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Assessment of Water Quality of Household Tanks in Jordan

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Abstract

Ensuring the quality of household water tanks is crucial for safeguarding human health and maintaining environmental sustainability. This study aims to assess the physical, chemical, and biological parameters of water samples taken from 22 household tanks in Jordan. The findings revealed substantial bacterial contamination in water tanks, notably high levels of Pseudomonas in 11 samples, with counts exceeding 100 CFU/100ml, and total coliforms exceeding permissible limits in two samples. While most chemical and physical parameters were within acceptable ranges, instances of elevated alkalinity and turbidity were observed in some samples. The Water Quality Index (WQI) classifies most samples as “Excellent,” representing 86% of the total, and 14% as “Good.” It is recommended to implement periodic monitoring and maintenance programs to control biological pollution and ensure long-term improvements in water quality . It is vital to enhance public awareness of adequate tank maintenance practices among users, improve public health protection, and help implement sustainable water management initiatives to address climate change.

Keywords: *Water Quality Index (WQI), Household Storage Tanks, Water Management, Water Quality, Jordan*

1. Introduction

Jordan has been categorized as the second most water-poor country in the world in terms of water availability (Malkawi, 2005). Jordan’s renewable water supply barely meets two-thirds of its population’s water demands. The situation is exacerbated by rapid population growth and successive waves of refugees from neighboring countries experiencing conflict, resulting in overwhelming pressure on the already-stretched water supply. Unfortunately, the situation is expected to worsen due to climate change (USAID, 2023). The annual renewable water share is less than 100 m3 per person, significantly below the threshold limit of 500 m3. Despite over 98% of the population having access to an improved water source, access to a safely managed source is about 93%, and only 86% access to the piped network (Al-Kharabsheh and Al-Zboon, 2021; UNICEF, 2022). Urban water supply networks are facing mounting pressures due to escalating water needs driven by population expansion and economic development, and more recently compounded by the impact of climate change where water is supplied to the urban areas once a week. In rural areas, it is even less frequent, typically less than once every two weeks, with reduced frequency during the summer months (Constantine et al., 2017; UNICEF, 2022).

Household water tanks with capacities of 500 to 2000 liters are prevalent in developing urban regions, serving as a dependable, uninterrupted water for households. These tanks are typically situated at an elevated position, granting constant, pressurized access to water throughout the day (Schafer and Mihelcic, 2012). Given that tank water is sourced from the public network or by truck, it is essential to conduct thorough inspections and implement control measures before and during these practices to prevent contamination of the supplied water. Water consumers should be made aware of the potential risks associated with consuming the first rinse water that is supplied after the water supply has been resumed, and they should be guided on appropriate measures to minimize their exposure to chemical and microbial contaminants in tap water. To ensure water safety and prevent the spread of microbes, tank trucks designated for transporting potable water must undergo thorough inspection and sterilization before use. Regular monitoring of disinfectant residues and microbial contaminants in water transported by trucks is necessary. Awareness programs should be conducted to educate families on the maintenance practices needed to ensure the safety of their water tanks, thereby minimizing water quality deterioration (Salehi, 2022).

Water quality issues in storage facilities can be categorized into microbiological, chemical, or physical categories. The degradation of water quality in storage facilities is likely due to prolonged water storage. The extended holding times may create favorable conditions for microbial growth and chemical transformations. Water tanks, especially roof tanks, can pose a health hazard if they are not correctly sited, covered, and adequately maintained. These tanks have frequently exhibited poor bacteriological results and outbreaks of waterborne diseases (Al-Ghanim et al., 2014).

The problem of microbial regrowth in Jordan is compounded by the storage of water for extended periods, lasting up to two weeks, particularly during the summer season. Kirmeyer et al. (1999) reported that storage periods may extend to several months, significantly increasing the risk of quality deterioration due to chemical reactions such as reduced disinfectant residual, formation of disinfection

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by-products, increased pH, taste and odor, corrosion, and hydrogen sulfide.

The household tanks predominantly used in Jordan are typically manufactured from galvanized iron and polyethylene. Long holding times decrease chlorine levels, and sediment buildup further enhances the likelihood of microbial growth in these storage tanks (Evison and Sunna, 2001).

Ogbozige et. al. (2018) investigated the impact of storage duration on chemical water quality across various container materials. The findings revealed that across all container materials examined, the maximum water retention period was approximately 21 days, except for clay-pot material, which had a retention period of no more than 6 days. Additionally, the study did not recommend the use of uncoated steel metal tanks. The conclusion reported that black plastic containers were more effective at maintaining water quality during storage than colored plastic containers, galvanized iron or coated steel containers, and clay pots.

Evison and Sunna (2001) investigated the regeneration characteristics of bacteria in various types of household storage tanks and the factors that affect their growth in Amman, Jordan. The results of the study showed that the bacterial count in water stored for 4 and 7 days increased significantly from log 1.7 to log 5.2 and log 5.7 CFU/mL, respectively. The regrowth of bacteria was mainly dominated by Actinomycetes, Pseudomonas species, and Moraxella spp. Interestingly, the different materials of the household tanks, such as polyethylene, fiberglass, and cast iron, did not significantly influence the total bacterial count of the stored water. The relationship between temperature and microbial regrowth suggests that conditions similar to ‘ ‘Jordan’s summer climate characterized by high ambient temperatures would likely exacerbate bacterial regrowth. However, the study revealed that temperature was the most crucial factor influencing microbial regrowth in household tanks. The higher the temperature, the higher the bacterial regrowth in the stored water.

A recent study in Jordan (Al-Nawafleh & Al-Zboon, 2025) examined the management of household water tanks in Irbid Governorate. It was found that while most households use plastic tanks, a substantial proportion still use galvanized iron tanks. Nearly half of homes do not regularly clean their tanks, which is directly related to contaminant levels in the water. This high contaminant level highlights the importance of proper tank maintenance to ensure safe storage, particularly in the Jordanian context.

This study was conducted during October–December 2022 and aimed to assess the quality of water in household tanks through chemical, physical, and biological analyses. This is to determine whether the water is suitable for drinking or other uses. The study provides recommendations to relevant authorities to raise awareness of the importance of drinking water of suitable quality and to take appropriate measures. To achieve the study’s objectives, water samples were collected from household tanks in the Irbid area and assessed for suitability for drinking.

2. Methodology

2.1 The Study Area

The Study area encompasses Irbid governorate, situated in the northern part of Jordan, covering approximately 1572 km² and located at the geographical coordinates of 32° 33’ 20” N, 35° 51’ 0” E (Figure 1). The climate in Irbid is Mediterranean, with hot and dry summers, cold and rainy winters. During the summer, temperatures can reach up to 35 °C, while during the winter, temperatures drop to around 5 °C and sometimes even to 0 °C. As of 2023, the population of the Irbid Governorate has reached around 2,135,000, making it the second-largest governorate in Jordan by population after the Capital Governorate. The governorate is divided into nine districts, namely, Qasabah, AL-Ramtha, AL-Koorah, Bani Kenanah, Bani Obeid, Aghwar Shamaliyah, Mazar Shamali, AL-Wastiyyah, and AL-Taybeh (DOS, 2024).

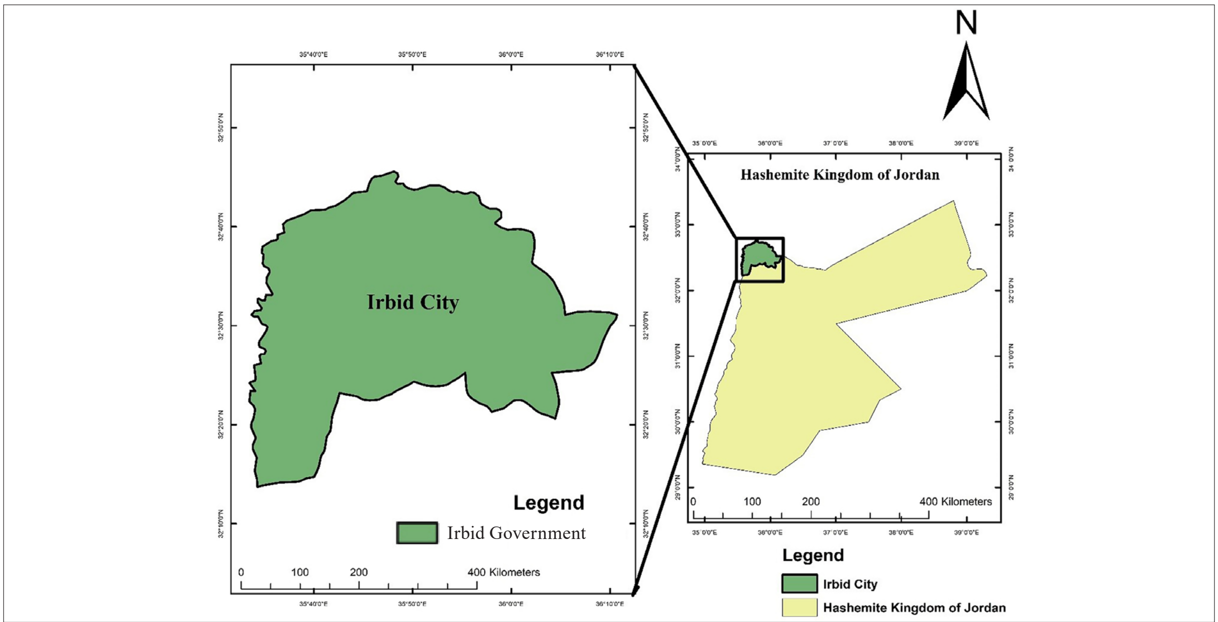

Figure 1. The Study area.

2.2 Water stress

Irbid District, the second-largest city in Jordan faces significant challenges related to water stress due to the influx of refugees from neighboring countries, which has intensified the demand for water in both urban and rural areas (UNHCR, 2021). Changes in precipitation patterns and rising temperatures, resulting from climate change, have also affected water availability, leading to prolonged droughts and reduced aquifer recharge rates (Bashabsheh and Alzboon, 2024). In this context, effective water management is crucial. The Yarmouk Water Company (YWC), responsible for water supply and wastewater management in Irbid and other northern governorates, plays a vital role in addressing these challenges through initiatives such as reducing leakage, ensuring water quality, promoting public awareness, and investing in modern technologies. YWC provided more than 96 million cubic meters of water in 2018 from surface and groundwater sources through more than 10,000km of the distribution networks (YWC, 2023).

2.3 Sampling

Twenty-two samples were collected from household water storage tanks between October 17, 2022 and December 11, 2022 from various locations in Irbid Governorate. The location of each sample was documented, using a global positioning system (GPS) device (Figure 2). All sampled tanks were supplied with water from the municipal network. For analysis, 2 liters of water were collected in two separate bottles: the first, with a capacity of 1.5 liters, was pre-sterilized for chemical and biological analysis at an environmental laboratory in Amman. The second bottle, with a capacity of 500 ml, was collected for analysis of turbidity, pH, electrical conductivity, dissolved solids, and alkalinity at the laboratory of Al-Balqa Applied University, Al-Huson College. All samples were placed in an ice box and analyzed within 12 hours.

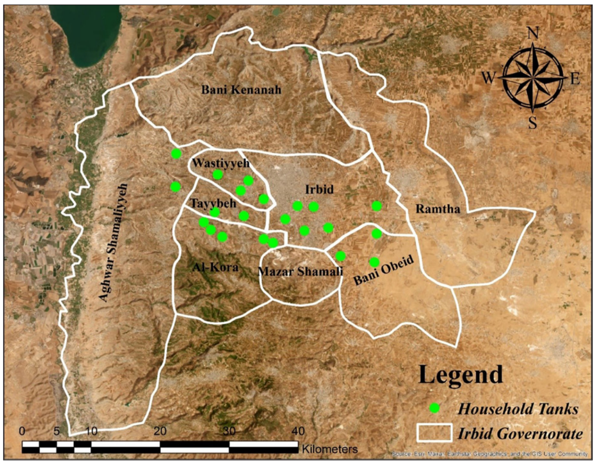

Figure 2. Locations of samples.

2.4 Water Quality

This study aims to investigate water samples for physical parameters such as turbidity and electrical conductivity, and chemical parameters such as pH, hardness, TDS, alkalinity, Ca+2, Na+, PO4-2, Cl-, SO4-2, NO3-, K+, Mg+2, and biological parameters such as total coliform, E. Coli, and pseudomonas, then, to compare the results with the World Health Organization (WHO) standards and the Jordanian standard. Table 1 below shows the instruments used for measurement and the international and national standards.

Table 1. Physical, chemical, and biological water tests with the instruments used and the standards of JS and WHO.

Parameter	Instrument	WHO standard (WHO, 2022)	Jordanian standards (JS 286:2015)
EC	HI-98194 Multiparameter pH/ EC/ TDS	< 1200 µS/cm	< 700µS/cm
Turbidity	HI-93414 Turbidity & Free/Total Chlorine Meter	< 5 NTU	< 5 NTU
pH	HI-98194 Multiparameter pH/ EC/ TDS	6.5 - 8.5	6.5 - 8.5
Hardness	Titration with EDTA	< 600 mg/L as CaCO3	< 500 mg/L as CaCO3
TDS	HI-98194 Multiparameter pH/ EC/ TDS	< 1000 mg/L	1000 - 1300 mg/L
Alkalinity	Titration with strong H2SO4	< 200 mg/L as CaCO3	---------
Ca+2	930 Compact IC Flex	< 100 mg/L	75 – 200 mg/L
Mg+2	930 Compact IC Flex	< 50 mg/L	50 – 150 mg/L
Na+	930 Compact IC Flex	< 200 mg/L	200 – 300 mg/L
PO4-2	930 Compact IC Flex	< 0.1 mg/L	-----
SO4-2	930 Compact IC Flex	< 400 mg/L	< 500 mg/L
Cl-	930 Compact IC Flex	< 250 mg/L	200 – 500 mg/L
K+	930 Compact IC Flex	< 20 mg/L	< 12mg/L
NO3-	930 Compact IC Flex	< 50 mg/L	< 50 – 70 mg/L
Total coliform	Membrane filtration	0 MPN/100	< 1.1 MPN/100
E. Coli	Membrane filtration	0 MPN/100	< 1.1 MPN/100
pseudomonas	Membrane filtration	-------	-----

2.5 Water Quality Index (WQI)

Water Quality Index (WQI) is a numerical expression that shows the impact of various water quality parameters on the overall suitability of water for human consumption (Şener et al., 2021). WQI is a rating method that assesses how specific water quality parameters affect overall water quality. WQI indicates if water bodies pose a risk to different water uses. It is a single indicator of water quality that integrates collected data based on weighted factors. By using WQI, we can use a single value as an indicator of water quality rather than examining tens of parameters.

WQI ranges from 0 to 100, classifying water quality as excellent, good, poor, very poor, or unfit for consumption (Nong et al., 2020). The WQI was proposed by Horton in 1965 to classify water quality based on the levels of measured physical, chemical, and biological indicators. These parameters may include temperature, pH, dissolved oxygen levels, turbidity, nutrients, heavy metals, and microbiological indicators (Akhtar et al., 2021). The Water Quality Index (WQI) is calculated using the Weighted Arithmetic Index method, as shown in the following equations (Bouslah et al., 2017).

$$WQI = \frac{\Sigma\,(Wn \times Qn)}{\Sigma\,Wn} \qquad \text{(Equation \_2.1)}$$

$$Wn = \frac{K}{Sn} \qquad \text{(Equation \_2.2)}$$

$$K = \left[\frac{1}{\Sigma\left(\frac{1}{Sn}\right)}\right] \qquad \text{(Equation \_2.3)}$$

$$\boldsymbol{Qn = \left[\frac{(Vn - Vi)}{(Sn - Vi)}\right] \times 100} \qquad \text{(Equation \_2.4)}$$

In equation 2.2, (Wn) represents the unit weight of water quality for a certain quality parameter. Sn is the standard permissible limit of the parameter (Table 1, Jordanian Standards), and K is a constant that can be determined from equation 2.3.

The constant K scales the unit weights appropriately, ensuring that the sum of all unit weights equals one.

In equation 2.4, Qn is the quality rating for a certain quality parameter, Vn is the estimated value of the certain quality parameter, and Vi is the ideal value of the parameter. The ideal (Vi0) value for drinking water is set to zero for all parameters except pH, which is set to 7.0 (Bouslah et al., 2017).

In this study, the Water Quality Index (WQI) will be determined based on fifteen parameters used in the analysis. These parameters include pH, Electrical Conductivity, Turbidity, Alkalinity, Hardness, Total Dissolved Solids, Calcium, Magnesium, Chloride, Sodium, Potassium, Nitrate, Phosphate, Sulfate, and Chloride. They have been selected as indicators for evaluating the overall water quality. Table 2 illustrates Water Quality Index (WQI) ranges, providing a way to interpret the overall water quality, based on the calculated WQI value.

Table 2. Water Quality Index (WQI) Classification (Brown et al., 1972).

WQI (Ranges)	water quality classification
0-25	Excellent
26-50	Good
51-75	Poor
76-100	Very poor
>100	Unfit for consumption

The ranges are typically divided into several categories, such as Excellent (WQI= 0-25) that signifies the high quality of water and safety for its various uses, including human consumption. Good category, (WQI= 26-50), indicates that the water may have minor deviations from ideal conditions for some parameters, but overall, it is still considered suitable for most purposes, including drinking. It suggests that the water is relatively clean and poses minimal health risks. Poor water quality, (WQI= 51-75), indicates that the water may have significant deviations from the desired standards for multiple parameters. It suggests that the water may require treatment or remediation before it can be used for certain purposes, particularly for human consumption. The presence of contaminants or pollutants may pose health risks. Very poor water quality, (WQI= 76-100), indicate that the water in this range exhibits substantial deviations from the desired standards for several parameters, indicating an elevated level of contamination or pollution. It implies that the water is unsuitable for most uses, including drinking, without extensive treatment or purification processes. Unfit for consumption (WQI>100): WQI values exceeding 100 indicate extremely poor water quality. Water falling within this range is unsuitable for consumption or most uses without thorough treatment (Horton, 1965).

3. Result and Discussion

3.1 Physical Parameters

Monitoring and managing the physical characteristics of water is essential to maintain its safety and suitability for various uses. The results obtained from analyzing the physical parameters of electrical conductivity (EC) and turbidity provide valuable insights into water quality) Figure 3(. There are many sources of turbidity in water tanks, such as air dust and bird waste in case of improper covering of the tanks. Also, the provided water may contain a significant level of turbidity. Turbidity is the cloudiness or haziness of water caused by particles such as sediment, organic matter, and microorganisms. High turbidity levels can reduce light penetration in water, affecting the disinfection process. Moreover, suspended particles can harbor harmful bacteria and viruses, making the water unsuitable for drinking (Hung et al., 2020). The maximum value of turbidity was 3.50 NTU in sample 13, and the minimum value (0.13 NTU) was found in samples 3 and 4, and the average turbidity was 0.88 NTU. All 'samples' values were within the permissible limit of 5 NTU according to both the WHO and Jordanian standards. Similarly, Luvhimbi et al. (2022) investigated the water quality of household containers and found that pH and EC ranged from 7.6 to 9.7 and from 19 to 903 µS/cm, respectively.

Electrical conductivity (EC) is a measure of a water sample's ability to conduct an electrical current. It is an important indicator of dissolved salts and other ions in water, such as Ca, Mg, and Cl (Razman et al., 2022). Water can dissolve many inorganic and organic substances such as Na, K, Ca, Mg, SO4, and bicarbonates. These dissolved solids impart an undesirable color and taste to water. The figure below displays the data for 22 samples. Based on the present study, it has been determined that the electrical conductivity (EC) ranged from 536.0 µS/cm to866.0 µS/cm, with an average value of 707.8 µS/cm. The obtained results fall within the permissible limit of 1000µS/cm according to the (WHO). However, according to Jordanian standards, some values exceeded the allowable limit of 700µS/cm.

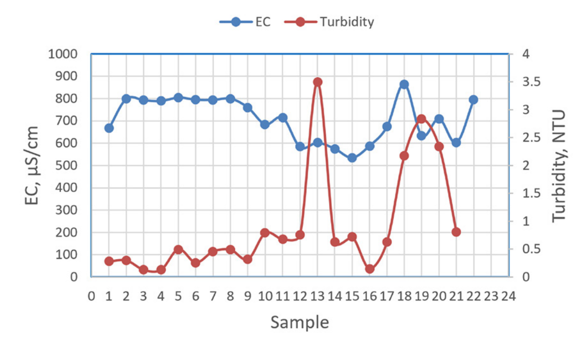

Figure 3. EC and Turbidity results for 22 samples.

3.2 Chemical parameters

Chemical quality refers to the concentration of different chemical substances in water. Assessment of the chemical composition is crucial because it greatly influences water suitability for drinking, industrial, and irrigation purposes. Many factors can affect the chemical composition of water, such as the type of roof material, tank cover, and storage method. Therefore, regular monitoring and assessment of the water's chemical quality are essential to ensure its safety and suitability for their intended uses. While most inorganic compounds are essential for human health and the formation of cells, organs, and tissues, elevated levels can cause adverse health effects. For example, Na is necessary to regulate fluid in the human body and to control muscle and nerve function; however, high levels of Na can cause high blood pressure and kidney and cardiovascular diseases (Luvhimbi et al., 2022). A low level of K is necessary for protein synthesis and carbohydrate metabolism; however, excessive levels can cause dangerous conditions such as cardiac arrest and reduced urine output (Ogoamaka and Osarumwense, 2022). Table 3 below illustrates the minimum, maximum, and average values for pH, hardness, Alkalinity, TDS, calcium, magnesium, nitrates, phosphates, sulfate, chloride, sodium, and potassium with the permissible limits for drinking water according to (WHO) and Jordanian standards.

Table 3. Results of chemical parameters for 22 samples.

Parameter	Min	Max	Average	WHO	JS
pH	7.3	8.3	7.7	6.5 - 8.5	6.5 - 8.5
Hardness	203.1	360	320.8	600 mg/L	500 mg/L
TDS	268	433	350	10000 mg/L	1000-1300 mg/L
Alkalinity	120	380	260.5	200 mg/L	-----
Ca+2	37.1	96.8	79.9	100 mg/L	75-200 mg/L
Mg+2	23.5	35.3	29.5	50 mg/L	50-120 mg/L
Na+	18.4	80.8	30.8	200 mg/L	200 – 300 mg/L
PO4	< 0.01	0.5	0.1	1 mg/L	-----
SO4-2	14.4	71.9	29.2	400 mg/L	500 mg/L
Cl-	37.3	133.9	56.2	250 mg/L	200 – 500 mg/L
K+	2.1	7.6	3.4	20 mg/L	12mg/L
NO3-	4.3	25.9	21.4	50 mg/L	50 – 70 mg/L

The pH values ranged from 7.3 to 8.3, with an average of 7.7. All values were within the allowable limits of WHO and Jordanian standards (6.5–8.5). For hardness, the maximum value was 360 mg/L, the minimum was 203.1 mg/L, and the average was 320.8 mg/L. All values were within the permissible limit according to WHO (600) and Jordanian standards (500). The TDS ranged from 268 mg/L to 433 mg/L, with an average of 350 mg/L, and all values were below the permissible limits for both standards. Water with a TDS level of more than 500 mg/L can cause many human health effects, such as gastrointestinal irritation (Ogoamaka and Osarumwense, 2022). The alkalinity was between a minimum value of 120 mg/L and a maximum value of 380 mg/L, with an average of 260 mg/L, where some values exceeded the permissible limit of WHO (200 mg/L).

The concentrations of magnesium and calcium were within the permissible limits of the WHO and Jordanian standards, with average concentrations of 79.9 mg/L and 29.5 mg/L for calcium and magnesium, respectively. The maximum concentrations reached 96.8 mg/L and 35.3 mg/L for both parameters. Excessive concentrations of Mg in drinking water result in osmotic diarrhea and laxative effects (Ogoamaka and Osarumwense, 2022). The sodium values were also within the permissible limits for both standards, with the highest value at 80.8 mg/L.

For SO4-2, Cl-, K+, and NO3-, the maximum values were lower than the permissible limits of the WHO and Jordanian standards, with max values of 71.9 mg/L, 133.9 mg/L, 7.6 mg/L, and 25.9 mg/L, respectively. A high level of Sulphate can cause cathartic or laxative effects on human health, while high concentration of NO3 causes blue baby syndrome, methemoglobinemia, and many health effects. The concentration of (PO4) ions in the water sample tested ranged from 0.01 mg/L to 0.5 mg/L, with an average concentration of 0.1 mg/L. It is worth noting that the maximum concentration of (PO4) was far below the permissible value set by the WHO, which is 1 mg/L. Overall, the results of chemical analyses were within the permissible limits set by the WHO and the Jordanian standard.

Luvhimbi et al. (2022) reported lower values of the chemical parameters in the water of household containers in South Africa, where the maximum values of Ca, K, Mg, and Na were 31.6, 1.8, 16.6, and 12.9 mg/l. The elevated levels of the chemical parameters in our study could be attributed to the longer storage period in the tank, which reaches 2 weeks during the summer season.

3.3 Biological Parameters

Household water tanks can be assessed based on several biological parameters, including the presence of microorganisms, such as bacteria, viruses, and parasites. The level of biological contamination in tap water is an essential aspect to monitor, as it can affect the quality and safety of the water supply. The present study measured total coliforms, E. coli, and pseudomonas. No contamination of E. coli was detected in the water storage tanks, as shown in Table 4. The investigation found that households' water storage tanks contained both Pseudomonas and total coliforms. Pseudomonas was found in 18 samples, 11 of which had concentrations greater than 100 CFU/100 ml, as shown in Table 4. This means the water in the storage tanks is unsafe to drink and must be cleaned before use.

Furthermore, some samples also contained total coliforms. Two of the samples had more than 100 CFU/100 mL, while 10 had less than 100 CFU/100 mL. However, it should be noted that both total coliform and Pseudomonas should be absent in drinking water according to the WHO guidelines. Luvhimbi et al., 2022, found that household storage tanks in Thulamela municipality, South Africa, contained high levels of total coliforms, with some samples exceeding 2000 MPN/100ml, whereas one sample showed a positive level of E. coli.

Table 4. Results of biological parameters for 22 samples

Sample	Total coliform	E. Coli	Pseudomonas
1	<1 CFU/100ml	<1 CFU/100ml	88 CFU/100ml
2	<1 CFU/100ml	<1 CFU/100ml	<1 CFU/100ml
3	<1 CFU/100ml	<1 CFU/100ml	5 CFU/100ml
4	<1 CFU/100ml	<1 CFU/100ml	5 CFU/100ml
5	<1 CFU/100ml	<1 CFU/100ml	40 CFU/100ml
6	<1 CFU/100ml	<1 CFU/100ml	< 1CFU/100ml
7	1 CFU/100ml	<1 CFU/100ml	262 CFU /100ml
8	<1 CFU/100ml	<1 CFU/100ml	2 CFU /100ml
9	<1 CFU/100ml	<1 CFU/100ml	33 CFU/100ml
10	<1 CFU/100ml	<1 CFU/100ml	8 CFU/100ml
11	13 CFU/100ml	<1 CFU/100ml	>100 CFU/100ml
12	19 CFU/100ml	<1 CFU/100ml	>100 CFU/100ml
13	>100 CFU/100ml	<1 CFU/100ml	>100 CFU/100ml
14	54 CFU/100ml	<1 CFU/100ml	>100 CFU/100ml
15	43 CFU/100ml	<1 CFU/100ml	>100 CFU/100ml
16	>100 CFU/100ml	<1 CFU/100ml	>100 CFU/100ml
17	49 CFU/100ml	<1 CFU/100ml	>100 CFU/100ml
18	44 CFU/100ml	<1 CFU/100ml	>100 CFU/100ml
19	33 CFU/100ml	<1 CFU/100ml	>100 CFU/100ml
20	49 CFU/100ml	<1 CFU/100ml	>100 CFU/100ml
21	14 CFU/100ml	<1 CFU/100ml	< 1 CFU/100ml
22	20 CFU/100ml	<1 CFU/100ml	10 CFU/100ml

3.4 Analysis of water quality index (WQI)

Table 5 illustrates the distribution of water quality index (WQI) values for 22 samples, along with their corresponding WQI categories. The WQI values ranged from 6.36 to 47.62, and the categories assigned are "Excellent" and "Good". Figure 4 shows that most of the water samples (86%) are classified as "Excellent", indicating a high level of water quality. A smaller proportion of samples (14%) fall within the "Good" range, still indicating satisfactory water quality. Notably, there are no samples classified as "poor," "Very poor," or "Unfit for consumption." In summary, the table provides an overview of the distribution of water quality in the given dataset. While most samples exhibit excellent water quality, there is still a need for improvement to address the smaller proportion of samples categorized as good. By focusing on pollution prevention, implementing effective water treatment measures, and adopting sustainable management practices, it is possible to ensure clean, safe, and reliable water for both human consumption and environmental sustainability.

Table 5. Water Quality Index (WQI) Analysis for 22 Samples

Samples	WQI value	WQI category
1	6.36	Excellent
2	7.55	Excellent
3	7.21	Excellent
4	7.09	Excellent
5	8.72	Excellent
6	7.29	Excellent
7	7.99	Excellent
8	7.05	Excellent
9	7.64	Excellent
10	10.26	Excellent
11	32.26	Good
12	18.32	Excellent
13	25.42	Excellent
14	18.48	Excellent
15	17.27	Excellent
16	20.91	Excellent
17	16.65	Excellent
18	20.04	Excellent
19	23.15	Excellent
20	20.62	Excellent
21	47.62	Good
22	42.69	Good

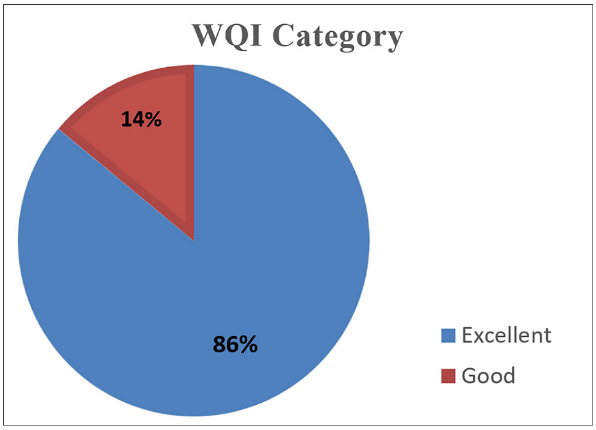

Figure 4. Percentage Distribution of Water Quality Status

4. Conclusion

Household water tanks are a common practice for water storage in developing urban regions, providing a dependable, uninterrupted water supply for households. The study of physical, chemical, and biological parameters of household water tanks in Jordan reveals critical insights into water quality. While electrical conductivity (EC) and turbidity levels are mostly within acceptable limits, some samples exhibit elevated turbidity due to sediment. Chemical analyses indicate that most parameters, including pH, hardness, TDS, and ion concentrations, comply with WHO and Jordanian standards, with occasional exceedances in alkalinity. Biological assessments highlight the presence of pseudomonas and total coliforms in several samples, underscoring the need for regular disinfection and maintenance. The Water Quality Index (WQI) classifies most samples as "Excellent," with a smaller fraction as "Good," emphasizing the overall high water quality but also the need for continuous monitoring and improvement to ensure safe, reliable drinking water.

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