSH) underscores the critical role that access to clean water, sanitation facilities, and proper hygiene practices plays in upholding human rights. Ellis and Feris [7] have noted that these two concepts are often used interchangeably, despite distinct nuances. The right to water explicitly focuses on providing every person with safe, accessible, adequate, and affordable water for personal consumption and domestic use [27]. In contrast, the right to WaSH encompasses an individual's entitlement to safe water, appropriate sanitation, and effective hygiene practices [8]. This broader perspective includes not only access to clean water for drinking and cooking but also access to sanitation facilities like toilets, garbage disposal units, and handwashing stations [5,6].

Within the framework of human rights, the right to water holds a central position, serving as a fundamental prerequisite for the realization of various interconnected rights. A myriad of human rights, encompassing social, cultural, political, economic, civic, household, and ecological aspects, are intricately linked to the right to water. This intricate interdependence arises from water's indispensable role in both human survival and environmental equilibrium. The right to water forms the bedrock upon which the foundations of social and economic rights are built [28,29]. The preservation of environmental quality is undeniably entwined with the preservation of cultural richness and identity, as water often holds cultural significance in societies [30]. At a fundamental level, the right to access water is related to human dignity, as its denial can lead to a degradation of living standards [31]. Ecologically, sound water management plays a pivotal role in preserving biodiversity and ecological balance, aligning seamlessly with ecological rights [32]. As a result, the right to water emerges as a multifaceted and sophisticated concept deeply entwined within a vast web of human rights and environmental protection.

2.2. WaSH as a Multidimensional Concept

Water, sanitation, and hygiene (WaSH) represent a multidimensional concept, with water security at its core [33]. Access to clean water, adequate sanitation, and the practice of good hygiene are integral components of the Sustainable Development Goals [34]. The importance of WaSH in achieving development and health objectives has gained increasing recognition [35].

Clean water plays a pivotal role in meeting daily needs such as drinking, cooking, and maintaining hygiene. It is particularly crucial in preventing the spread of diseases, especially in low- and middle-income countries [36,37]. Waterborne illnesses, including diarrhea, cholera, typhoid, and hepatitis A, are often contracted through the consumption of contaminated water [37,38]. Lack of access to clean water poses a significant threat to public health, especially in areas with poor sanitation and hygiene practices [39]. The consumption of contaminated drinking water, inadequate sanitation, and poor hygiene practices are estimated to cause over 1 million deaths annually from infectious diseases such as diarrhea, with children under 5 years old bearing a disproportionately large share of the burden [37]. Diarrhea continues to rank among the top 10 diseases globally that lead to Disability-Adjusted Life Years (DALYs) [40] and remains one of the most prevalent diseases among children under 5 years old. Additionally, water-related diseases like ascariasis, dracunculiasis, hookworm infection, schistosomiasis, and trachoma are more likely to occur in areas with inadequate sanitation and water infrastructure [36,41].

Proper sanitation practices are crucial for disease prevention. Improper disposal of human waste can contaminate nearby water sources [42] and provide breeding grounds for disease-carrying insects, such as flies [43]. Moreover, it attracts rodents and vermin, further spreading disease-causing excrement. In just one gram of infected human excreta,

numerous microbes, including pathogenic viruses, bacterial pathogens, protozoan cysts, and parasite eggs, can be found [44]. When individuals lack awareness and access to proper sanitation facilities, they may resort to open defecation, a practice associated with the transmission of diseases such as diarrhea, cholera, dysentery, typhoid, and urinary tract infections [45]. These diseases contribute significantly to morbidity and mortality, especially among young children under the age of five [46]. Open defecation also facilitates the transmission of soil-transmitted helminths such as hookworms, roundworms, whipworms, and threadworms [47]. In addition to its health implications, open defecation undermines the objectives of the Sustainable Development Goals [48].

2.3. Gender Disparities in WaSH and Their Impact on Women's Well-Being

Accessing water presents significant challenges for specific genders and marginalized individuals, due to entrenched gender disparities. Studies reveal that women bear the primary responsibility for water collection in households, often facing physical strain, longer collection times, and increased risks of harassment and assault [49,50]. This issue is extensively documented in academic literature, shedding light on the multifaceted implications for women's safety, well-being, and overall quality of life. Long distances to water sources and safety issues [51], along with the time-consuming collection process [52] all make it difficult for women in vulnerable environments to access water. Therefore, their vulnerability is exacerbated by risks of attack, health issues, and limited opportunities for education and income due to the demanding nature of water retrieval tasks [53].

One of the most significant concerns surrounding gender disparities in WaSH is the heightened risk to women's safety and dignity. Women and girls often face assault and humiliation when they lack access to proper sanitation facilities [54]. The absence of private and secure toilets forces them to seek open spaces for their sanitation needs, exposing them to potential harassment and violence. This vulnerability is especially evident in overcrowded urban slums and informal settlements, where the scarcity of safe sanitation facilities forces women to navigate precarious situations regularly [18].

Open defecation further compounds the challenges faced by women, particularly when practiced in environments with widespread bacterial contamination. Such conditions make women highly susceptible to infections, adding to their health burdens [55]. Inadequate sanitation infrastructure not only jeopardizes their physical health but also erodes their sense of security and dignity.

Pregnant women represent a particularly vulnerable group within this context. Studies have consistently highlighted the risks associated with open defecation during pregnancy, which can have detrimental effects on both the mother and the developing fetus. The lack of access to safe and clean sanitation facilities increases the likelihood of infections and complications during pregnancy [56]. These complications can lead to adverse maternal and neonatal outcomes, including preterm birth, low birth weight, and maternal morbidity [57].

Inadequate access to clean water and sanitation facilities also puts women at heightened risk of reproductive health problems during their menstrual cycles. The absence of private and hygienic spaces for managing menstruation can lead to infections and discomfort [19]. This not only affects their physical health but also carries emotional and psychological consequences, potentially impacting their overall well-being.

Gender disparities in accessing water, sanitation, and hygiene (WaSH) services extend beyond the traditional gender binary, impacting individuals across the gender spectrum disproportionately. Research has shown that the issue of transgender and intersex access to sanitation is under-addressed in the WaSH sector, highlighting the need for a more inclusive and intersectional approach to addressing gender inequalities [58].

Addressing gender disparities in WaSH is not only a matter of promoting gender equality but also a fundamental human rights imperative. Ensuring that women and girls have equal access to safe and dignified sanitation facilities is essential for upholding their basic human rights, including the right to health, dignity, and security. Moreover, it is inte-

gral to achieving broader development goals, such as the Sustainable Development Goals (SDGs), which emphasize gender equality and the importance of leaving no one behind.

Therefore, the gender disparities prevalent in the realm of WaSH have far-reaching implications for women's safety, health, and overall quality of life. Efforts to promote gender-sensitive and inclusive WaSH policies and infrastructure are essential not only for gender equality but also for advancing human rights and sustainable development.

2.4. WaSH, Malnutrition, and Economic Impact

Poor WaSH conditions can exacerbate malnutrition, especially among children, by contaminating water sources [59]. Diarrheal diseases, which result from poor WaSH practices, lead to dehydration and malnutrition as they cause the body to lose fluids and essential nutrients [60]. Malnutrition can impair immune function and lead to respiratory infections [61], making it a major cause of child mortality worldwide [62]. Poor WaSH practices, particularly in children, can lead to chronic malnutrition, commonly known as stunting [63]. Studies have identified poor environmental conditions, including inadequate access to safe drinking water, poor hygiene, and sanitation practices, as major contributors to diarrhea among children under 5 years old [64].

In addition to its health implications, poor WaSH also has a substantial economic impact. It increases healthcare expenditures [65,66], reduces tourism [67], and decreases productivity (Economic Costs of Inadequate Water and Sanitation, Asian Development Bank). The lack of water infrastructure can have dire economic consequences by diverting time away from income-generating activities, such as formal employment, agricultural labour, and small business endeavors [68]. Poor domestic waste disposal and inadequate toilet designs have been associated with lower household income, with squatter populations more likely to use non-improved water sources and sanitation facilities [69]. In India, poor sanitation has resulted in losses equivalent to approximately 6.4% of the nation's GDP.

Thus, access to clean water and sanitation is an inseparable human right, foundational and indispensable for the realization of other fundamental rights. Denying individuals their right to WaSH is tantamount to a violation of their basic human rights.

2.5. Refugee and Water Crisis

Millions of people across the globe are forced to leave their homes due to various crises, including armed conflict, persecution, and natural disasters [70–72]. In their pursuit of safety, these displaced individuals often seek asylum in host countries and find themselves temporarily settled in refugee camps, where they face extreme living conditions and a lack of basic necessities [73,74].

Among the many challenges faced by refugees in such circumstances, inadequate access to water and sanitation facilities stands out as one of the most pressing issues [75,76]. These camps are frequently overcrowded, lacking proper water, sanitation, and hygiene (WaSH) infrastructure and clean water sources [77,78]. The demand for water is high due to the dense population, while resources and infrastructure to meet this demand are often insufficient [76]. As a result, refugees may resort to using unsafe water sources like contaminated wells or waterways, which pose significant health risks [75,76].

The consequences of inadequate WaSH conditions in refugee camps are dire, leading to elevated rates of morbidity and mortality, especially in low- and middle-income countries [78]. An individual in an emergency situation requires 3 to 7 L of water for drinking and 15 to 20 L for domestic purposes [79]. Without a sustainable supply of clean water, refugees face a higher risk of waterborne diseases such as cholera, dysentery, typhoid fever, and diarrhea [80]. Studies have shown that refugee camps with adequate water facilities have significantly lower cholera rates compared to those without [81].

In some instances, like the Rwandan refugee crisis in the Kivu region, the absence of proper WaSH facilities resulted in extremely high mortality rates due to recurring cholera and shigellosis outbreaks [82]. Similar trends were observed in Afghanistan, where a significant number of internally displaced or repatriated refugees died due to diarrheal

diseases [82]. Studies have unequivocally demonstrated that the rate of individual and household diarrheal illnesses is highly correlated with WaSH education and practices [83]. Improved access to water and sanitation is linked to a significantly lower incidence of diarrheal deaths [84].

Natural disasters, such as floods and tsunamis, exacerbate the risk of diseases such as cryptosporidiosis, non-specific diarrhea, and polio [85]. The post-emergency situation often sees a surge in mortality rates, primarily due to communicable diseases [86]. This is particularly concerning for individuals with pre-existing health conditions, including diabetes, cancer, and chronic respiratory diseases [87]. Moreover, the poor hygienic conditions in refugee setups can lead to the spread of emerging diseases like leptospirosis, malaria, and gastrointestinal diseases [88].

Vulnerable populations within refugee communities, such as children, women, and the elderly, bear the brunt of inadequate WaSH conditions [77,89]. Children, whose immune systems are still developing, are especially susceptible to illness, which can have long-term effects, including malnutrition and stunted growth [89].

The lack of toilets and sanitation infrastructure in many refugee settings forces individuals to resort to open defecation, further deteriorating hygiene conditions [90]. Overcrowding and limited access to sanitation facilities add strain to already stretched resources [91]. Open defecation poses a severe risk of disease transmission and can contaminate water sources [92,93]. Septic tanks, often used in refugee camps, can potentially contaminate aquifers and groundwater, compromising water quality [94].

To address these pressing challenges, it is essential to provide refugees with prompt access to clean water and sanitation facilities, considering both quantity and quality [79]. Each person requires an average of 15 to 20 L of water per day for drinking, cooking, personal hygiene, and washing [79]. Ensuring an adequate supply of clean water and proper sanitation facilities is crucial to prevent waterborne disease transmission and maintain hygiene in refugee camps [80]. Unfortunately, WASH initiatives are frequently overlooked in emergency settings, despite being vital for survival, health, and dignity.

2.6. Examples: Case Studies Illustrating the Interlinkage between Refugees, Human Rights, and WaSH

(1) Rwandan Refugee Crisis (1994): During the Rwandan refugee crisis, the lack of clean water and sanitation facilities in overcrowded camps led to cholera and shigellosis outbreaks, resulting in significant mortality rates [82].
(2) Afghanistan (2001): In post-conflict Afghanistan, internally displaced and repatriated refugees faced high mortality rates due to diseases like diarrhea, emphasizing the critical need for WaSH interventions [82].
(3) Mozambican Refugee Crisis (1980s): Poor water quality significantly contributed to mortality among Mozambican refugee households due to fecal and mouth infections [89].
(4) Kyangwali Refugee Camp, Uganda: In Kyangwali camp, overcrowding and the need to fetch water daily affected children's access to education, illustrating the impact of WaSH on vulnerable populations [89].
(5) Natural Disasters and Disease Outbreaks: Cases of cryptosporidiosis, non-specific diarrhea, and other diseases surged in post-disaster scenarios like floods and tsunamis, underscoring the importance of WaSH during emergencies [85].
(6) Pre-existing Health Conditions: Refugee populations with pre-existing health conditions faced worsened outcomes in poor hygienic conditions, highlighting the broader health implications of inadequate WaSH [95].
(7) Emerging Diseases: Refugee setups with poor hygiene conditions are at risk of spreading emerging diseases like leptospirosis, malaria, and gastrointestinal diseases [88].
(8) Vulnerable Populations: Children, women, and the elderly are particularly susceptible to the adverse effects of inadequate WaSH in refugee settings, emphasizing the importance of targeting these groups in interventions [77].

The link between refugees, human rights, and water, sanitation, and hygiene (WaSH) is evident in the myriad challenges faced by displaced populations, especially in emergency settings. Addressing these challenges requires not only acknowledging the fundamental human right to WaSH but also implementing comprehensive policies and interventions to ensure access to clean water and sanitation facilities for all refugees, thereby upholding their dignity, health, and well-being.

3. Method and Data

3.1. Study Area

Our study area, Delhi, the national capital and a union territory of India, is historically significant and bordered by Uttar Pradesh and Haryana. It is important to clarify the differences between Delhi, New Delhi, and Delhi-NCR, as these terms are often used interchangeably. Delhi refers to the overall national capital territory. Within Delhi lies New Delhi, one of its nine districts, known for its 20th-century British architecture and key government institutions. Delhi-NCR (National Capital Region) extends beyond Delhi to include nearby districts like Noida, Gurugram, and Ghaziabad, created to manage the region's growing population and development needs.

Located in the heart of the northern plains of the Indian subcontinent, Delhi (Figure 1) is a major urban conglomeration according to the Census of India, 2021. It is situated on the west bank of the Yamuna River, a tributary of the Ganges River, in the northern plains of the Indian subcontinent [96].

Delhi's geographical coordinates range from 28°24′17″ to 28°53′00″ north latitude and 76°50′24″ to 77°20′37″ east longitude, covering an area of 1483 square kilometers (Government of NCT of Delhi, 2021). The city experiences a tropical steppe climate characterized by dry and hot summers, with a monsoon season from July to September that brings rainfall averaging 714 mm annually [96].

Delhi is home to numerous water bodies, but several of them face pollution and encroachment issues due to rapid urban development [97]. The city's population stands at approximately 19.8 million people as per the 2021 census, making it the second most populous city in India after Mumbai (Census of India, 2021). Delhi is celebrated for its diversity and cosmopolitan nature, attracting people from different religious, linguistic, cultural, and socioeconomic backgrounds (Government of NCT of Delhi, 2021).

Situated in the southeastern part of Delhi, Madanpur Khadar is an integral part of the Okhla Industrial Area and is in close proximity to the Yamuna River [98]. It falls within the Okhla assembly constituency for the Delhi Legislative Assembly and is part of the East Delhi parliamentary constituency [98]. Madanpur Khadar's landscape exhibits a diverse range of land uses, encompassing urban, rural, industrial, agricultural, residential, and commercial zones [99]. The terrain in this region is predominantly flat and low-lying.

Located here, the camp comprises individuals of various age groups, there are a total of 260 residents (as of July 2023). Among them, 55 families reside, with 35 situated on land allocated by a local NGO, while the remainder live adjacent to the road. Each family has been allocated a living space of 10 ft/10 ft under the supervision of district sub-divisional magistrate. For research purposes, the entirety of space utilized by the Rohingya refugees, including the narrow 3 to 4 m path serving as a lane within the camp, has been regarded as part of the camp area. Water sources in Madanpur Khadar primarily rely on groundwater, which is accessed through handpumps or motor pumps [100]. Some residents also resort to using bottled mineral water or water supplied by the Delhi Jal Board (DJB) (Government of NCT of Delhi, 2021). However, the nearby Yamuna River is heavily polluted due to industrial and domestic waste, rendering it unsuitable for direct consumption or domestic use [98].

It is worth noting that the Rohingya settlement in this area is situated adjacent to a site designated for garbage dumping and sewage drainage, posing significant environmental and health challenges for the community [98].

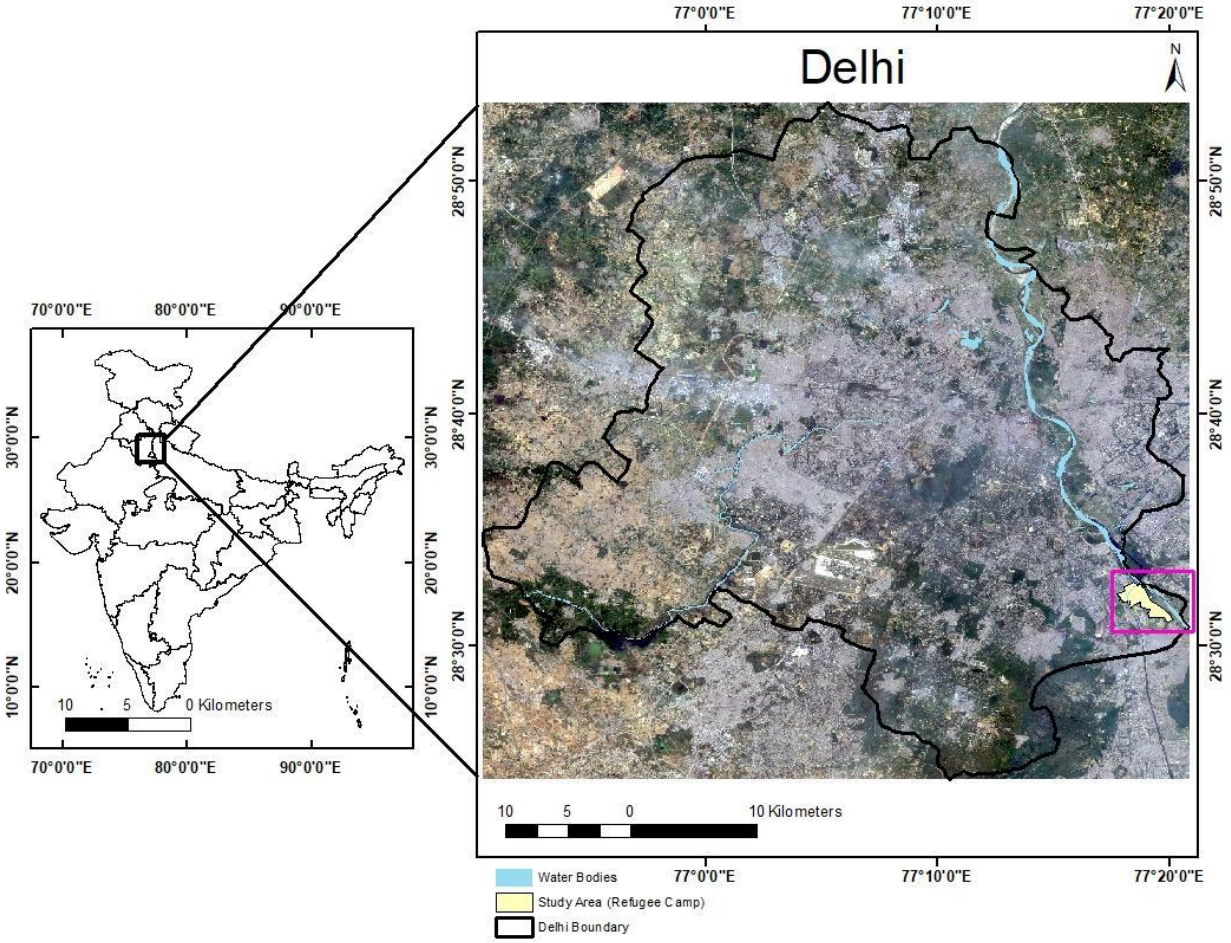

Figure 1. Location of the study area: Rohingya Refugee Settlement, colloquially known as camp, in Madanpur Khadar (marked with the Pink Square) within Delhi, India.

3.2. Data and Methods

The research methodology employed a comprehensive approach that integrated both qualitative data collection methods to gain an in-depth understanding of the multifaceted water-related issues within the refugee camp. The qualitative component of this research involves in-depth interviews, focus group interviews, participant observations, and document analysis. These methods allow for an exploration of the lived experiences, narratives, and perceptions of Rohingya refugees in New Delhi regarding water insecurity and its implications for their basic human rights. The qualitative method enables an in-depth assessment of the situation within the camps, including the socio-economic disparities and power dynamics influencing access to water resources [101]. The data for this study was collected through structured surveys administered to residents of the camp. Information on water access, sanitation, health, and socio-economic factors was gathered.

Complementing the qualitative analysis, this study employs statistical techniques to evaluate the quantitative dimensions of water insecurity in Rohingya camps. Data collected from surveys and secondary sources are subjected to rigorous analyses to determine the prevalence and distribution of water-related challenges, including quality and quantity issues. This quantitative assessment provides valuable insights into the overall magnitude of the problem and can identify the potential disparities across different segments of the refugee population. Munajed and Ekren [102] employed a comparable approach, carrying out qualitative interviews with refugee families, experts in the field, and development practitioners, to thoroughly examine and comprehend the effects of COVID-19 protective measures on Syrian refugees residing in Turkey and Lebanon. Their study revealed signifi-

cant barriers faced by refugees, such as overcrowded living conditions and limited access to healthcare, which hindered effective distancing.

Additionally, satellite imagery and geographic data were utilized to map the area. In addition to focused group discussions (FGDs) and one-on-one household interviews, this study also utilized literature surveys and document archival research as valuable methodologies.

- Focused Group Discussions (FGDs)

The FGDs served as a pivotal component of data collection, offering a platform to gather diverse perspectives and insights from the camp's inhabitants. The objective was to delve into the perceptions, opinions, and attitudes of the refugee population regarding specific water-related topics. To ensure gender balance and capture diverse opinions, participants were selected based on their gender, creating separate FGDs for men and women. To ensure a comprehensive representation, a total of 97 male and 85 females (including the minors), constituting approximately 70% of the camp's population, actively participated in the FGDs. In total, there were 12 groups: 6 for male and 6 for female, each distributed according to their age (Table 2a). The sample size of 182 participants was strategically determined to provide a robust understanding of the population's views and experiences. To facilitate more focused discussions and encourage active participation, respondents were categorized into smaller groups based on their age and gender. This approach aimed to foster an environment where participants felt comfortable sharing their viewpoints. As highlighted by Morgan [103], focus groups have become popular for qualitative data collection, often used alone or with other methods like surveys and interviews. Their advantages, stemming from group interaction and moderator guidance, can be enhanced with careful research design and more methodological focus on data analysis and participant concerns.

Table 2. Respondent's demographics (total respondents, n = 182, i.e., 70% of the total Rohingya population within the New Delhi camp).

(a) Age-Wise		
Age	**Male**	**Female**
12 to 20	8	8
21 to 26	12	7
27 to 36	17	11
36 to 45	24	28
46 to 60	28	24
Above 60	8	7
(b) Income-Wise		
Individual Monthly Income	**Male**	**Female**
Nil	28	62
Up to 1000	4	4
1001 to 5000	42	11
5001 to 8000	19	8
8001 to 12000	4	0
Above 1200	0	0

The discussions predominantly centered around closed-ended questions, which are designed to yield specific and measurable information and lasted approximately about 45 min to 1 h. The utilization of closed-ended questions facilitated precise data collection, enabling us to quantitatively assess participants' attitudes towards water-related issues,

their WaSH practices, and their implications. This structured approach improved the clarity and comparability of responses, allowing for a more comprehensive examination of the data in our study. In the study by Chen et al. [104], it was found that patients were more efficient in reporting their problems specifically when using closed-ended questions compared to open-ended questions. This comparison demonstrated the benefits of closed-ended questions in generating specific information from responders.

- One-on-One Household Interviews

Complementing the insights gathered from the FGDs, one-on-one household interviews provided an avenue to explore individual experiences, challenges, and practices related to water within the household context. These interviews offered a deeper understanding of the unique circumstances faced by each household member. This one-on-one interview enabled us to explore individual's experience, practices, and challenges related to WaSH within the context of their household, providing a deeper understanding of the unique circumstances they have encountered. Although this approach risks missing diverse household perspectives, it allows for detailed, nuanced individual insights. In the study conducted by Krueger D [105], household interviews provided a comprehensive method to collect data on the prevalence of chronic diseases within a general population sample. This method allowed for gathering information directly from individuals within their home environment.

During a meticulously organized two-month period, representative members from each household were individually interviewed. The interviews conducted were guided by community leaders, both male and female, who acted as moderators. From the total of 55 households interviewed, only 10 female individuals participated. This limited participation was due to a significant reluctance among the women, most of whom were hesitant and not open to communication. This trend is something that needs further research in the future, to ensure we include women's experiences. Consequently, the majority of the interviewees were men. The sample encompasses representatives from every household within the community, ensuring comprehensive coverage and inclusivity. The selection of one member per household was intended to capture a diverse range of perspectives within the given constraints. Additionally, the involvement of community leaders as moderators helped facilitate more accurate and culturally sensitive data collection, enhancing the reliability of the findings despite the gender participation disparity. These interviews required a substantial time commitment, typically lasting three to four hours per session. This extended duration allowed for in-depth investigations into the respondents' experiences and perceptions, shedding light on their daily interactions with water-related challenges.

The one-on-one interviews primarily employed open-ended questions, fostering a qualitative approach that encouraged participants to express their concerns, elaborate on challenges encountered, and share strategies they employed to address these challenges. Such semi-structured interviews have the advantage of allowing the interviewer to go further into complex topics while also probing for additional information depending on the responses provided [106]. This flexibility can result in rich, comprehensive data that more rigorous interview forms may not capture.

The initial research plan aimed to include interviews with the camp officials and the officer in charge of the local police station to gain insights into their perceptions and to understand the underlying reasons for the limited intervention, post-survey in the camp. Understanding their perspectives was crucial for comprehensively addressing the systemic challenges and evaluating the institutional responses to the identified issues. However, efforts to engage these officials were thwarted by significant reluctance and an uncooperative stance, which hindered the collection of critical viewpoints necessary for a thorough analysis of the intervention dynamics within the camp. This obstruction not only impeded a fuller understanding of the operational barriers but also underscored the challenges faced in achieving effective collaboration with key stakeholders in the humanitarian response.

- Literature Surveys and Document Archival Research

In addition to primary data collection methods, this study conducted extensive literature surveys and document archival research. This involved a comprehensive review of existing literature, reports, and documents related to water access, sanitation, and hygiene issues in refugee contexts. By synthesizing information from academic publications, government reports, and international organizations, this approach enriched the study with valuable historical and contextual insights. Furthermore, document archival research allowed for the examination of policies, initiatives, and interventions previously implemented within the refugee camp, providing a critical backdrop for assessing the current water-related challenges and potential solutions. This process is necessary for a comprehensive analysis and a well-rounded perspective. Webster and Watson [107] argue that a thorough literature review is essential to the development of a robust theoretical foundation and provides a contextual understanding that enhances empirical findings.

Throughout the data collection process, utmost attention was dedicated to upholding ethical standards. This included obtaining informed consent from all participants, ensuring that they comprehended the research objectives and their role in the study. Additionally, strict measures were implemented to safeguard the confidentiality of the respondents, assuring them that their identities and responses would remain anonymous.

By combining focused group discussions, one-on-one household interviews, literature surveys, and document archival research, this research methodology aimed to provide a holistic understanding of water-related issues within the refugee camp, capturing both the quantitative and qualitative dimensions of the challenges faced, and the strategies employed by the inhabitants.

4. Findings and Discussions

The findings of this study illuminate the dire water, sanitation, and hygiene (WaSH) conditions experienced by the Rohingya refugee community in the Madanpur Khadar area of Delhi, India. The analysis and discussions that follow shed light on the multifaceted challenges faced by the inhabitants, the implications for their health and well-being, and the urgent need for intervention and support.

4.1. Inadequate Water Supply

The status of water supply within the refugee camp emerges as a critical concern. Despite the provision of a 10,000 L water tank by The Delhi Jal Board, the average quantity of water received by per family falls significantly below the standards set forth by the United Nations. This glaring deficiency in the water supply places an immense burden on the camp's residents. On average, families in this survey collect water 3 to 4 times per week, indicating a frequent need to secure water for daily use (Table 2).

The inconsistency and irregularity of water tank deliveries compound the problem. The water tank's purported daily arrival frequency often dwindles to once every 4–5 days, and at times, only once a week during peak summer months. Furthermore, the alarming practice of delivering water tanks that are already half empty exacerbates the water scarcity issue. The residents are compelled to queue for extended periods to collect water (Figure 2). Frequently, those positioned towards the end of the line are left without an adequate supply, or in many cases, without any water at all (Table 3). As a coping mechanism, families have implemented an alternative rotation method for water collection.

Figure 2. Water scarcity situation in the Madanpur Khadar Rohingya settlement in Delhi, India. Individuals are lined up with their buckets, waiting for their turn to collect water.

Table 3. Familywise (n = 55) water statistics of the study area: Rohingya Refugee camp of New Delhi, India.

1. The primary Source of water in the camp	Water tank delivered by Delhi Jal Board
2. Secondary or other source of water (Multiple options)	
No additional source of water	16%
Receive help from others	78%
Buy drinking water	67%
3. How often are you supposed to get water	Once a day
4. How often do households receive water in a typical week?	3 to 4 times on average
5. Does water collection frequency vary between weekdays and weekends?	
Water collection frequency remains consistent throughout the week.	-
Water supply is irregular in the weekends	15%
Water supply is irregular in the weekdays	-
There is no such pattern. It is inconsistent	85%
6. Are there differences in the time spent collecting water during different times of the day?	No
7. How would households rate the quality of the water they have access to?	
Clean	25%
Somewhat Clean	69%
Contaminated	7%
8. Specific issues with the quality of water	
Turbid Water	75%
Odor	11%
Colour	4%
Particulate-laden water	67%
9. What is the average amount of water collected per household per day (in liters)?	
10 to 20 L	5%
20 to 30 L	16%
30 to 40 L	62%
40 to 50 L	16%
10. What is the average distance households travel to collect water from the water source?	Within 100 m (approximately)

Table 3. *Cont.*

11. Do households have access to water storage containers or tanks?	Yes
12. What is the approximate time to collection water in the queue?	
Less than 30 min	-
30 to 45 min	6%
45 min to 1 h	8%
1 h to 1 h 30 min	71%
1 h 30 min to 2 h	15%
More than 2 h	-
13. What are the main challenges faced by households during the water collection process? (Multiple choices option)	
Queuing and waiting time	31%
Inadequate water availability	95%
Physical strain	16%
Disrupted Routine	91%
14. Are households practicing water conservation methods, such as using water-saving devices or reusing water?	No
15. Overall % of households reported any health issues related to water quality or scarcity?	100%

4.2. Impact on Daily Life

The insufficiency of water in the camp has profound consequences for the daily lives of its residents, primarily impacting their basic hygiene practices (Tables 3 and 4). Sabina, a 36-year-old mother of two, exemplifies the struggles faced by many. Her account of waiting for hours to obtain a single bucket of water highlights the immense challenges posed by the inadequate water supply (Table 3). This situation forces residents to ration their water usage and prioritize essential needs, often at the expense of their hygiene, cleanliness, and overall well-being.

Table 4. Gender Differences in Sanitation, Hygiene Practices, and Water Consumption in a New Delhi Refugee Camp (total respondents, *n* = 182).

Questions	**% of Respondents**	
	Male (*n* = 97)	**Female (*n* = 85)**
1. Please indicate your method of performing sanitary activities, including defecation, based on the options provided below:		
Completely relying on open defecation and utilizing outdoor spaces for other sanitary needs.	91%	-
Using a designated area within the hut for defecation and other sanitary activities.	2%	95%
Adapting sanitary practices based on the situation, which includes both open defecation and using the designated space inside the hut for various sanitary activities.	7%	5%
2. Please indicate your method of cleaning yourself after defecation:		
With water and soap	30%	20%
With simple water	54%	69%
With old newspaper or clothes	16%	11%

Table 4. *Cont.*

Questions	% of Respondents									
	Male (*n* = 97)					Female (*n* = 85)				
3. Please indicate the number of times you take a shower in a typical week:										
Once a week	12%					27%				
2–3 times a week	78%					64%				
4–5 times a week	6%					9%				
6–7 times a week (daily)	-					-				
4. How often do your wash your clothes?										
Daily	-					-				
Once or twice a week	22%					16%				
Once or twice a month	71%					78%				
Rarely	7%					6%				
5. How do you wash your clothes?										
With water	35%					46%				
Using detergent	65%					54%				
6. Please rate the following challenges you face in maintaining personal hygiene due to water shortages in the camp, from 1 to 5, with 1 being the lowest and 5 being the extreme (Multiple options) (values displayed in %)										
	Male (*n* = 97)					Female (*n* = 85)				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Scarcity of water for cooking and drinking	-	-	14	18	68	-	-	-	8	92
Difficulty in maintaining cleanliness and sanitation	-	-	7	34	59	-	-	-	32	68
Impact on overall health and well-being	-	8	21	29	42	-	-	14	41	45
Limited privacy for personal hygiene activities	3	-	15	33	49	-	-	-	3	97
Increased physical burden to fetch water from distant sources	-	9	17	21	53	-	12	32	47	9
Dependency on unsafe water sources	22	53	25	-	-	51	43	6	-	-
Increased economic burden	-	-	16	23	61	-	7	21	40	32
7. On average, how many liters of water do you consume for drinking purposes each day?										
Less than 1 L	8%					21%				
1–2 L	22%					20%				
2–3 L	51%					51%				
More than 3 L	20%					8%				

Abdul, a 29-year-old store assistant, faces the compounding challenges of balancing work and water collection. The uncertainty surrounding water availability frequently leads to tardiness at his workplace, underscoring the economic and social implications of the water crisis within the camp. Even when the water tank arrives as scheduled, the allocated amount proves insufficient to meet the demands of the camp's population.

4.3. Health Consequences

The insufficient water supply directly correlates with a multitude of health-related issues within the camp. Waterborne and vector-borne diseases, including diarrhea, dehydration, and skin disorders, are alarmingly prevalent. Limited access to sanitary facilities and clean water exacerbates the residents' struggle to maintain proper health and hygiene standards (Table 5). A significant proportion of men engage in open defecation and utilize

inadequate amounts of water for post-defecation hygiene. Women, on the other hand, use small, designated areas within their huts for defecation (Table 4) (Figures 3 and 4).

Table 5. Familywise Water Collection, Treatment, and Storage Practices among Surveyed Individuals (n = 55).

Questions	% of Respondents
1. Do you treat the water you collect before using it for drinking or cooking?	
Yes	7%
No	31%
Sometimes	62%
1.a. If yes, what methods do you use for water treatment? (Multiple options)	
Boiling	62%
Chlorine or water purification tablets	13%
Filtration	-
Solar disinfection (SODIS)	-
2. If you do not always treat the water, what factors influence your decision? (Multiple options)	
Lack of awareness about waterborne diseases	58%
Limited access to water treatment resources	35%
Difficulty in implementing treatment methods	-
Perceived low risk of waterborne diseases	-
Economic challenges	95%
Other (please specify):	-
3. Do you keep drinking water and water for other uses (like cleaning) separately?	
Always	-
Often	-
Sometimes	-
Rarely	24%
Never	76%
4. How often do you wash the container you use to store water?	
Daily	7%
Every 2–3 days	-
Once a week	-
2–3 times in a month	7%
Once a month	25%
Rarely	67%
5. Do you use a lid or cover for your water storage container?	
Always	53%
Often	33%
Sometimes	15%
Rarely	-
Never	-

Table 5. *Cont.*

Questions	% of Respondents
6. How do you take out water from the storage container?	
With cup/mug with long handle	85%
With hand	-
Any random utensils	15%
Other: (specify)	-
7. How often do you clean the area around your water storage containers?	
Daily	-
Weekly	-
Monthly	38%
Rarely	62%
Never	-

Figure 3. The open area in close proximity to the Madanpur Khadar Rohingya settlement that is used for open defecation.

Figure 4. The designated area within each living space or hut inside the Madanpur Khadar Rohingya settlement. This area is used for cleaning utensils and clothes, storing water, and for defecation by females.

Tragically, the camp has witnessed several cases of death due to waterborne diseases in recent years, highlighting the urgency of addressing the health risks posed by the water crisis. Among children in the camp, diarrhea is a common ailment, further underscoring the vulnerability of the younger population. The lack of proper sanitation facilities has resulted in mental distress, particularly for women. The absence of covered toilet setups leaves them feeling vulnerable and embarrassed during defecation or urination. This discomfort often leads to delayed or suppressed urges, causing further health complications. Women resort to storing waste in buckets overnight, emitting unpleasant odors that permeate the camp (Figure 4). This lack of proper sanitation facilities has seriously impacted the health of the

community, exacerbating mental distress and leading to significant health complications (Figures 5 and 6).

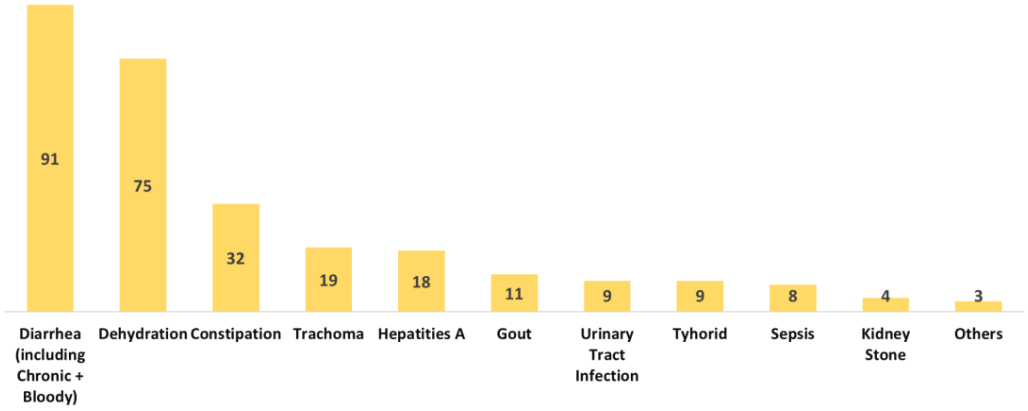

Figure 5. Health issue faced by male in the camp in last 5 years due to inadequate WaSH (n = 97).

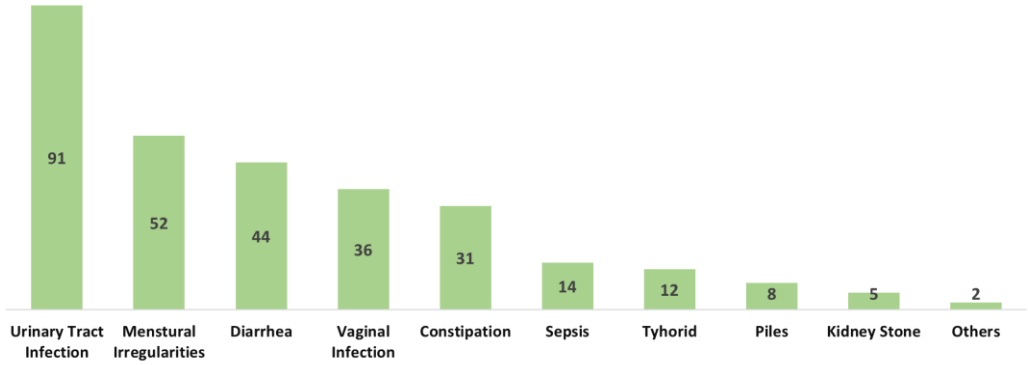

Figure 6. Health issue faced by female in the camp in last 5 years due to inadequate WaSH (n = 85).

4.4. Gender Disparities in Water Consumption

This study reveals a notable disparity between genders in the amount of water consumption. Adult women drink an average of 1.9 L per day, whereas males drink 2.5 to 3 L (Table 4). The main reason is that men tend to engage in works outside the camp, like labour or helping at local stores, where water is more readily accessible. As a result, their water needs are sufficiently met during the day. In contrast, women, who are typically responsible for managing household water resources, are left with limited access, resulting in their lower water consumption. Another significant factor is the deeply ingrained tradition wherein women in the community prioritize the needs of their children and husbands over their own, often leading to the neglect of their own needs. They often consume less water, considering the needs of others over their own.

Moreover, women face unique challenges associated with inadequate WaSH facilities. Approximately 91% of female respondents reported experiencing urinary tract infections (UTIs), with some cases severe enough to necessitate hospitalization (Figure 6). The prevailing unhygienic conditions have compelled women to limit their urination and defecation, especially at night or during adverse weather conditions. The lack of proper disposal mechanisms for sanitary napkins further exacerbates their health risks.

4.5. Economic and Social Impact

The camp's water scarcity issue extends its impact beyond health concerns. Residents are forced to purchase additional water for drinking and cooking during periods of extreme scarcity, straining their limited financial resources. Furthermore, the uncertainty surrounding water supply disrupts job opportunities, as individuals must allocate substan-

tial time for water collection, leading to missed workdays and potential loss of income. This makes already-existing inequality and hardship worse, since the most vulnerable people are left with the most burdens (Table 6). The survey reveals that most families in the camp purchase additional water 4 to 6 times a month. This frequent need to buy water results in significant financial strain, with 74% of families spending between 501 and 700 INR monthly on water expenses. The average income in the camp is low, with a significant proportion of both males and females earning less than 5000 per month, and a substantial number of females having no income at all (Table 2b). Majority of families (74%) spend between 501 and 700 Indian rupees (INR) per month on water expenses. This suggests that a significant portion of households allocate a substantial budget towards securing water. The financial strain and lost income opportunities further entrench poverty and widen the socio-economic gap within the community. In households where there is a single source of income, this financial burden becomes exceedingly challenging.

Table 6. Water collection, frequency, purchase, and expenses per month for surveyed families (in %) (n = 55).

How many liters of water does your family collect on the arrival of the water tank?	
10–20	2%
20–40	93%
40–60	5%
60+	-
On average, how many times a week does your family get the chance to collect water?	
1 to 2 times	-
2 to 3 times	38%
3 to 4 times	62%
5 to 6 times	-
More than 6 times	-
How frequently do you purchase water for consumption?	
Once a month	5%
2–3 times a month	18%
4–6 times a month	74%
7–10 times a month	3%
More than 10 times a month	-
What is the approximate cost of water expenses for your family in a month in Indian rupees (INR)?	
Less than 100	5%
100 to 500	18%
501 to 700	74%
701 to 1000	3%
More than 1000	-

4.6. Environmental Impact

The landscape of the camp settlement, located in a shallow terrain, exacerbates water-related challenges during the monsoon season. The camp experiences flooding, with water levels rising up to 2 feet above ground level. The huts, often constructed without cemented floors, bear the brunt of this flooding. Stagnant water becomes a breeding ground for disease-carrying mosquitoes, posing a health risk to camp residents (Figures 7 and 8).

Figure 7. The area outside the Madanpur Khadar Rohingya settlement after rainfall in the month of August.

Figure 8. The narrow lane that runs within the Madanpur Khadar Rohingya settlement.

The following table (Table 7) highlights the multifaceted understanding and role of water, sanitation, and hygiene conditions in the camp as revealed by the survey. By examining dimensions such as social, health, economic, environmental, infrastructure, policy, socio-political, and bio-physical factors, we can better comprehend the intricate challenges faced by the community. This comprehensive perspective is essential for developing effective interventions and policies to improve WaSH conditions in the camp.

Table 7. Comprehensive Analysis of the Dimension and Factors impacting the WaSH Conditions in the Camp.

Dimensions	Factors	Specific Issues Related to Water, Sanitation, and Hygiene
Social	Gender Inequality	• Significant disparity in water consumption levels between males and females. • Distinct differences in sanitation and hygiene practices between genders.
	Community Dynamics	Dispute over water allocation and uneven level of water collection
Health	Waterborne Diseases	• Prevalence of diseases like diarrhea and cholera

Table 7. *Cont.*

Dimensions	Factors	Specific Issues Related to Water, Sanitation, and Hygiene
Health Economic	Gender Disparities	• Women are disproportionately affected health-wise by inadequate WaSH facilities
	Mental Health	• Stress and anxiety due to water scarcity
	Financial burden	• High costs of purchasing water from private sources • Added cost to mitigate health issues
Economic Environmental	Employment Impact	• Loss of work hours due to time spent fetching water
	Location Vulnerability	• Flooding and contamination during monsoon season
Environmental Infrastructure	Waste Disposal	Lack of proper sanitation facilities leading to open defecation
	Water Supply Systems	• Irregular delivery and inadequate capacity of water tanks
Infrastructure Policy and Governance	Water Storage Capacity and usage	• Insufficient options for proper water storage • No separation between drinking and daily use water jeopardizes hygiene.
	Regulatory Oversight	• Lack of government intervention and support
Policy and Governance Socio-Political	Resource Allocation	• Inequitable distribution of water resources
	Refugee Status	• Limited access to public services
Socio-Political Bio-Physical	Local Integration	• Local resentment against the
	Soil Contamination	• Poor sanitation practices contaminating local soil

5. Conceptual Framework of Water, Sanitation, and Hygiene (WaSH) and Its Association with Different Dimensions of Human Rights, including Refugee Rights

From the abovementioned findings and discussion, it is clear that we need improved frameworks to help us monitor and respond to needs in our communities. We therefore propose a conceptual framework of WaSH which can be used for further in-depth studies in the future. The proposed conceptual framework of water, sanitation, and hygiene (WaSH) not only encompasses the intrinsic right to clean water and sanitation but also intersects with various dimensions of human rights, including ecological rights, cultural rights, civil rights, socio-economic rights, and refugee rights. This comprehensive framework underscores the multidimensional significance of WaSH for individuals and communities, particularly for vulnerable populations such as refugees. Many studies [108,109] have linked SDGs and human rights to WaSH; however, few have a comprehensive rights framework that allows us to capture the multidimensionality of rights that intersect with and are affected by WaSH issues. Our rights framework include the following:

Intrinsic Right to WaSH: At its core, this framework recognizes access to clean water, sanitation, and hygiene as an inherent human right (Resolution 64/292, United Nation General Assembly on 28 July 2010, United Nations, 2010). This intrinsic right is firmly rooted in the right to life, as clean water is essential for survival (Article 3, Universal Declaration of Human Rights). It serves as the foundation upon which other fundamental human rights are built.

Ecological Rights: WaSH are intricately linked with ecological rights, emphasizing the need for sustainable water management to preserve biodiversity and ecological equilibrium [110]. Ensuring access to clean water while safeguarding the environment aligns with the principles of ecological rights, recognizing the responsibility to protect the natural world for current and future generations as per the World Commission on Environment and Development, 1987.

Cultural Rights: In many cultures and traditions, water is revered and worshiped as a symbol of purity, fertility, and renewal [111]. Water is seen as a cultural right because it is required for sustaining livelihoods and participating in specific cultural customs. This is recognized in General Comment No. 15 of the Committee on Economic, Social, and Cultural Rights, which defines the right to water as "the right of everyone to sufficient, safe, acceptable, physically accessible, and affordable water for personal and domestic uses".

Civil Rights: The right to obtain water is closely tied to human dignity, as the denial of this right can result in a degradation of living standards [112]. Access to WaSH facilities is integral to maintaining civil rights, including personal security and privacy (Article 12, Universal Declaration of Human Rights). Adequate sanitation and clean water are essential for upholding civil rights and preventing discrimination, particularly among marginalized groups, including refugees.

Socio-economic Rights: This framework acknowledges that WaSH play a pivotal role in socio-economic development. Poor WaSH conditions can increase healthcare expenditures, reduce productivity, and lower household income [65]. Realizing socio-economic rights, such as the right to work and an adequate standard of living, is contingent on access to WaSH.

Refugee Rights: Within this framework, refugee rights are a critical component. Refugees, forcibly displaced from their homes due to conflict, persecution, or environmental factors, face unique challenges in accessing clean water and sanitation. This framework underscores the importance of addressing the specific WaSH needs of refugees, ensuring that they receive adequate support and protection (UNHCR, 1951).

Thus, the conceptual framework of WaSH recognizes its intrinsic importance as a fundamental human right and highlights its associations with various dimensions of human rights, including refugee rights. This multidimensional perspective underscores the interconnectedness of WaSH with different facets of human rights, emphasizing the need for comprehensive policies and actions to ensure equitable access to clean water, sanitation, and hygiene for all, including vulnerable populations like refugees.

6. Conclusions

The findings of this study underscore the urgent and multifaceted nature of the water, sanitation, and hygiene (WaSH) crisis in the Madanpur Khadar refugee camp. The camp is confronted with severe water scarcity, where the existing infrastructure fails to provide a reliable supply of clean water, thereby jeopardizing the daily health and well-being of its burgeoning population. The sanitation facilities are critically deficient, lacking essential privacy and safety measures, particularly for women, and failing to provide adequate support for menstrual hygiene management. This sanitation inadequacy is exacerbated by the high prevalence of waterborne diseases, skin disorders, and urinary tract infections, stemming from the limited access to healthcare services. The gender disparity in water consumption and hygiene practices further intensifies the vulnerability of women, who are disproportionately affected by the lack of appropriate facilities. Additionally, the camp's environmental management is compromised by ineffective drainage systems, leading to recurrent flooding and soil contamination, which further degrade living conditions. The economic burdens on the residents are significant, with high costs associated with purchasing water from private sources, deepening their financial strain. These intertwined challenges demand an immediate and coordinated response from governmental bodies, humanitarian organizations, and the international community to ensure the provision of sustainable WaSH services, thereby alleviating the profound humanitarian crisis and enhancing the quality of life for the Rohingya refugee population.

Thus, the common perception of community members in the camp regarding water insecurities is marked by profound anxiety, frustration, and systemic lack stemming from the erratic and insufficient water supply. Residents articulate a pervasive sense of vulnerability, driven by the irregular delivery of water tanks and the perceived inequities in resource allocation, which significantly disrupt their daily routines and compromise essential hygiene

practices. This acute water insecurity not only exacerbates health risks and fuels communal tensions but also perpetuates a state of perpetual uncertainty and socio-economic instability. Such conditions are reported to severely impede not only their health and well-being but also their capacity for social cohesion and community resilience, thereby entrenching the broader cycle of deprivation and distress within the camp. Furthermore, the lack of reliable water access is perceived as a critical barrier to educational and economic advancement, as the time spent managing water shortages detracts from opportunities for learning and income generation. This situation underscores the urgent need for systemic interventions to alleviate these pervasive water-related challenges.

6.1. Addressing the Complex Nexus of Water, Sanitation, and Human Rights in Refugee Camps

The humanitarian crisis witnessed within the Madanpur Khadar Rohingya refugee camp in Delhi, India serves as a stark reminder of the urgent need to address the complex interplay of water, sanitation, and human rights in the lives of vulnerable populations. This conclusion encapsulates the key findings and discussions from various sections of this study, underlining the multifaceted challenges faced by the Rohingya refugees and the imperative for comprehensive intervention.

6.2. A Dire Water Crisis

The plight of the camp's residents is defined by a dire water crisis. Despite the provision of a 10,000 L water tank, the daily allocation of 38 L per person falls significantly below international standards. The irregularity of water tank deliveries compounds the problem, forcing residents to ration their water usage and prioritize essential needs. As a result, residents endure prolonged waiting times in queues under harsh conditions to secure their share of meager resources.

6.3. Health Implications

The scarcity of water has profound health implications for the camp's inhabitants. Waterborne and vector-borne diseases, including diarrhea and skin disorders, are alarmingly prevalent. Several instances of death due to waterborne diseases have occurred in recent years, underscoring the urgency of addressing health risks. Women, in particular, face unique challenges associated with inadequate WaSH facilities, with a staggering 95% reporting urinary tract infections (UTIs) due to unhygienic conditions.

6.4. Gender Disparities and Economic Struggles

A notable gender disparity emerges in water consumption patterns, with adult women consuming significantly less water than men. The burden of water collection and management often falls disproportionately on women. The economic repercussions of the water crisis are significant, as residents are compelled to purchase additional water, leading to financial strain and missed work opportunities.

6.5. Environmental Impact

The camp's location in a shallow terrain exacerbates water-related challenges during the monsoon season. Flooding leads to stagnant water, creating breeding grounds for disease-carrying mosquitoes and posing health risks. The lack of sanitation facilities exacerbates the environmental impact.

6.6. Human Rights and Dignity

The dire WaSH conditions within the camp directly impede the realization of fundamental human rights. Access to clean water and sanitation is an inherent human right, as recognized by international conventions. The camp's residents are deprived of this basic entitlement, leading to violations of their dignity, privacy, and overall well-being.

7. Recommendations for Comprehensive Intervention

Addressing the multifaceted challenges faced by the Rohingya refugees in the Madanpur Khadar camp requires a holistic approach that encompasses various dimensions of water, sanitation, and human rights. The following recommendations outline key actions needed to alleviate the dire situation within the camp:

(1) *Increase Water Supply:* The most immediate and pressing concern is the need for a consistent and adequate supply of clean water. Efforts should be made to ensure that the 10,000 L water tank provided by The Delhi Jal Board is filled to its capacity with potable water. Regular and transparent monitoring of water allocation should be implemented to prevent irregularities and ensure that each resident receives their fair share of water. Moreover, it is crucial to explore options for enhancing the overall quantity of water supplied to the camp, considering the increasing population.

(2) *Sanitation Facilities:* The camp urgently requires the establishment of proper sanitation facilities. Accessible and gender-sensitive toilet facilities should be constructed, providing residents with a safe and private environment. Special attention should be given to the needs of women and girls, ensuring that they have access to clean and secure sanitation facilities. Menstrual hygiene management facilities, including the provision of sanitary napkins and disposal mechanisms, should be made available.

(3) *Healthcare Services:* Improved access to healthcare services is essential to address the health challenges resulting from the water and sanitation crisis. Preventive healthcare measures, health education, and awareness campaigns should be conducted within the camp. Regular health check-ups and medical support for those suffering from waterborne diseases or other health issues should be provided. Additionally, efforts should be made to address the mental health impacts of living in such challenging conditions.

(4) *Gender Equity:* Recognizing the specific vulnerabilities faced by women and girls in the camp, gender-sensitive interventions should be prioritized. This includes ensuring their safety and privacy in sanitation facilities and addressing menstrual hygiene needs. Women should be actively engaged in decision-making processes related to water and sanitation.

(5) *Environmental Management:* Given the camp's vulnerability to flooding during the monsoon season, measures should be taken to mitigate the environmental impact. Improved drainage systems and elevated housing structures can help prevent stagnant water, which becomes a breeding ground for diseases. These initiatives should be accompanied by waste management strategies to ensure the camp remains clean and safe.

(6) *Economic Support:* The economic burden on camp residents due to water scarcity cannot be underestimated. As such, mechanisms should be established to provide economic support to families facing financial strain. This may include income-generating opportunities, subsidies for essential goods, or financial assistance programs.

(7) *Community Engagement:* The active involvement of the refugee community in decision-making processes and intervention implementation is crucial. Residents should be empowered to participate in shaping the solutions that directly impact their lives. Community-led initiatives and awareness campaigns can also play a significant role in improving water and sanitation practices.

In summary, the Madanpur Khadar Rohingya refugee camp epitomizes the urgent need for humanitarian action and international solidarity. Addressing the water and sanitation crisis within the camp is not merely a matter of improving living conditions but a moral imperative rooted in the principles of human rights and human dignity. It is a collective responsibility to ensure that vulnerable populations, like the Rohingya refugees, are afforded the basic necessities of life, including clean water, sanitation, and the preservation of their inherent human rights. By heeding these recommendations and implementing comprehensive interventions, we can take meaningful steps towards

alleviating the suffering of those who have already endured so much. The time for action is now.

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