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Impact of Non-Conventional Water Use Development on the Well-Being of Refugees in Jordan

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ABSTRACT

This study aims to explore the dimensions of non-conventional water (NCW) resources, including wastewater treatment and greywater, and their impact on the well-being of refugees in the context of Alzatari refugee camps in Jordan. The research employs the theory of planned behavior (TPB) as a conceptual framework. To look into the connections between NCW, attitudes, subjective norms, and the well-being of public health, education, the environment, and income, the study uses statistical methods like descriptive analysis with SPSS, confirmatory factor analysis (CFA), and mediation analysis with SEM-AMOS. The findings demonstrate that attitudes and subjective norms play mediating roles in the relationship between NCW and the well-being of refugees. The study highlights the importance of addressing these factors, as they significantly influence decision-making processes and perceptions of NCW. Additionally, the analysis reveals that income well-being do not exhibit a significant relationship in the context of refugee camps. Where mental health was the most affected factor. In conclusion, the analysis of refugee attitudes supports the theoretical conclusion of the TPB model, which emphasizes the interaction between well-being and sustainable technological characteristics. These insights contribute to our understanding some of water technology development requirements in vulnerable regions and facilitate the sustainable management of water resources in refugee camps. The study provides valuable information for the development of strategies to address water scarcity while safeguarding the well-being and livelihoods of refugees in asylum areas.

1. INTRODUCTION

Water scarcity is a pressing global issue that affects billions of people and threatens their human rights. Access to adequate water and sanitation is essential for survival, and is recognized as a fundamental human right. However, climate change and extreme weather events, such as droughts and floods, have made water scarcity more prevalent in many regions of the world [1], including the Middle East. Jordan, in particular, is highly vulnerable to water scarcity because it heavily relies on groundwater as its primary source of freshwater [2]. The sustainable management of water resources is crucial for achieving the 2030 Agenda for Sustainable Development. Non-conventional water (NCW) resources, such as desalination, wastewater treatment, greywater, and rainwater collection, have been identified as potential solutions [3], and wastewater treatment has been highlighted under SDGs [4].

In this context, the utilization of NCW sources enhances the accessibility of water resources. Low-quality NCW resources have the potential to be utilized for various purposes such as irrigating lawns, cleaning vehicles, flushing toilets, and cooling systems. Consequently, a substantially larger quantity of drinkable water would be accessible to fulfill the human need for water that is free from contaminants. Effective water systems can prevent contamination and health hazards, boost mental health, and provide open-source green spaces for positive health effects [5]. Not all NCW systems are effective; however, when used in this manner, alternatives have different risks. Ineffective water treatment systems cause environmental contamination, health hazards, psychological distress, social norms, and technology perceptions, which influence public opinion and impact overall well-being [6-9]. The Middle East's wastewater treatment systems are poor imitations of Western concepts and struggle with small- to medium-sized communities with high operating and maintenance costs [10-13]. Jordan stands out as one of the most vulnerable countries concerning water scarcity. However, the success of NCW sources relies on attitudes, social norms, and perceived control. Understanding these factors affects mental health and well-being and plays a role in the success or failure of water reuse programs [14].

The Al-Zaatari refugee camp, is situated in Al Mafraq, Jordan. It is home to 166,827 refugees; the remaining refugees are dispersed across other locations in Jordan. Amman, the capital of Jordan, had the largest concentration of refugees, with a total of 198,020. Figure 1 depicts the quantities of water consumed and wastewater generated in the camp. The refugee camp has three wells with a combined daily capacity of 3000 cubic meters, and trucks deliver water to 55% of the camp's dwellings. 22.3% of the population use communal tanks, 26.7% obtain bottled water from sources outside the camp, and the amount of wastewater generated is 3600 m^3.

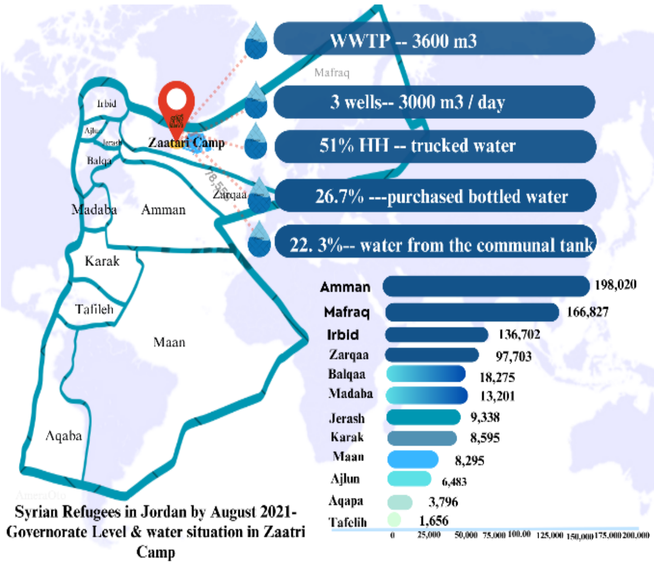

Figure 1. Syrian refugees in Jordan (2021)
Source: UNHCR (2019) and Obeidat & Awawdeh (2021)

This amount of wastewater generation makes it a possible future resource to mitigate water scarcity and climate change [15].

On the other hand, large-scale population displacement can overwhelm wastewater treatment facilities and increase environmental pollution in host communities [16]. Al-Zaatari refugee camp, located in Jordan, is one of the largest refugee camps globally and is situated in a region facing severe water scarcity. The camp is located over the Amman-Zarqa aquifer, and the Jordanian government is concerned that the wastewater from the camp will adversely affect the groundwater quality [17].

Reusing inefficiently treated water can pose difficulties and risks to human health because treated water may contain pathogens, chemicals, and other contaminants. However, the disposal of inefficiently treated water can have negative environmental impacts, such as contamination of surface water and groundwater. Additionally, reusing untreated or inefficient water can lead to problems with plumbing and household installations, such as clogged pipes, foul odors, and corrosion. Constant worry and burden of managing NCW can contribute to increased stress and anxiety among refugees. Unsanitary NCW living conditions and potential health risks can lead to feelings of hopelessness and reduced overall wellbeing. The time and effort required to manage NCW can also reduce opportunities for recreational and social activities, further affecting mental health. Furthermore, time spent collecting, treating, or disposing of greywater can take away from the time that could be spent on educational activities, especially for children. Poor health owing to water-related illnesses can lead to absenteeism and decreased school performance. Lack of access to clean water and proper sanitation facilities in schools can also negatively affect student attendance and learning.

In conclusion, income would be affected, and people would need to look for alternative water resources and spend money on health issues and maintenance work. This highlights the fact that reusing NCW can cause difficulties for public health, the environment, and income. This study emphasizes the ways in which NCW technology affects various aspects of well-being. Therefore, to ensure the smooth introduction of NCW technologies, it is fundamental to understand how water reuse interacts with the existing possible NCW system and impacts refugees' well-being in camps. This study contributes to the ongoing debate on water reuse by conceptualizing the interaction between NCW technologies and refugees' well-being, and addressing the adoption decision and development of NCW systems by assessing their consequences for well-being.

2. LITERATURE REVIEW

2.1 Non-conventional water (NCW)

Non-conventional water (NCW) can be defined as an alternative water resource and a long-term rescue plan against severe water scarcity that does not use traditional water sources (surface water and groundwater). It refers primarily to treatment processes and reuse, which includes desalination (seawater), wastewater treatment, reuse of agricultural drainage water, groundwater extraction, rainwater collection, brackish water, greywater, transportation of water across continents, and transportation of ice masses. To avoid negative impacts, certain criteria and indices are required to justify the consumption level and prevent undesirable effects. Energy is required to produce NCW, and energy consumption has numerous negative economic and environmental effects. Additionally, wastewater treatment and greywater are considered as NCW tools [18, 19]. In other hand the utilization of wastewater for various purposes has been acknowledged as a promising approach to address the issue of water scarcity and climate change on a global scale [20], where wastewater is treated for reuse for industrial, agricultural, and other domestic purposes [21]. Wastewater refers to water that has been contaminated as a result of human use, which can arise from a variety of activities including industrial, agricultural, commercial, and domestic practices.

According to Almanaseer et al. [22], treated wastewater is of significant importance as a NCW resource. Several sectors, including agriculture, crop irrigation, urban landscape irrigation, and industrial processes, use treated wastewater. Places with limited water resources, particularly semi-arid and arid areas, have used this method [23, 24]. Moreover, greywater can be described as a collective term for household wastewater from various domestic sources, including bathtubs, hand basins, showers, laundry machines, kitchen sinks, and dishwashers, except for toilet flushing water [25, 26]. It which constitutes a significant proportion of the total wastewater volume worldwide, ranging from 50% to 80%. In areas where water scarcity is prevalent, treated greywater can serve as a non-conventional alternative to alleviate water scarcity for non-potable purposes, necessitating the implementation of advanced technological methods to effectively eliminate contaminants, particularly micropollutants, associated with the use of various personal care products [27]. However, public approval is important because the costs and effects of these projects directly affect the customers [28, 29]. Recently, there has been a noticeable shift in public perception regarding wastewater reuse, mostly driven by the pressing issue of freshwater scarcity. The increasing acceptance of wastewater reuse demonstrates this shift in attitude, as previously raised concerns have gradually diminished.

Hussein et al. [30] highlighted the effects of the Syrian refugee crisis on Jordan's water sector. Table 1 presents the effects of the four potential scenarios (S1–S4) on the demand for drinking water and wastewater generation in the Mafraq governorate Al-Zaatari camp until 2045. As shown in the table, by 2045, the water demand and wastewater generation will triple if Syrian migrants remain in Jordan. Water demand will increase by 30 MCM/year and wastewater generation will increase in Al-Mafraq. Water demand and wastewater generation in the Al-Mafraq area, particularly in the vicinity of the Al-Zatari camp, will increase under various scenarios from 2015 to 2040. Table 1 highlights the significance of wastewater reuse as a means of addressing water demand in the region while increasing the population.

Table 2 provides a thorough overview of the merits and demerits associated with the use of NCW, particularly focusing on greywater and wastewater treatment (WWT). Drawing from a range of prior studies, the table highlights how NCW adoption may bolster water supplies in regions grappling with scarcity. However, it also underscores the persistent challenges and limitations outlined in the existing literature.

To implement NCW projects effectively, both tangible and intangible factors must be considered. This entails investigating public viewpoints, understanding the significance of incorporating local community members of all genders into the design and maintenance processes, and identifying potential hazards to vulnerable populations. Addressing these considerations is crucial for ensuring the sustained well-being of target communities.

Furthermore, we should adopt a series of measures to promote the wider acceptance and practice of water reuse. This includes establishing new regulations and incentives, as well as advancing sophisticated, economically viable, and environmentally sustainable technological treatment systems. Recognizing water reuse as a distinct alternative within the context of water markets could also contribute to broader integration. Addressing the challenges posed by water scarcity, further compounded by the pressures of conflict and economic crises, is crucial [31].

2.2 Well-being

It includes the concept of well-being, including physical, emotional, social, and psychological aspects. This is crucial for assessing an individual's overall well-being [32]. Influences include cultural and value systems as well as objectives, expectations, and personal beliefs. Sustainability prioritizes societal well-being over environmental well-being.

This finding suggests that relationships with others and the environment can influence self-perception [33]. This highlights the emerging significance of understanding the connection between well-being and non-conventional water sources. This study examines five components of well-being: health, mental health, education, income, and the environmental well-being of refugees. Two instruments developed to assess various aspects of well-being are the Australian Unity Wellbeing Index (AUWI) (PWI, NWI) and the Middle East (ME) index. These instruments have shown a strong performance in previous studies [34-37], see Figure 2.

Table 1. The Mafraq governorate demand for drinking water and wastewater generation through 2024 (scenarios)

Gov.	2015			2020			2025		
Mafraq	Population	Water demand (MCM/y)	WW generation (MCM/y)	Population	Water demand (MCM/y)	WW generation (MCM/y)	Population	Water demand (MCM/y)	WW generation (MCM/y)
	549,948	16,058,428	10,277,428	610,169	17,816,943	11,402,843	676,985	19,767,962	12,651,496
	2023			**2035**			**2040**		
	Population	Water demand (MCM/y)	WW Generation (MCM/y)	Population	Water demand (MCM/y)	WW Generation (MCM/y)	Population	Water demand (MCM/y)	WW Generation (MCM/y)
	751,117	21,932,625	14,063,880	833,367	24,334	15,573,969	924,624	26,999,022	17,279,374
	2045								
	Population	Water demand MCM/y	WW Generation						
	1,025,874	29,955,512	19,171,527						

Note: 380km^3/year (total volume of Wastewater & Grey Water)
Source: Hussein et al. [30] and Breulmann et al. [31]

Table 2. Advantages and disadvantages of NCW from analysis of studies

NCW	Advantages	Disadvantages
Greywater	1) Is useful for landscape irrigation in urban areas 2) Provides plant nutrients and fertilizers in agriculture	1) Spreads infectious diseases and causes bioaccumulation of toxic elements in plants 2) Increases salinity and nitrogen in the soil 3) May cause groundwater contamination 4) Requires the public acceptance 5) Affects mental and psychological health
Wastewater	1) Is suitable for agricultural and urban landscape irrigation, dust control, toilet flushing, and use in carwashes	1) May be dangerous to aquatic life 2) Requires sophisticated treatment 3) Requires the continuous input of energy, chemicals, and labor 4) Requires the public acceptance 5) Affects mental and psychological health

Source: Karimidastenaei et al. [38]

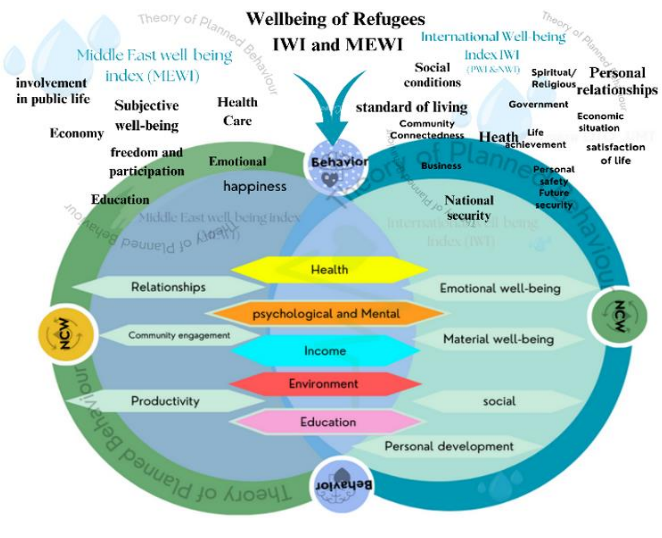

Figure 2. IWI and MEWI [39, 40]

An earlier evaluation categorized the association between NCW systems and well-being as either positive or negative, depending on the effectiveness of the system. This relationship is influenced by a variety of factors, including those related to the environment, human health, education, and economy, as shown by the fact that effective ineffective water systems cause environmental contamination, health hazards, psychological distress, social norms, technology perceptions, and trust, which influence public opinion and impact overall well-being [39, 40]. New water systems and management can impact trust, sociality, worldviews, and relationships between water users and providers [41]. Recycled water can contribute to water resource protection, conservation, and sustainability, as a key component of water and wastewater management.

Numerous studies have reported various implications for well-being resulting from the implementation of NCW systems. These implications manifest in diverse ways, and have been documented in a range of contexts. The proper structuring of NCW systems is crucial for preserving the environment and human health. However, the presence of water-treatment systems in populated areas can adversely affect these critical components. The inadequacy of NCW systems can lead to the release of low-quality water, which may contain a variety of hazardous air pollutants that pose serious health risks to nearby communities [42, 43], and research addresses health concerns over wastewater treatment plant odours [44].

Ineffective systems can potentially contaminate the environment and disrupt the ecological balance, leading to serious health hazards. Furthermore, the leakage of untreated or low-quality water and the perception of the presence of such systems in more vulnerable regions can cause psychological distress and anxiety among individuals, potentially affecting their overall well-being [45, 46]. Research suggests that societal norms, perceptions of the benefits and risks associated with water reuse, and trust in the technology and institutions responsible for its administration can all influence public opinion and indirectly affect people's well-being [47].

This study combines the International Well-being Index (IWI) and the Middle East (ME) well-being index components. This study aims to assess how NCW technologies impact the well-being of refugees across health, mental health, education, income, and the environment. This combination is illustrated in Figure 3. This study evaluated the components of well-being within the framework of NCW technologies used in refugee camps. The survey items are rated from 1 to 5, with higher scores reflecting greater satisfaction. Subsequently, a numerical scale from 0 to 100 was created based on the ratings, with higher scores indicating elevated levels of well-being. This study evaluates the relative importance of each domain and indicator, specifically in the context of NCW technologies. Furthermore, these weights were multiplied by the overall well-being score on a 100-point scale, which also involved assessing well-being across various domains, such as environment, education, income, mental health, and physical health.

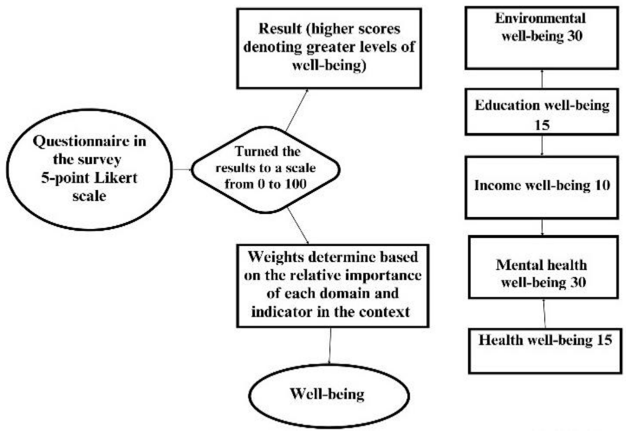

Figure 3. Measuring well-being index

2.3 Theory of planned behavior (TPB)

TPB is a social psychological theory that aims to predict and understand why individuals perform certain behaviors. Behavioral intention is a product of distal constructs, including attitude, subjective norms (SN), and perceived behavioral control (PBC). Attitude, SN, and PBC are hypothesized to predict behavioral intentions, which are directly related to performing the behavior. Attitude and PBC are the most consistent predictors of food choice intentions in young adults and adults. TPB is useful in predicting intention and performance for various health behaviors. TPB found by Ajzen is one of the most commonly applied theoretical perspectives to predict behavioral changes in different sectors. It states that behavior is predicted by an individual's intention to perform a certain behavior, which is influenced by their attitude towards the behavior, or the evaluation of the behavior; SN, or the perception of what others consider appropriate regarding the behavior; and perceived behavioral control, or the perception that one can and is in control of their behavior [48].

TPB suggests that people's attitudes, SN, and perceived attitudes can influence their attitudes. In the context of NCW sources, people's attitudes, perceived social norms related to using NCW sources, and perceived control over using NCW sources can influence their decision to use NCW sources. By taking these factors into account, we can predict how the availability and use of NCW sources will affect people's social and economic well-being. Several cross-sectional studies related to dietary patterns have demonstrated that these constructs directly affect behavior and indirectly affect behavioral intentions. Thus, we will examine whether intention, attitude, subjective norms and behavioral control are associated with refugees' well-being towards NCW development systems' reuse water consumption in Jordan.

3. METHODOLOGY

The study uses theoretical frameworks and empirical research to explore the relationship between NCW and attitude and well-being variables. Microsoft Excel was used for preliminary data exploration, and IBM SPSS Statistics 25 was used to verify the questionnaire's validity and reliability. Descriptive analysis techniques like means, standard deviations, and correlations were employed to provide a comprehensive overview of the collected data. Furthermore, the study employed an established hypothesis-testing approach to examine the causal relationships between observable and/or latent variables. The study used confirmatory factor analysis (CFA-SEM) [49, 50], to validate associations between observed variables and latent constructs, and mediation analysis to evaluate the role of TPB variable in affecting the link between NCW and attitude and well-being. This rigorous methodology integrated statistical techniques and theoretical frameworks to explore the complex interplay between these variables.

Study builds in the model by including the mediating variable as the independent variable and testing the relationship between the independent and dependent variables (i.e., regress Y on X and M).

$$RW = \beta_0 + \beta_1 (WWTP) + \beta_2(GW) + \beta_3(WQ) + \beta_4(ATT) + \epsilon \quad (1)$$

Note: RW is the Refugee Well-being, WWTP is Wastewater Treatment Plant, GW is Grey Water, WQ is Water Quality, ATT is Attitude; ϵ is the error term

The indirect impact studies the relationship that goes from an independent variable to a mediator and then to a dependent variable (a*b). Verify the relationship between the mediating and dependent variables (i.e., regression Y on M).

$$RW = \beta_4 + \beta_5(ATT) + \omega \quad (2)$$

Test the relationship between the independent and mediating variables (i.e., regress M on X).

$$ATT = \beta_4 + \beta_1 (WWTP) + \beta_2(GW) + \beta_3(WQ) + \theta \quad (3)$$

3.1 Sources of data

A literature review was conducted to identify the dimensions of NCW and water quality that influence refugees' well-being and develop the research model. The dimensions examined included environmental factors, mental health, physical health, education, and income [51-55].

The data was obtained for the variables measured from a survey conducted with 500 respondents who were refugees residing in Zaatari camp. The findings illustrate that the majority of the respondents are male, comprising 56.40 percent, while 43.60% are female. In terms of age distribution, the largest group is 31-40 years old, accounting for 34.6% of the respondents. The second largest group is 21-30 years old, making up 30.4%. Respondents aged 41-50 years old make up 17.2%, while those aged 16-21 years old estimate 11.6%. The smallest age group is 50 years old and above, representing 6.2 percent of the total. Overall, the sample is skewed towards male respondents and the 31-40 and 21-30 age groups. The demographic distribution varied, with 32.2% having university or college education, 31.8% having completed secondary school, and 19.6% without any formal education.

In terms of housing, most households resided in tents and caravans. Employment status within these households varied, approximately 34.6% are unemployed, 16.2% are self-employed, 18.2% are involved in part-time work, and 18.6% are housewives.

The reported household income ranged from 100 to 300 Jordanian Dinar. Furthermore, the survey revealed a diverse range of household sizes with a significant proportion of large families.

4. EMPIRICAL RESULT

4.1 Measurement model

A total of 500 valid questionnaires were obtained. The results of CFA indicated an acceptable fit of the TPB measurement model x2 (1912.516, $p < 0.001$, df 737, x2/pdf 2.595, RMSEA 0.05, NNFI 0.926, and CFI 0. 953. Further calculations of composite reliability (CR) and average variance extracted (AVE) were used to assess the reliability, convergent validity, and discriminant validity of the measurement instrument [56]. Based on CR values that were higher than Bagozzi and Yi's [57] recommended value of 0.60, all of the constructs demonstrated good internal consistency. AVE, the average variance extracted for these two constructs (0.876, 0.885), where discriminant validity was achieved for all constructs, was greater than the squared path coefficient (0.752); hence, the discriminant has good validity according to the minimum criterion of 0.50 suggested by Fornell and Larcker [58]. Therefore, it can be concluded that the convergence validity of each dimension is good as showed in Table 3.

Table 3. Model fitting

Bsolute Measures	Structural Model
$\chi 2$ (chi-square)	1912.516
Degrees of freedom	737
Probability	0
GFI	0.988
RMSEA	0.057
Normed chi-square	2.595
Incremental Fit Measures	
NFI	0.926
CFI	0.953
TLI	0.942
Parsimony Measures	
AGFI	0.754
PNFI	0.756

In addition to the above indicators, to test the degree of difference among different facets (potential variables), in this study, a validity test was made. It was found by Fornell that there is good, differential validity among potential variables in a model if the square root of the AVE value for each facet (potential variables) is greater than the Pearson correlation coefficient between that facet and the other facets. Based on the results of the discriminate validity test and the suggestions of Fornell and Larcker, it is important to check if the square root of the AVE value for the relevant latent variable is higher than other related coefficients and other latent variables. Therefore, from Table 4, it can be seen that the latent variables of the questionnaire have better discriminatory validity.

Table 4. Discriminant validity for the measurement model

	WWT	GW	WQ	INM	BI	ATT	PC	SN	H	EDU	MH	ENV
WWT	0.876											
GW	0.752	0.806										
WQ	0.794	0.814	0.885									
INCOM	0.022	0.022	0.025	0.9								
BI_TBP	0.743	0.802	0.782	0.02	0.94							
ATT_TBP	0.755	0.831	0.86	0.03	0.86	0.92						
PC_TBP	0.755	0.775	0.818	0.03	0.83	0.87	0.83					
SN_TBP	0.768	0.788	0.831	0.03	0.85	0.88	0.86	0.9				
H_WB	0.513	0.516	0.573	0.02	0.56	0.61	0.57	0.6	0.96			
EDU	0.462	0.465	0.516	0.02	0.5	0.55	0.52	0.5	0.55	0.94		
MH_WB	0.268	0.269	0.347	0.01	0.29	0.32	0.3	0.3	0.45	0.45	0.91	
ENV_WB	0.667	0.741	0.746	0.03	0.73	0.8	0.75	0.8	0.7	0.57	0.42	0.91

Note1: The figures on the diagonal in bold are AVE.
Note2: Cell entries can be read as an example of:
I. The square structural path coefficient between WWTP and GW is 0.752
II. The average variance extracted for WWTP= 0.876 and GW=0.885
III. The average variance extracted for these two constructs (0.876,0.885) was greater than the squared path coefficient (0.752), hence discriminant validity is established

4.2 Hypothesis testing

Hypothesis testing revealed that the causal relationships between NCW and refugees' well-being (H5, H6, and H7) were not supported. This indicates that there is no statistically significant impact of wastewater treatment plants (t-value = 0.395, p-value = 0.519), greywater (t-value = -1.683, p-value = 0.092), or water quality (t-value = 3.025, p-value = 0.566) on refugees' well-being. Consequently, the study did not accept these hypotheses (see Figure 4).

The findings indicated that H1, H2, H3, and H4 had a total positive effect of attitude on refugees' well-being (p-value = 0.01, t = 19.143), WWTP (p-value =0.02, t = 3.025), GW (p-value = 0.00, t-value = 7.933), and WQ (p-value =0.00, t = 12.94). Further findings for using TPB theory suggest a mediating role of core TPB variables in this effect chain, which is labelled one concept "attitude," indicating a total positive indirect effect of NCW on well-being through TPB variables, which findings indicated significance values for attitude (ATT), subjective norms (SN), and perceived behavioral control (PC) are important factors that affect people's decisions and actions, whereas PC shows no mediation rule for WQ on RW. However, there was no statistically significant effect of greywater and water quality on the well-being of refugees. Overall, attitudes towards behavior and subjective norms (SN) fully mediated the relationship and explained the effects of NCW and RW (see Table 5). In this study, a literature review was conducted to identify the dimensions of NCW and water quality that influence refugee well-being. The dimensions examined included environmental factors, mental health, physical health, education, and income [58-60]. Structural equation modeling (SEM) was employed to analyze these dimensions. The results presented in Table 6 indicate that environmental factors, mental health, and education had a statistically significant association with NCW and water quality. However, income did not exhibit a significant association, suggesting that it did not play a significant role in this study.

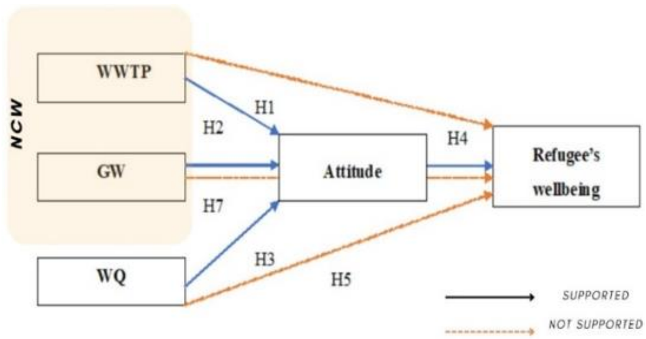

Figure 4. Hypothesis testing

Table 5. Summary of the mediation analysis of TBP components, towards refugees' well-being

Relationship	Direct Relationship	Indirect Relationship	Confidence Level 95%		p-value	t-value	Conclusion
			Lower Bound	Upper Bound			
WWTP→BI→RW	0.761	-0.213	-0.692	0.234	0.389	-0.113	Partially Mediated
WWTP→ATT→RW	0.581	1.664	1.198	2.139	0.003	0.147	Fully Mediation
WWTP→SN→RW	0.587	0.803	0.496	1.152	0.001	0.209	Fully Mediation
WWTP→PC→RW	0.63	0.487	0.22	0.795	0.001	0.3	Fully Mediation
GW→BI→RW	-0.422	-0.411	-1.113	0.308	0.254	-0.178	NO Mediation
GW→ATT→RW	3.005	2.307	0.731	2.96	0.002	0.138	Fully Mediation
GW→SN→RW	1.19	1.215	0.337	2.094	0.005	0.368	Fully Mediation
GW→PC→RW	0.481	0.477	0.021	0.914	0.037	0.472	Fully Mediation
WQ→BI→RW	-0.322	-0.346	-0.976	0.248	0.254	-0.896	No Mediation
WQ→ATT→RW	2.424	0.888	0.719	1.088	0.002	0.105	Fully Mediation
WQ→SN→RW	0.644	0.538	0.003	0.09	0.049	0.513	Fully Mediation
WQ→PC→RW	0.015	-0.118	-0.892	0.527	0.681	-2.975	No Mediation

Table 6. Dimensions of NCW and water quality for refugees' well-being

	Unstandardized	Standardized	t-value	P	R^2
ENV_WB<---WWT	0.616	0.671	20.221	***	0.45
MH_WB<---WWT	0.242	0.221	5.06	***	0.049
EDU<---WWT	0.363	0.482	12.289	***	0.232
H_WB<---WWT	0.455	0.523	13.708	***	0.274
INCOM<---WWT	0.004	0.004	0.084	0.93	0
ENV_WB<---GW	0.718	0.747	25.071	***	0.557
MH_WB<---GW	0.314	0.273	6.337	***	0.074
EDU<---GW	0.409	0.518	13.523	***	0.268
H_WB<---GW	0.464	0.508	13.179	***	0.258
INCOM<---GW	-0.002	-0.002	-0.046	0.96	0
ENV_WB<---WQ	0.615	0.761	26.18	***	0.579
MH_WB<---WQ	0.331	0.342	8.139	***	0.117
EDU<---WQ	0.346	0.522	13.661	***	0.272
H_WB<---WQ	0.465	0.606	17.014	***	0.367
INCOM<---WQ	0	0	0.01	0.99	0

5. POLICY IMPLICATION

Researchers and policymakers can develop capacity-building initiatives for refugees and understand their concerns, focusing on sustainable water systems and raising awareness of their potential future use. By understanding the effluences and risks associated with these systems, refugees can be educated on their effective management and maintenance. Community engagement and awareness campaigns can empower refugees to modify their behavioral intentions, strengthen subjective norms, build trust, and encourage alternative water use systems. Water authorities can enhance the effectiveness and sustainability of projects by considering psychological standards and user well-being. NGOs, donors, and governments should prioritize sustainable support for water and sanitation projects, considering the unique challenges faced by vulnerable people, and ensuring suitable technology for all in the absence of funding allocated to refugees.

6. CONCLUSION

This study highlights the urgent need for resilient water management systems in asylum areas, particularly in areas vulnerable to water scarcity owing to climate change and extreme weather. This emphasizes the importance of local governments and NGOs in understanding people's attitudes and involving them in the process of effective and sustainable implementation.

This study explored the impact of NCW on refugees' well-being, revealing the environmental, educational, health, and mental health factors. Mental health was the most influential factor. This study highlights the importance of understanding the theoretical framework for NCW development in refugee camps. However, behavioral intention did not mediate the relationship between NCW and refugees' well-being. Impediments to NCW acceptance include health concerns and psychological factors" such as the yuck factor and cultural aversion towards NCW, as reflected in SN, attitude, and PC reads.

The findings suggest that stakeholders in developing NCW in refugee camps should prioritize well-being and consider attitudes, norms, and perceived behavioral control. Further research is needed to understand these interactions in different contexts, particularly in vulnerable areas. Addressing cultural aversion and promoting the acceptance of NCW systems can be achieved by involving refugees as stakeholders in effective strategies.

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