

**Working Paper  
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# **Bringing WASH into the Water–Energy–Food Nexus in Humanitarian Settings**

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**Shilpi Srivastava, Jeremy Allouche, Roz Price and  
Tina Nelis**

**February 2022**

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## Summary

This paper examines the water–energy–food (WEF) nexus in a humanitarian context, with a specific focus on water, sanitation and hygiene (WASH). It highlights the complex and non-linear interactions that WASH has with other areas of the WEF nexus. In doing so, it blends the social dimensions (access, safety, consumption, and use) with the WEF resource dimensions (availability and resource sustainability), including a further emphasis on sanitation as a key, but often ignored, element of the WEF nexus.

Drawing on the case of the Rohingya refugee camps in Bangladesh, we examine how household-level access to WASH shapes and is shaped by use, access, and availability of energy and food, and finally their effects on host–refugee interactions. We find that there are implicit and explicit links between WASH and WEF. Moreover, any small intervention in any of the WEF areas has positive knock-on effects on the other resources, especially in enhancing resource access and use. We conclude that bottom-up perspectives on these interlinkages with active participation from both host and refugee households are required to understand the implicit and explicit connections across WASH and the WEF nexus in humanitarian contexts. We also argue that sanitation is a key element of the WEF nexus and should not be ignored within the predominant resource-centric framing of the WEF.

## Keywords

Water–energy–food; WEF nexus; sanitation; WASH; humanitarian; refugees; host.

## Authors

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## Executive Summary

The water–energy–food (WEF) nexus is increasingly viewed by policymakers and practitioners as a facilitator of sustainable development to move beyond sectoral, policy, and disciplinary silos. However, the emphasis on the productive uses of water (agriculture, industry) means that the domestic and livelihoods perspectives have largely remained peripheral to the nexus. This has also meant that water, sanitation and hygiene (WASH), and in particular sanitation, often gets relegated as the ‘hidden’ sector within the WEF debates.

This Working Paper aims to contribute to the understanding of applying the WEF nexus in a humanitarian context, with a specific focus on WASH. In most humanitarian settings, due to the multiplicity of actors, and service providers, WASH provision is a collection of overlapping systems of consumption and provision that are heavily structured around daily living conditions. These tensions and siloes have been recognised and new approaches around a humanitarian–development nexus are being developed, but these still need to engage far more with issues of access and the social dimensions of resource use rather than broader politics and planning processes.

The paper is based on a study undertaken for the United Nations High Commissioner for Refugees (UNHCR) that examined the multi-sector programme planning for the Rohingya refugee crisis. The original study deployed a sequential mixed-methods design drawing on qualitative and quantitative data collection and analysis methods. In this paper, we primarily focus on the qualitative component of the study. We emphasise the everyday dimensions of access, use, safety, and security that shape the social interactions within and across the WEF nexus, to move away from a purely resource-centric understanding of the nexus.

Differential access across the four sites meant that the interactions between WASH, food, and energy are also quite different across these sites. The sanitation services are still confronted with this last-mile problem as vulnerable populations within the refugees continue to face challenges of access and use.

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## Acronyms

CLTS	Community-Led Total Sanitation
FSM	faecal sludge management
LPG	liquified petroleum gas
NGO	non-governmental organisation
(S)WFE	sanitation–water–energy–food
UNHCR	United Nations High Commissioner for Refugees
WASH	water, sanitation and hygiene
WFE	water–energy–food

# 1. Introduction

In recent years, an integrated approach to the water–energy–food (WEF) nexus has been increasingly viewed as a facilitator of sustainable development by policymakers and practitioners (de Andrade Guerra *et al.* 2021). This was especially the case following the 2007–08 crisis, in that food and energy supply was in high demand but with limited access; cooperation between these different sectors was seen as a way to address these challenges (Al-Saidi and Elagib 2017).

As such, a nexus approach can provide useful insights for the integration of complex systems (Srivastava and Allouche 2017). The nexus aims to ‘identify trade-offs and synergies of water, energy, and food systems, internalize social and environmental impacts and guide the development of cross-sectoral policies’ (Albrecht, Crotoft and Scott 2018: 1). It proposes that these systems are inextricably linked, and thus integrated approaches are required that move beyond sectoral, policy, and disciplinary silos. The nexus is also a political process, one where the interplay of different types of power, as well as the actors wielding them, is not just a procedurally technical one (Allouche, Middleton and Gyawali 2019).

Whilst conceptually it seems logical that resource use is interconnected, making this into useful, practical planning tools has proven elusive (Allouche, Middleton and Gyawali 2014), with sector experts reluctant to ‘stray’ into other people’s work, and time constraints preventing engagement with different theoretical models (UNHCR n.d.). Hence, despite its global currency and integrated frameworks to bring together the three interdependent sectors (water, energy, and food), there is no clear way in which to implement this approach. Although the nexus is promoted as a planning tool across policy actors, its context-specific drivers and implications are often ignored leading to tension between top-down and bottom-up processes. Equally, looking at the interactions between water, energy, and food through a resource-centric lens and placing a strong emphasis on quantitative and modelling approaches (Kaddoura and El Khatib 2017; Zhang *et al.* 2018) has meant that the everyday dimensions of access, use, safety, and security that shape the day-to-day (or social) interactions within and across the WEF nexus – which we have called the social nexus – have been obscured (UNHCR n.d.). This paper aims to explore these critical issues in humanitarian contexts.

Context plays a fundamental role in the success or failure of such an approach. For example, water has always been central to the WEF paradigm (Allouche *et al.* 2014). However, the emphasis on resource dynamics (water for agriculture, industry, or what are generally known as the productive uses of water) (Li *et al.* 2021; Moiola *et al.* 2018) means that the domestic and

livelihoods perspectives have largely remained peripheral to the nexus. Although, as several scholars have argued, these are inextricably linked (see Mehta *et al.* 2020; van Koppen, Moriarty and Boelee 2006), this has meant that water, sanitation and hygiene (WASH), and in particular sanitation, often gets relegated as the ‘hidden’ sector within the WEF debates.

Importantly, in the humanitarian sector, there has been limited practical knowledge around the WEF nexus in humanitarian contexts (FAO and Practical Action 2020). In humanitarian situations where interventions initially designed in the acute emergency response phase are no longer fit for purpose in a protracted crisis setting, the importance of the interlinkages between WASH pathways and the WEF nexus cannot be underestimated but are rarely considered. We will do this by foregrounding WASH in the WEF paradigm using the term (S)WEF (sanitation–water–energy–food) nexus to tease out the different pathways through which water and sanitation shape the nexus and vice versa. For example, in critical emergency settings, WASH infrastructure and services often constitute the first line of response. However, the time-sensitive nature of response can result in neglecting the resource dimension, thus focusing predominantly, and understandably so, on providing critical services. This can result in trade-offs in the long term with significant spillover effects on other sectors such as food, energy, security, and livelihoods.

This Working Paper is based on a study undertaken for the United Nations High Commissioner for Refugees (UNHCR) that looked at multi-sector programme planning for the Rohingya refugee crisis. The paper aims to contribute to the understanding of applying the WEF nexus in a humanitarian context, with a specific focus on WASH, and highlights the complex and non-linear interactions it has with other areas of the WEF nexus (Srivastava and Allouche 2017). Using primary data from four Rohingya refugee camps based in Cox’s Bazar district in Bangladesh, we focus on examining how these (S)WEF interactions play out in the livelihoods and daily practices of local people and how they shape their access to and use of resources, livelihood patterns, host–refugee interactions, and their overall wellbeing (protection, security, labour). Thus, the paper offers a nexus perspective on water and sanitation that blends the social nexus dimensions (access, safety, consumption, and use) with the WEF resource dimensions (availability and resource sustainability), including a further emphasis on sanitation as a key (but often ignored) element of the WEF nexus.

The paper is structured as follows. Section 2 discusses the idea of the WEF nexus in humanitarian settings and how water and sanitation can be linked to these resources and social interactions. Section 3 provides an overview of these resource and social challenges and interactions in four Rohingya refugee camps in Cox’s Bazar. Finally, Section 4 provides concluding thoughts and key recommendations on how to take this policy agenda forward.

## 2. What is the WEF nexus?

The World Economic Forum first proposed the concept of the WEF nexus in 2008; its formulation was largely driven by water security concerns but nowadays incorporates other drivers. It has also been promoted as one of the underlying concepts by the German government in the development towards the Sustainable Development Goals, and others argue that it is a main component of the green economy. It is also now present in many regional policies and strategies in Europe, North America, and Asia with respect to sustainability. Many research–policy–practice partnerships are also currently being developed using this concept. Several transnational corporations (such as SABMiller and Nestlé) have also been keen to operationalise this concept through global supply chains and have developed policy and project-level partnerships with conservation non-governmental organisations (NGOs) such as the International Union for Conservation of Nature (IUCN) and the World Wide Fund for Nature (WWF).

As a concept, it lacks a uniform definition (de Andrade Guerra *et al.* 2021), evoking an ‘integrative imaginary’ (Cairns and Krzywoszynska 2016). And although its boundaries are still very much disputed (Pittock, Hussey and McGlennon 2013; Rees 2013; Srivastava and Mehta 2014), it is often seen as a planning tool to provide knowledge that decision makers can then use ‘to reduce trade-offs and encourage synergistic integration across sectors, avoiding the externalities and adverse effects arising from considering each sector separately’ (de Andrade Guerra *et al.* 2021: 99).

Despite this adoption in certain policy spheres and through research–policy–practice partnerships, WEF thinking has not penetrated the humanitarian sector to any notable degree. As we argue in this paper, if we understand nexuses to be interlinkages across different kinds of resources – water, energy, food, climate – then we are essentially referring to not only interdependent systems (as emphasised by the nexus thinking) but inherently complex systems which, as we explain, can be far more challenging in humanitarian contexts.

### 2.1 WEF nexus in humanitarian settings

In humanitarian settings, nexus assessment is even more complex because of the multi-layered nature of governance. This is constituted by interactions between humanitarian actors and the government, across humanitarian actors, and within these humanitarian actors’ relationships with NGOs. The political situation is also less predictable because of the refugee–host relationships, as well as the relationship between the host government and the government of the country from where the (refugee) populations have been displaced.

## 2.2 Bringing WASH into WEF in humanitarian contexts

In most humanitarian settings, due to the multiplicity of actors, and service providers, WASH provision is a collection of overlapping systems of consumption and provision that are heavily structured around daily living conditions (O’Keefe *et al.* 2015). These overlapping systems and the ways they evolve sometimes create tensions and siloes in parallel to more development-oriented approaches to WASH. Of course, these tensions and siloes have been recognised and new approaches around a humanitarian–development nexus are being developed, but these still need to engage far more with issues of access and the social dimensions of resource use rather than broader politics and planning processes.

The different objectives and goals of humanitarian and development WASH programmes translate into different modalities for service delivery. Analysis by Mason and Mosello (2016: 3) highlighted that problematic differences in implementation arise around timeframes, (over)reliance on supply-driven or demand-driven WASH approaches, and longer-term management responsibilities. There are also tensions between subsidised and demand-led approaches to WASH, especially related to sanitation (*ibid.*). For example, **payment and reward** to communities is a major point of contention as this contrasts with the common approach of development-oriented WASH interventions, which require voluntary inputs from communities to enhance ownership and reduce costs. In development contexts, there is widespread use of approaches such as Community-Led Total Sanitation (CLTS) which discourage the use of any subsidies in order to avoid distorting or disrupting collective action around ending open defecation (Kar 2018; Mason and Mosello 2016). For many humanitarians, subsidised, supply-driven service provision meanwhile remains necessary for reaching highly vulnerable households and safeguarding public health.

Additionally, the use of **technology and management systems, especially for WASH**, in humanitarian settings has been an important topic up to now. However, Tull (2017) highlights that there is a paucity of information describing models used in specific refugee camps in low-income areas and that there are few published evaluations on affordable wastewater treatment plants used in emergency settings. Through an extensive global consultation with over 900 WASH practitioners and in-depth evidence reviews (including a gap analysis), Elrha (2019) identified a list of recurrent WASH challenges that remain unaddressed, including in faecal sludge management (FSM), safe drinking water, and surface water treatment. The lack of an evidence base for the effectiveness of commonly used treatment technologies such as household water filters in humanitarian settings; the lack of low tech, simple solutions which are acceptable, maintainable, and sustainable by the local population; and the

limited evidence and guidance on safe water provision, especially when it comes to water chlorination and other disinfection protocols were highlighted as key issues for water treatment (Elrha 2019: 26).

In the Elrha review, sanitation was identified as the area with the most challenges and potential for innovation. Priority areas include limited options for storing, treating, and disposing of faecal sludge, particularly in areas where building pit latrines is not possible, and the lack of practical guidance on how to set up safe and sustainable faecal sludge disposal. Another core challenge is the limited use of purpose-built latrines, as these often fail to address the sanitation needs and practices of affected communities, leading people to prefer open defecation (*ibid.*: 50). Two core problems were highlighted for effective surface water drainage: (1) while surface water drainage solutions exist, the information is scattered across multiple sources, and it is not always clear which solutions are best to use in which context; (2) most of the existing solutions come from the development sector and are often resource-intensive and impractical in a humanitarian crisis (*ibid.*: 72) as well as not being grounded in the local realities of host–refugee interactions, vulnerability, and security.

For example, in the Za’atari camp in Jordan, which has around 100,000 Syrian refugees, refugees’ concerns around personal safety and privacy deterred the use of communal WASH blocks. As a result, the majority (84.6 per cent by late-2014) constructed toilets and showers adjacent to their shelter (van der Helm *et al.* 2017), thereby increasing the risk of water contamination. This was also observed in the context of the Rohingya refugee camps (see Section 3). Not all pathways are straightforward, and these are often embedded in the particularities of place, resource availability and access and, most importantly, in the context of humanitarian settings, host–refugee interaction. This is also discussed further in the paper.

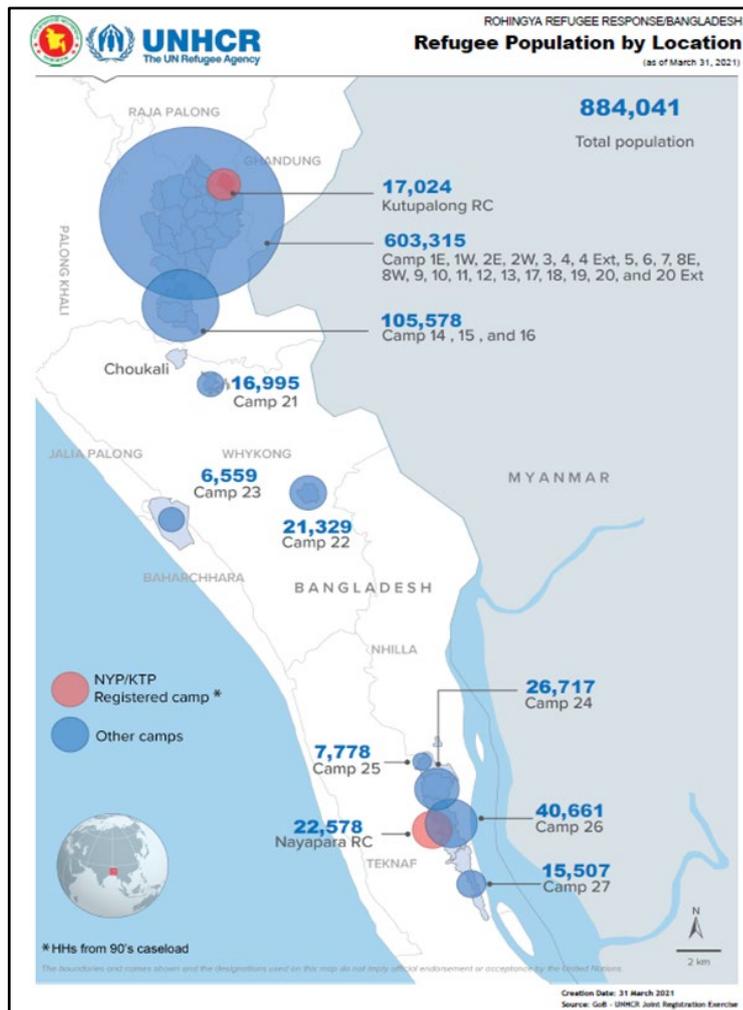
Through the case of the Rohingya refugee camps, this paper will demonstrate how WASH is interconnected with energy, food, and nutrition systems, particularly at the host-camp and household levels.

## 3. Studying WASH through the WEF lens: the case of Cox's Bazar

### 3.1 Background

Since August 2017, approximately 733,343 Rohingya refugees from Myanmar have arrived in the Cox's Bazar district in Bangladesh as a result of military repression in Myanmar's state of Rakhine (UNHCR 2021). Prior to the refugee influx in 2017, there were several waves of displacement in 2016, 1991–92, and 1978. The camps in Cox's Bazar district are now the largest in the world and the Rohingya refugee crisis continues to place a major hosting effort on the Ukhiya and Teknaf administrative sub-districts.

Figure 3.1 Refugee camps in Cox's Bazar



Source: UNHCR (2021), CC BY 3.0.

Cox's Bazar ranks among the less-developed districts in Bangladesh and the region lagged behind the national average even before the crisis. The displaced Rohingya population influx has further exacerbated the situation. Low levels of access to energy, drinking water, sanitation, and nutrition are reported across host and refugee households in the Ukhiya/Teknaf Peninsula (ISCG 2019).

The complex and volatile policy dynamics in Cox's Bazar also shapes critical service delivery and access. The state of Bangladesh is still unclear about medium- and long-term planning around the Rohingya crisis. It is also facing broader resource management issues in the Ukhiya/Teknaf Peninsula, security and safety issues most notably linked to the drug trade (Inter-Agency Report 2018), and the management of the co-existence between the host communities and refugees. The major concern for humanitarian organisations and the local government is managing the relationship between refugees and host communities; however, the current dominant narrative is mostly around negative impacts, especially concerning the Rohingya crisis' impact on the local economy and job opportunities. In addition to these social challenges, the rocky, undulating terrain in the peninsula and flooding in monsoon season presents further physical challenges in this region.

## 3.2 Methodology

The original study from which this case is derived drew on Flammini *et al.*'s (2014) approach of the nexus assessment to understand the WEF interactions, using a context analysis followed by a more in-depth assessment of the impacts of selected technological interventions on resource use. These include **technological solutions** (such as developing biogas facilities, solar pumps, rooftop vegetable gardening, food vouchers); **social interventions** or solutions developed to improve interactions between the host and refugee communities (markets); and **formal and/or informal practices** through which people access water, sanitation, food, and energy according to their preferences and social and economic conditions.<sup>1</sup> Both formal (innovation-based) and informal (buying, selling, or sharing of WEF resources) mediums of access and use were studied. In this Working Paper, we explicitly focus on the innovations within WASH (FSM plants,<sup>2</sup> mechanised systems of water access, access to and use of toilets) and those that shape its use and access (liquefied petroleum gas (LPG) and solar lighting).

Four UNHCR-managed camps in Ukhiya sub-district (*upazila*) and Teknaf sub-district contiguous with their host communities were chosen for the study (see

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1 Specific innovations studied were: WASH (FSM and solar pumps); energy (mini-grid for solar lights and LPG); food (farmers' market and e-voucher); and livelihoods (homestead vegetable production).

2 We used availability and access to toilets, and practices around the disposal of faecal waste as proxies for FSM to simplify our communication with household respondents.

Table 3.1). Data collection was conducted over a period of one month, August–September 2020, and conducted by icddr,b – our local partner in Bangladesh.

**Table 3.1 Camp profiles and status of water and sanitation facilities**

	Location and context	Population (2020)	Number of functional latrines (2020)	Number of functional water points (2020)	Average litres of potable water per person/per day at HH level (2019)
Camp A	Some blocks located in hilly areas so some challenges in WASH delivery	38,005	891 (chambers) Number of people per functional latrine: 20	492 Number of people per functional water point: 250	11.7 litres
Camp B	Heavily affected by the monsoon rains – both flooding and landslides	16,713	166 (chambers) Number of people per functional latrine: 101	114 144	12.9 litres
Camp C	Hilly topography presents challenges for the provision of basic services (e.g. water), with a lack of groundwater and risk of landslides, particularly during monsoon season	40,440	1,222 (chambers) Number of people per functional latrine: 33	153 Number of people per functional water point: 266	33.9 litres

	Location and context	Population (2020)	Number of functional latrines (2020)	Number of functional water points (2020)	Average litres of potable water per person/per day at HH level (2019)
Camp D	Topography and remote location challenges access to sanitation, with low availability of sanitation services	14,921	1,027 (chambers)  Number of people per functional latrine: 14	248  Number of people per functional water point: 60	9.3 litres

Source: Adapted from UNHCR (2019, 2020) and interviews (IDS 2020).

**Data collection:** The study deployed a sequential mixed-methods design drawing on qualitative and quantitative data collection and analysis methods (UNHCR n.d.). The original research design had to be adapted to remote data collection methods, which principally relied on remote stakeholder interviews (conducted via Microsoft Teams and Zoom) and household interviews (conducted via phone). As a first step, 1,010 quantitative surveys were conducted. Most surveyed households lived within the four sites. These 649 in-camp households comprised 501 Rohingya refugee households and 148 host households. Host and refugee respondents were randomly sampled (residential location and gender) from the proGres database by UNHCR; this is the population database and the data points were randomly drawn from only the four in-camp sites we were interested in. Rapid qualitative household interviews (focusing on 10–12 questions) were conducted with a sub-set of the quantitative sample. This was done to understand the household level WEF interactions and perceptions regarding the use of innovation and its role (or not) in shaping wellbeing of refugee households. Similarly, we conducted interviews with host households (men and women) to understand the WEF interactions around key livelihood resources (food, water, or energy). During the quantitative survey, we asked the respondent whether s/he was willing and available to be part of our rapid interview and also got enumerators to lodge their consent. We ensured that the selected households were not outliers based on these key variables. In addition, we conducted 15 key informant interviews (KIIs) with NGOs and UNHCR field staff working in the four camps. In total, 126 qualitative interviews were conducted.

**Table 3.2 Snapshot of methodology**

	Quantitative	Qualitative	Total
Total sample size	1,010	126	1,136
Tools of the survey	Phone-based survey	Remote KIs via Zoom platform; phone-based qualitative interviews	3 tools
Type of stakeholders	Refugee and host households	Key stakeholders (NGOs; humanitarian and donor agencies working in the camps; key respondents from the camps ( <i>majhi</i> , imams, shopkeepers, refugee and host households)	3

Source: UNHCR (2020), unpublished.

**Data analysis:** All interviews and discussions were transcribed by icddr,b researchers using the audio recordings and notes. All transcripts were cross-checked by the research lead and translated into English. The qualitative data was analysed using a directed content analysis approach focused on the main qualitative questions for Phase 2 (Patton 2008). Data analysis started with open coding of several interview transcripts (in NVivo12) using the qualitative topic guides as the overarching framework. Open coding means that the transcripts were read several times and then initial codes were created to summarise and categorise the findings. Based on this, an initial coding scheme that guided the coding of the remaining data was developed. To increase the rigour of the data analysis, coding was done independently by two researchers. The quantitative survey was administered using Kobo toolbox. The enumerators who conducted the phone survey from their homes were trained by the UNHCR to use the Kobo platform. Quantitative data was uploaded to and stored on the UNHCR-managed server running Kobo toolbox. Data cleaning was done by icddr,b using Stata. There were some duplicates, which were removed during data cleaning. Qualitative data was stored in the shared Teams folder and then uploaded to a secure OneDrive platform at IDS. Data was anonymised before uploading it to the cloud-based service.

**Limitations and caveats:** The study was interrupted by the Covid-19 pandemic, and the camps were ‘locked down’ before the primary data collection could be undertaken in 2020. As a result, the team adapted the methodology to use telephone interviews, with respondents randomly sampled. Since the key stakeholders were also responding to the Covid-19 emergency, not all respondents were available for a discussion. This challenge was particularly acute when it came to household-level interviews where network connectivity was a huge barrier. Skewed mobile ownership and access also created challenges of accessing female respondents. The study focused on essential resources such as food, water, and sanitation. Since basic services were affected due to Covid-19, this immediate experience of reduced services and the ensuing challenges may have coloured the household responses. Additionally, data was collected during the monsoon period when WASH challenges are plenty and this could have shaped the responses as well.

### 3.3 Findings: WASH and the nexus

Water and sanitation provision in the camps was initially extremely chaotic because the humanitarian actors were responding to the emergency of the sudden Rohingya refugee influx (Faysal and MacDougall 2018). The emergency toilets, typically based on the standard Bangladeshi design for emergency flood response latrines (with 2.5-foot diameter rings and a 5-foot depth), were not fit for purpose in the Rohingya camps due to the number of users and poor infiltration of liquid into clayey and waterlogged soils (UNHCR n.d.). Improved designs with higher capacity pits were developed and standardised. Alternative toilet models, with partial treatment of the waste during containment, were installed and two technologies (biogas digesters and vermi-filter toilets) were scaled up for more rigorous evaluation (*ibid.*). Furthermore, during the early stages of the Rohingya influx, WASH response did not undertake gender analysis to inform the design and implementation of activities and the construction of facilities, leading to women and girls facing major barriers to accessing WASH facilities (such as facilities being non-sex-segregated and unsafe) (ISCG 2021). Many of these issues are now well documented and understood and steps are being taken to address them.

Thus, this situation has gradually been brought under control over the years that the camps have been in existence, although some challenges persist as documented in this study. The main pillars of the emergent system are a water ‘master plan’ and a patchwork of sanitation solutions. For example, whilst the water master plan serves the Kutupalong mega-camp, the Teknaf/Nayapara camps in the south of the peninsular face water stress (ISCG 2019). Reservoirs have been built in the camp to take account of the extensive monsoon rains, but this has still not solved the increased pressure (IDS 2020). Whilst Ukhiya appears to have ample groundwater, the massive population strain because of

the refugee influx has also created water access issues, especially for the local population. A 2020 survey of the aquifers has shown a deep, clay-lined reservoir with minimal salty water ingress. However, the major increase in usage means that the water levels drop some 18 metres until the monsoon, which then recharges the aquifer (Groundwater Relief and Dhaka University 2020). With the majority of local water access via shallow handpump tube wells, this means that when the aquifer level drops, these are no longer viable. This has fed resentment in the local community as they associate it with the negative impact of the refugees (Roy 2018).

Reliance on all surface water and river-collected water also increases the possibilities of surface water contamination in the case of poor sanitation practices (see below). For example, a study by UNHCR (n.d.) also noted that effluent and biosolids disposal may be the biggest challenge in the long term due to the limited availability of land and the low flows of watercourses. Three interrelated sanitation strategies (FSM, inclusive sanitation facilities, and solid waste management) have been developed by the WASH sector in the Rohingya camps, focusing on the minimum requirements for interventions (UNHCR n.d.). We now turn to the everyday WASH practices, including use and access, and explore the links with the wider nexus dynamics.

**Access:** Differential access across the four sites meant that the interactions between WASH, food, and energy were also quite different in these sites. Some camps were located in hilly areas with poor service provision, some in more remote areas, or some on sites that were more prone to flooding and landslides during the monsoon season. In all four camps, water availability has improved in recent years although spatial access to water remains highly uneven. In Teknaf (Camps C and D), water is supplied by large tanks brought from outside. There are some seasonal challenges related to water access, especially during the summer months as the reservoirs run dry. There are also challenges in Ukhiya in the hilly areas of A and B, where refugees reported long wait times and restricted access as people collected water in big jars or gallons.

In terms of water access and use, the key issue is drinking water. While on average, most refugee households reported that they had switched to using water tanks or tube wells provided by NGOs in the last year (as of August 2020) instead of accessing water through open sources (ponds and canals), some households resort to using rainwater for drinking while others had to buy water from host communities. This trend was particularly noticeable among refugees who live outside of the camp in rented accommodation. Host households in the camp considered that their situation in terms of water access and availability was worse compared to refugee households since their exposure to innovation (tank and tube wells was quite limited). For example, a host respondent in Camp A mentioned this differential access in the following way:

*Tube well was provided here for Rohingya, the water pipeline was given. There are many Rohingyas, men and women, who come here to collect water. I can collect water from the tube well after they finish collecting water. It takes a long time to fetch water.*

(Host: Camp A)

There is a **high burden on the use of toilets** within refugee and host areas. After the 2017 influx, emergency toilets were set up in various camps. These were makeshift structures in the emergency phase. However, over three years – in the consolidation phase – sanitation services have become more targeted although certain access-related challenges persist. For example, one of the critical problems in Camp B is the distance to communal toilets. As a key stakeholder pointed out, one of the main risks is that the most vulnerable populations (older adults, girls, and women) do not go to the toilets at night due to the distance (KII: Camp B). Thus, sanitation services are still confronted with this last-mile problem as vulnerable populations within the refugees continue to face challenges of access and use. Due to the high burden on toilets, respondents complained of long wait times, lack of lights in the toilets, and problems with maintenance. This was particularly difficult for women who had to walk long distances to access toilets. Some respondents also mentioned that toilets were too far:

*We cannot go at the time when you need to access the toilet... it is very far. We need to go in the time of Fazr [morning prayer time]. Suppose we need to go to the latrine at any time of the day, then we cannot use it. It is a problem for all of us.*

(Refugee woman: Camp C)

FSM is functional in all four camps and refugee respondents reported that the desludging of toilets was done regularly, although they did not have any knowledge about sewage being reused in any way to generate energy such as cooking gas.

We now turn to how access to and use of water and sanitation services are shaped by and also impact social and resource interactions in other sectors.

### 3.4 (S)WEF interactions

In the following sections, we analyse how the exposure to WASH innovations or improved services shape the resource nexus in the camp and adjoining host areas. We explicitly focus on how household level access to WASH shapes and is shaped by access to, use of, and availability of energy and food, and finally their effects on host–refugee interactions.

### 3.4.1 Energy

Four key pathways of interaction between water, sanitation, energy use, and access were identified in the study.

**Improved availability of water reduces dependence on open and shallow wells:** Water and energy interactions were clearer in the Ukhiya camps where water is supplied via piped water networks. In Camps A and B, mini energy grids and solar pumps are used. This also means that households have better access to water services. For example, a stakeholder from Camp A explains this interaction in the following way:

*Yes, the solar pumps have brought a change in water access and availability. As I mentioned about the water supply for the beneficiaries, there are tap stands inside the blocks in several places to let people get access to safe drinking water because people used to drink water from shallow tube well sometimes.*

(KII: Camp A)

These households also reported positive health outcomes by way of reduction in diarrhoea. For example, a key stakeholder in Camp B mentioned:

*In these camps, there is relatively less disease incidence because many deep tube wells have been installed in these camps. So, there are fewer outbreaks of diseases such as diarrhoea. In other places outside, where water is taken from shallow sources, the outbreak is higher.*

(KII: KRC)

However, there are limitations with the use of self-reported diarrhoea as a health outcome of an intervention due to inherent biases in the self-reporting process (Ramesh *et al.* 2015; Schmidt 2014). Despite this, there have been previous studies that have found associations between increased access to tube wells and a lower risk of childhood diarrhoea in Bangladesh (see Wu *et al.* 2011).

**Improved LPG/energy access reduces the risks of water contamination:** Another area of interaction is the **use of energy (LPG/firewood) for boiling water**. This was highlighted by those respondents who rely on rainwater or open sources for drinking water or household needs. The Rohingya refugee operation is one of the few in the world that has focused on improving energy provision at the household level. This consists primarily of distributing cooking gas (LPG) to all households as a means of reducing the need for firewood collection. Whilst LPG is the main fuel option, there are other small-scale initiatives underway for energy production.

**Limited uptake of reusing shit as biogas:** In the development sector, several studies (McConville *et al.* 2020; Panesar *et al.* 2018) have explored the reuse potential of shit for biogas. This initiative is also being trialled in a few camps in Cox’s Bazar; however, the uptake is quite low and scaling up remains an issue. It was mentioned that before the 2017 influx, about 10–12 per cent of the population relied on these biogas plants in the camp since a buy-in was created through an IKEA-funded initiative. Camp B has 86 biogas plants; none of the respondents mentioned the use of biogas as a potential source of energy. A KII in Camp A also offered his scepticism about the use of biogas in the following way:

*I have not seen that the sludge is being used for biogas plants. I have seen that [to a] minimal extent in Camp E. But due to the stink, people were not willing to use it.*

In addition to the problem of smell, the introduction of LPG where cylinders were provided to refugee households has also discouraged the uptake of this system.

**Improved energy access leads to improved access to and use of toilets:**

The correlation between better public lighting and access to WASH services has been highlighted in several reports (UNHCR and REACH 2018; UNHCR 2018). Lighting provision has improved over the years. As a result, with solar lighting in place, several male and female respondents reported improved use of toilets and a reduction in the practice of open defecation. However, safe access to toilets in the evening was highlighted as a major issue in several interviews.

All camps are provided with solar lighting in public areas but as with the water services, access to solar lighting also varies across camps and blocks within a particular camp. In the last two years, partner organisations have tried to scale up lighting provision in public spaces (near the mosque, toilets – especially female toilets and water taps). However, these advancements are stymied by the problems of maintenance (KIIs: Camps A, C and D). Several respondents reported instances of theft as the batteries fetch a good price in the market. This illegal sale provides liquid cash which is then used for buying essential provisions such as food (IDS 2020). For example, a key stakeholder in Camp D noted:

*In this case, sometimes we get reports of a few incidents. For example- the host community take away the [toilet] door if they need tin. Sometimes, many solar lights are stolen. We get reports about these types of incidents... if we build good quality toilets, it can also lead to the possibility of more thefts in future.*

This example aptly demonstrates the indirect links between sanitation provision, energy access, and food.

### 3.4.2 Food

In the survey and interviews, host and refugee respondents did not mention any explicit connection between improved water and sanitation conditions with access to food. However, these links are more implicit as several respondents related improvement in terms of better water availability, reduced drudgery, or better cooking habits and thereby improvement in health outcomes. This also resonates with the experiences of some of the refugee households, who agreed that improved water supply had led to changes in their cooking habits, better hygiene, and an increase in meal frequency because of a reduction in their daily drudgery thus leading positive outcomes for women and young girls who often had to spend hours collecting water. Three implicit pathways were identified:

**Improvements in access to water and sanitation have helped in controlling contamination pathways.** Examples of contamination were evident in some of the camps in Cox's Bazar as people resorted to going to the toilet indoors, utensils were then washed in contaminated water, and thus food also became contaminated. Agencies also reported a direct connection between differential access to water, seasonality, and health and food programming in the following way:

*Suppose one wants to do a cooking demonstration programme. In that case, he/she needs to clean rice, vegetables, fish, cooking pans properly which is not possible during a water crisis because if they use lots of water in washing they cannot drink or use water for any other work. They need sufficient water to maintain hygiene. So, where there is a shortage of water supply, they fail to maintain hygiene properly.*

(KII: Camp C)

**Lowering of the disease burden:** Initially, the disease burden was higher than expected and related to safety issues as people – particularly women and girls – felt unsafe accessing latrines at night (due to insufficient lighting and locks). As such, households created bathing spaces within their shelters, negatively affecting the storage quality of water in their homes:

*We used to drink contaminated water before [one year], so we were attacked by diarrhoea a lot, and we had to seek treatment. Now our suffering has reduced, we can bring food from the market and eat after washing them.*

(Refugee committee member: Camp C)

**Improvement in cooking practices** was also reported among households with better access to water leading to improved hygiene. For example, a female refugee stated:

*Previously I had to suffer water scarcity, but now I have enough water available, I have no shortage of water so I can cook with water nicely. I can cook well after cleaning food now. I am getting pure water to use now.*  
(Refugee committee member: Camp D)

### 3.4.3 Host–refugee interactions

One of the more surprising insights in this study was the degree to which the host community was intermingled with the refugees in the camps. This was most prevalent in Camp B, which has been in place for the longest amount of time. In this context, resources are shared (food, for instance) and where the resources benefit both – intuitively – both host and refugee households have incentives to manage these resources properly. However, in the case of water and sanitation, the study noted negative interactions mainly due to differentiated access to provision and services, especially FSM.

**Sharing of water and sanitation services between host and refugee households:** Many of the host households that live within the boundaries of the camp reported sharing toilets and water services with the refugees. This is common across all four camps. Interviews with site focals also noted this shared use of WASH facilities, including FSM services (KII: Camp A). However, in some cases, host households experienced limited exposure to these innovations and some resented being denied the right of first use.

**Limited exposure to innovation leads to poor sanitation practices:** Services and innovation exposure in the host household is quite limited. Host households who do not share services reported poor access to toilets and FSM services. Unlike the refugee households, where respondents could relate to mechanised services for de-sludging, host households tend to resort to poor and unsafe practices of faecal disposal. These include throwing the faeces in the drain/canal or digging a pit. These practices are not only detrimental to their wellbeing but also to the ecosystem, as faecal waste enters soil and water bodies. This is quite critical because both these communities share the same water and waste shed. For example, a host respondent in Camp D stated:

*We dug a hole beside the latrine to dispose of faecal matters... In the camp, people clean the latrine on time. But no one cleans in our area.*  
(Host: Camp D)

All these interactions across the (S)WEF nexus highlight how this approach can provide insights into the management of these resources in humanitarian settings. Dominant humanitarian approaches and policies consider water, sanitation, nutrition, and health as central to humanitarian response, but the above findings highlight how energy and the social nexus, namely the interactions between host and refugee, are central to the way in which this nexus can operate.

## 4. Conclusion and recommendations

Broadly, the study found that there are positive and negative interactions taking place between the (S)WEF nexus. There are both natural resource aspects to these interactions (the resource nexus) as well as socially constructed aspects (the social nexus). It is also possible to see the trade-offs being made. In terms of the social nexus, the study observed refugee and host communities (which are either living inside the camp or living in the peripheries) sharing both water points and toilets; this can lead to positive interaction and mutual understanding through proximity but can also lead to conflict if supply is insufficient. Hence, the social nexus is as important as the physical resource nexus.

**Improvement in water availability and quality has positive effects on food habits and health outcomes.** However, in Teknaf, there is no aquifer and water continues to run out during the dry season, putting pressure on households and thus resulting in communal tensions between host and refugee households.

**Sanitation continues to be a problem:** The Rohingya camps are very different to the contexts in which sanitation technologies have succeeded or failed in the past, due to the unique topography with steep slopes but poor drainage of sub-basins, and the privacy needs of women and girls in Rohingya communities. With the exposure to innovations, refugee communities report improved access to (S)WEF resources. In-camp host communities are also exposed to some (S)WEF innovations since they live within the boundaries of the camp. However, sanitation continues to be a problem, especially for the host communities who feel they do not enjoy the same access to services as the refugees. This may be encouraging unsafe practices such as open defecation and unsafe disposal of faecal waste by the host communities.

**Explicit and implicit links between WASH and energy:** Solar lighting has also been less effective in the camps, although its critical links to protection (primarily for women, girls, and older people at night) and **optimal water and sanitation use is acknowledged by all.** Maintenance and ownership issues are the biggest problems with solar lighting, with some cases of theft of lighting for resale noted as a concern. Delivery interventions in sanitation also tend to ignore these energy–sanitation–precarity links on the ground.

This study has found that any small intervention in any of the WEF areas has positive knock-on effects on the other resources, especially in enhancing resource access and use (water to food/nutrition OR energy to toilet use). This is likely because, in a resource-scarce environment, any small improvement alleviates stress in other areas too. However, this finding also highlights the precarity inherent in such an environment. A sudden drop in funding for LPG

would have serious consequences for the environment, women's workloads, dietary diversity, and host–refugee relations.

## 4.1 Recommendations

**WASH innovations need to be grounded in particular contexts, needs, and locations for positive nexus outcomes:** There is a need to balance the resource-centric (how sanitation–water–energy–food interact) view of the nexus with an analysis of how these resource interactions shape day-to-day interactions of people (i.e. a social/people-centric view), which we have called the social nexus. This means examining how these WEF interactions play out in the livelihoods and daily practices of local people and shape their access to and use of resources, livelihood patterns, host–refugee interactions as well as their overall wellbeing (protection, security, labour). A new institutional entry point could be around the integration and coordination of local innovations that are being introduced or emerging in the camps and the host locations. We propose a bottom-up perspective of seeing this form of integration where hybrid variations of formal and informal governance mechanisms can be introduced to understand and effectively manage access and quality of these resources. This would require understanding resource flows (direct and indirect) as well as interactions (both with the eco-systems and their spillover effects on social interactions).

**Protection, security, and wellbeing are connected to the design of services and innovations:** This is well covered in protection studies by UNHCR (Sida *et al.* 2018) but emerges strongly once more in interviews for this case study. Street lighting is critical to the way water and sanitation are used at night, as is the geographic location of facilities. Poor water and sanitation use has implications for health and wellbeing. Energy (solar lighting) affects water and sanitation use, affects health and nutrition; something best understood in this example as stemming from protection concerns. The case study has shown that there is interesting innovation between water, sanitation, and energy as a complex recycled system where sewage was used to produce biogas. This is a very limited initiative in Camp B with 86 biogas plants and may not be generalised. Also, cultural concerns around waste use and re-use should be factored into these initiatives.

**Focus on both host and refugee households:** Humanitarian camps are not just about refugees but are in many cases places where host and refugee populations mix, particularly in protracted contexts. However, intervention design is just targeted at refugees and their development. This study shows that there are significant spillover effects if host populations are not included in these designs. This has implications for the 'shared' water and waste ecosystem and for wider environmental sustainability. There are both positive and negative social interactions around water, sanitation, energy, and food services. It is

important to identify both positive and negative refugee–host interactions, investing in the positive ones and mitigating the negative ones. Investing in positive social interactions, and in community ownership of resources in general, is both sustainable and relatively low cost. Refugees themselves are the best resource for maintaining current (S)WEF infrastructure, particularly in any scenario where access becomes more constrained. For example, creating refugee maintenance-ownership groups for all critical infrastructure, such as street lighting.

To conclude, bottom-up perspectives on these interlinkages with active participation from both host and refugee households are required to understand the implicit and explicit, and visible and invisible links within and across the nexus in humanitarian contexts.

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