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Questionnaire-Based Survey of Drinking Water Quality and Public Health Impacts in Urban and Rural Diyala Governorate, Iraq

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Abstract

Background: Depleted water levels and water pollution pose a risk to public health and contribute to the spread of diseases and epidemics among the population.

Objective: To evaluate the impression of insignificant drinking water quality provided to households and the perceptions of urban and rural communities concerning drinking water safety and its impact on public health in Diyala Governorate, Iraq.

Methodology: This survey assessed the obtainability and quality of safe drinking water and its related effects on the health of local populaces in urban and rural areas of Diyala Governorate, Iraq. The primary questionnaire was accomplished with (91) household heads. The additional questionnaire, a community insight survey, was completed with (285) household heads. The merged instruments in together questionnaires yielded a collective sample of (376) respondents, providing near-representative coverage of the governorate with a margin of error of (±5%) at a (95%) confidence interval.

Results: Mutually questionnaires, with a whole of (376) respondents, offer a comprehensive picture of the water state in urban and rural parts of Diyala Governorate. (74%) of households rely on the local water system. (15%) dependance on artesian wells, while approximately (10%) dependance on tanks and other water supplies. Recurrent water interruptions (66%) of households reported regular water interruptions, while (25%) reported infrequent interruptions. Only (8%) of surveyed households described any water interruptions at totally. Concerning household water treatment methods, (81%) of households used filters or further water treatment devices.

Conclusion: Greatest households receive imperfect water flow, i.e., less than four hours each day. Consequently, the collected evidence points to a fragile, poorly active, dilapidated, and unsanitary water system, which undermines public health and community trust.

Keywords: Drinking water, Diyala, Public health, Water treatment methods, Pollution

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مسح استبياني لجودة مياه الشرب وتأثيراتها على الصحة العامة في المناطق الحضرية والريفية بمحافظة ديالى، العراق

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الملخص

الخلفية: انخفاض مستويات وجودة المياه المزود للمنازل يشكل تهديداً للصحة العامة، ويساهم في انتشار الأمراض والأوبئة.

الهدف: تقييم تأثير انخفاض جودة مياه الشرب المنزلية، وانطباعات المجتمع في المناطق الحضرية والريفية حول سلامة مياه الشرب والصحة العامة في ديالى، العراق.

الطرق: تم في هذه الدراسة تقييم توفر وجودة مياه الشرب وتأثيرها على صحة السكان في المناطق الحضرية والريفية من محافظة ديالى، العراق. استخدم في الدراسة استبيانين الأول شارك فيه 91 رب أسرة. أما الاستبانة الثانية فكانت حول تصورات المجتمع، وشارك فيه 285 رب أسرة. وقد أسفرت الأدوات المدمجة في الاستبيانين عن عينة شاملة من 376 مشاركاً، مما وفر تغطية شبه ممثلة للمحافظة بهامش خطأ ±5% عند مستوى ثقة 95%

النتائج: تقدم الدراسة، التي شارك فيهما 376 شخصاً، صورة شاملة لمشكلات المياه في المناطق الحضرية والريفية بمحافظة ديالى. يعتمد 74% من الأسر على شبكة المياه المحلية، بينما يعتمد 15% من الأسر على الآبار الارتوازية، ويعتمد حوالي 10% من الأسر على الخزانات ومصادر مياه أخرى. أما انقطاع المياه المتكرر، فقد أبلغ عنه 66% من الأسر بانتظام، بينما أشار 25% إلى انقطاعات عرضية. 8% فقط من الأسر المشاركة أفادت بعدم تعرضها لانقطاع المياه. وفيما يتعلق بطرق معالجة المياه المنزلية، يستخدم 81% من الأسر المرشحات أو أجهزة معالجة المياه.

الاستنتاج: تحصل معظم الأسر على تدفق مائي محدود لا يتجاوز أربع ساعات يومياً، وبالتالي تشير الأدلة مجتمعة إلى نظام مياه هَشّ، متعثر، وقديم وغير صحي، مما يقوض الصحة العامة وثقة المجتمع في محافظة ديالى.

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الكلمات المفتاحية: المياه الصالحة للشرب، ديالى، الصحة العامة، طرق معالجة المياه، التلوث

Introduction

Water pollution remains an insistent global apprehension, posing a risk to environmental sustainability and public health. Pollutants movement into water sources through various pathways and sources, including industrial discharges, agricultural runoff, untreated sewage, and urban stormwater runoff, as well as various naturally happening substances such as arsenic (Lin, 2022).

The healthy consequence of water pollution are heavy and multifaceted. Numerous acute diseases that pose a threat to persons health, such as diarrhea, cholera, typhoid, and hepatitis, are linked to microbial contamination, while inveterate exposure to chemical pollutants, including heavy metals and persistent organic pollutants, can take to cancer, neurological disorders, and organ damage. (Mustafa, 2024) .

Arrival to clean water, orderly sanitation, and perfect hygiene are fundamental support of public health, foster environmental sustainability and economic output. Improved water form, sanitation, and hygiene are linked to depress rates of various diseases, such as diarrhea, parasitic worm infections, under-five mortality, and developmental delays. (Annette Prüss-Ustün, 2019); (Organization, 2022)

The location of Diyala Governorate is of great importance as it is situated in eastern Iraq and has a population of approximately 1.6 million people, according to the statistics of the Ministry of Planning - Central Statistical Organization in Iraq for the year 2023 ((COSIT), 2023). The province's water resources primarily depend on three rivers originating outside its borders: the Diyala River, the Al-Adhaim River, and the Tigris River, which forms part of the western border with Salah ad-Din Governorate.

Lake Hamrin serves as the province's main reservoir for flood control, as most of its water comes from rainwater runoff. It is also used for irrigation and agriculture. Groundwater, from numerous wells and springs throughout the province, provides additional water. (Ministry of Water Resources, 2024). Population growth in recent years has led to an increased need and demand for water resources, which has increased the pressure on safe drinking water resources for domestic, agricultural and industrial purposes ((COSIT), 2023). Due to limited water resources, water pollution, which exacerbates the difficulty of meeting increasing water needs, poses a serious threat to public health.

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The presence of industrial waste is the greatest threat, as these pollutants usually come from diverse sources. In addition to pollution from pesticides, agricultural fertilizers, and untreated sewage, all these and other pollutants lead to a real and severe deterioration in the quality of surface and groundwater, increasing the risk of waterborne diseases. (Ministry of Water Resources, Water Resources and Management Report in Iraq, 2024). ((UNEP), 2016).

In addition, neglect of infrastructure leads to its deterioration, characterized by the deterioration of water treatment plants and distribution networks, which increases water quality and availability problems (Al-Ansari, 2013). Climate alteration is a prime cause of altered rainfall manner and reduced rainfall amounts, leading to lengthy droughts. Elevation temperatures have also participated to water scarcity.

Theses agent highlights the variability in environmental route and underscores the necessity to take over adaptive strategies that enhance water management under such conditions ((UNDP), 2020). The crossing 0f growing population growth, pollution, weak infrastructure, and climate modification forms a close and combination link that threatens water security and public health in both urban and rural communities.

The expansion of gastrointestinal and waterborne diseases in both communities excess the burden on healthcare systems and local management. Process these challenges demand an integrated tactic that includes uninterrupted infrastructure development and renovation , pollution control, climate-sustaining planning designed for arid conditions, and effective governance) (UNDP) (2020 ،)(COSIT)(2023 ،) The current study aims to assess the quality and availability of water and its impact on public health in Diyala Governorate, Iraq.

METHODOLGY

3.1 Research Design

The survey adopted a cross-sectional research styling, including an overview of water availability and fineness in urban and rural areas of Diyala Governorate. This design is proper because it ease data collection from a deputy sample of households in the community meantime a particular time period, thus providing a description of immediate conditions.

The styling methodology also enabled the combination of qualitative and quantitative data, which in turn provided a overall understanding of the water availability and quality question in the study area.

3.2 Study Population

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The survey involved a sample of mature heads of households (≥18 years old) in Diyala Governorate, both males and females representing their families, who were able to provide data on water availability and quality. (Tumwesigye, 2024).

3.3 Area of Study

Diyala Governorate in Iraq lies between latitudes (33°) and (35°) North and longitudes (44°) and (46°) East. Located in the Iraq eastern, it has a semi-arid climate, characterized by dry summers very hot, and cool, moderately rainy winters.

Anniversary rainfall is concentrated between November and March, averaging between (150) and (350 mm), with high volatility rates throughout the year. These climatic conditions significantly, influence water availability, particularly during the dry season (Environment., 2021).

3.4 Population

The survey population act that total number of households in Diyala Governorate. depending to the Central Statistical Organization of the Ministry of Planning in Iraq (CSO, 2023), the inhabitance of Diyala Governorate is rated at approximately (1.8 to 2.0) million, dispense across the administrative region and their rural areas, Baquba, Al-Muqdadiya, Khanaqin, Baladruz, and Al-Mansuriya. Households in these areas reverberate diverse environmental, economic, and geographical conditions, ranging from urban centers in Baquba and the district centers to rural and agricultural areas throughout the governorate. This diversity gives a suitable context for studying water quality and availability in the governorate, as water sources supplying households, water exhaustion patterns, and service coverage vary between region and between urban and rural areas. ((CSO)., 2023). ((UNFPA)., 2022)

3.5 Sample Collection and Sample Size

The research sample for this survey was choice to enclose environmental diversity, population intensity, and economic variety, act both urban and rural environments. These environments diverge in terms of water feeding infrastructure and nearness to surface and groundwater sources. Stratified random sampling was employed.

Households were foremost categorized according to urban and rural stratification, and the study sample was then randomly selected proportionally to the overall number of households participating in the two surveys within each stratum. This way ensures fair representation and minimizes sample bias.

In reality, (376) heads of households partake in the surveys, which included

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two kinds. The first was a household-level survey, with (91) heads of households partake, addressing oncoming to water, its sources, and related public health outcomes.

The second survey concentrate on community perceptions, with (285) partake heads of households, and concentrated on satisfaction with water management practices in urban and rural areas of the governorate. The collected sample size is close to the recommended size (approximately 380 households) to represent the governorate, with a margin of error of (±5% and a 95%) confidence level (Hemmerling, et al., 2024).

3.6 Sample Collection Data

Two separate but complementary questionnaires were used:

Table 1: Household-level questionnaire (number of espondents)

	Information	Data
1	Demographic information	age, gender, education
2	Water availability and continuity	hours of daily use, interruptions
3	Primary water sources	mains, well, tankers, etc.
4	Household treatment practices	filters, boiling, etc.
5	Health impacts	self-reported water-related illnesses

Table 2: Community perceptions questionnaire

	Information	Demographic data.
1	Satisfaction with current water management	Diyala, urban and rural areas.
2	Perceptions of challenges facing authorities	infrastructure, management, scarcity
3	Proposed solutions for water management	treatment facilities, dams, policy reforms

3.7 Data Analysis and Management

Data was exported from Microsoft forms to Excel spreadsheets, which included cleaning to remove incomplete responses and formatting demographic variables for comparison.

The analysis followed a descriptive comparative approach, where frequencies and percentages were

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calculated for all categorical variables. Household survey results were used to provide an accurate description of the practical reality related to access to safe water.

Community perceptions survey results were used to describe public satisfaction, governance issues, and climate perceptions. The two datasets were then compared narratively to highlight similarities and differences regarding household-level water outages versus community perceptions of water sector mismanagement (Ramya, Reddy, & & Kamath, 2021).

3.8 Ethical Considerations.

Data were collected anonymously from participants and used for research purposes only, following best practices in recent mixed-method studies on water quality (Association, 2013) .

Results and discussion

4.1 Household-level survey

Demographic characteristics

Participating age groups, the majority of household head participants in the survey were between 31 and 50 years old (59%), followed by 18-30 years old (29%), and over 50 years old (12%). Gender, male participants constituted 57%, while female participants constituted 43%. Education level, most participants held university degrees (65%), while those with postgraduate qualifications comprised 22%.

Only 13% had secondary or intermediate education. Regarding the water availability and continuity of water supply, only 29% of households reported continuous water supply, while 31% reported intermittent water supply, and 40% reported uninterrupted water supply.

More than half of household heads of daily water supply hours (56%) reported less than 4 hours per day, while 25% received 4-8 hours, and only 14% received more than 8 hours.

Available water sources 74% of households rely on the local water network. 15% of households rely on artesian wells, while approximately 10% of households rely on reservoirs and other water sources. Recurrent water outages were reported by (66%) of households, while (25%) announce occasional outages.

However, (8%) of households surveyed did not record any water outages. Household water treatment methods diversified, with (81%) of households using filters or water treatment devices. Untreated water show cause for (16%) of all untreated water.

Sixty percent of surveyed households reported sustain various health problems they believed were linked to contaminated water, such as diarrhea,

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typhoid fever, jaundice, and various skin conditions. Thirty-eight percent of households reported no public health problems.

Table 3: Demographic characteristics

Category	Group/Value	Percentage (%)
Age Group	18–30 years	29%
	31–50 years	59%
	Over 50 years	12%
Gender	Male	57%
	Female	43%
Education Level	Secondary/Intermediate	13%
	University Degree	65%
	Postgraduate	22%
Water Supply Continuity	Continuous	29%
	Intermittent	31%
	Uninterrupted	40%
Daily Water Supply Hours	Less than 4 hours	56%
	4–8 hours	25%
	More than 8 hours	14%
Water Treatment Methods	Used filters/devices	81%
	Untreated water	16%
Health Impacts	Water-related illnesses	60%
	No reported problems	38%

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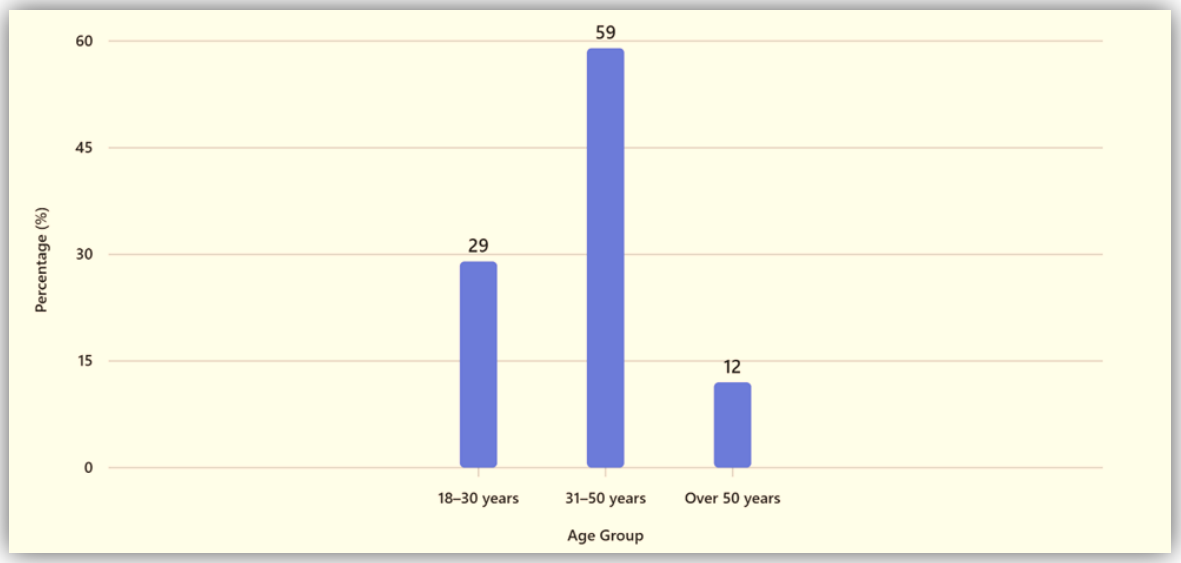

Figure 1: Histogram displaying the distribution of Age Group

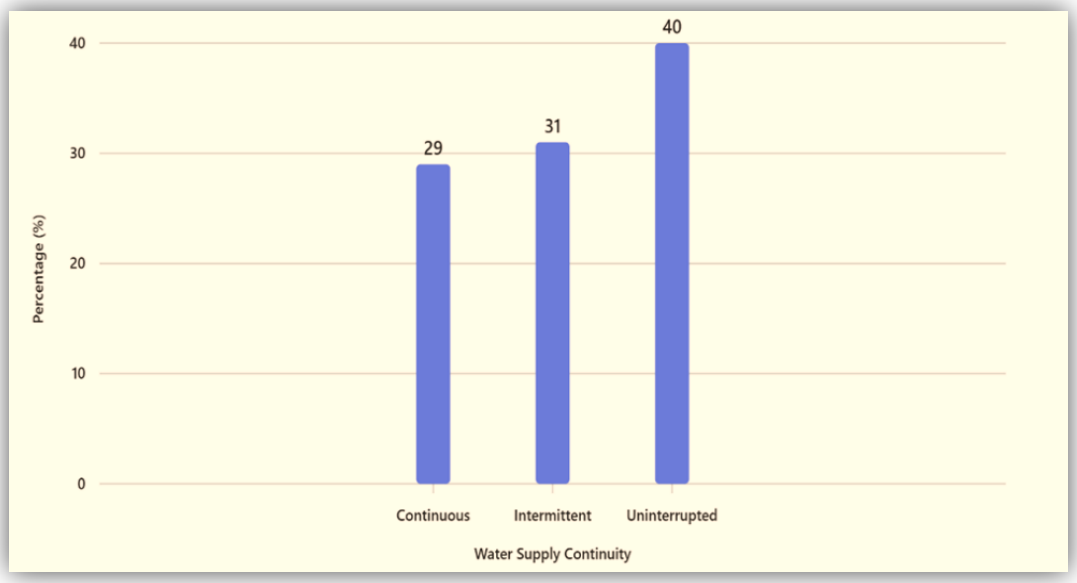

Figure 2: Histogram displaying the Water Supply Continuity

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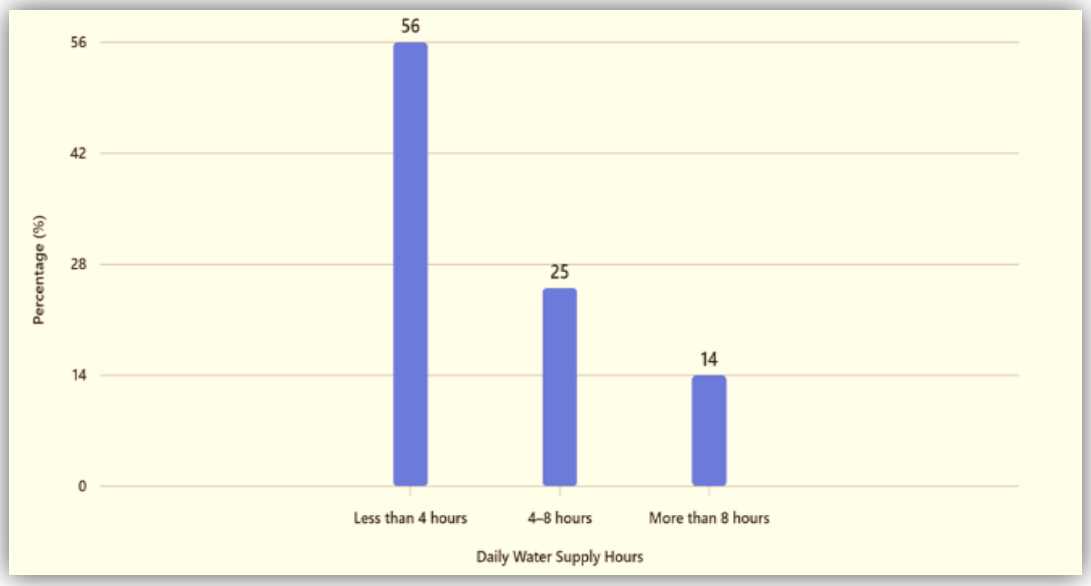

Figure 3: Histogram displaying the Daily Water Supply Hours

4.2 Community perception survey

Demographic Profiles

The survey entrant were of various ages, with the greatest group being (26-60) years old, and included both sorts, with a moderate majority being male. The educational grades of the heads of households ranged from secondary to postgraduate, reverberate the diversity of the population sample.

Relating contentment with water management, generality participants reported dissatisfaction with the water services provided in both urban and rural areas, citing unreliable water supplies due to pollution, inadequate infrastructure, and poor management.

There are a minimal group expressed doubt about the performance of water equipping and management, while only a minority of entrant expressed gratification.

Concerning take on, entrants cited considerable obstacles and difficulties in water department, from purse to infrastructure, in the governorate, such as obsolete pipelines and poorly maintained remediation plants.

They are also evident to successive mismanagement and corruption in areas such as managing purse scarcity crises due to population increase, inoperative operation, unequal monitoring, and credence on water tankers.

4.3 Proposed Solutions

All these included evolve water remediation facilities, structure dams and tanks for water storage, recondition and upgrading local water networks, assured a regular and well continuous water

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equipping, promoting rightful water distribution policies, regulating the operation of private water tankers in devious and rural areas, and raising society awareness about water maintenance practices. Concerning, the climate revision, and water availability, general survey entrants believed that climate change is already manipulate water resources in Diyala through convert rainfall patterns during the autumn, winter, and spring seasons, leading to lower river scale and superfan drought.

While the small group of entrants across uncertainty or did not believe that climate variation has any impact on water availability.

Discussion

This study assessed the availability and quality of drinking water, along with its health impacts, in urban and rural areas of Diyala Governorate using two integrated questionnaires. The first was a household-level questionnaire (which collects factual data such as specific water sources, water purification methods, and disease incidences).

The number of household heads who participated in this questionnaire was ninety-one. The second was a community perception questionnaire, (which surveyed community perceptions by collecting subjective information such as trust in the local water network, changes in rainfall amounts, and satisfaction with governance) (Ramya, Reddy, & & Kamath, 2021). The number of household heads participated in this questionnaire was 285. Together, these two questionnaires provide a combined sample of 376 respondents from urban and rural areas in Diyala Governorate, which is close to or represents the statistically recommended size to represent the governorate with a margin of error of ±5% (95% confidence interval).

The household survey questionnaire revealed that only 29% of households in Diyala Governorate have continuous access to water, but most receive less than four hours of water per day. This is consistent with previous Iraqi studies that have reported that water supplies are often intermittent, particularly in rural and peri-urban areas.

The results here demonstrate that Diyala falls far short of the World Health Organization's standard and guidelines, where continuous access to piped water is a basic criterion for safe water services ((Iraq), (Iraq), & Iraq, 2021).

Most households (74%) surveyed rely on the local water network. However, frequent and unscheduled outages force many to resort to digging wells (15%) or using tankers, often in rural areas. The widespread use of household water treatment practices (81%), including the use of filters and boiling, indicates a lack

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of confidence in the safety of the water supplied to them.

Our study is consistent with broader reports indicating that water scarcity in Iraq has increased reliance on unregulated or unsafe sources. Previous studies in Iraq show that the aging and deterioration of pipelines and the lack of modernization of the local water network lead to significant problems with water quality and supply.

Many households rely on wells to supplement the irregular local water supply, and in some cases, chlorine levels in used well water have been found to be below recommended safe limits. These findings highlight the gap between water service provision and people's perceptions of the safety of domestic water, a problem highlighted in several previous regional studies, where low residual chlorine and old pipelines contributed to increased contamination risks) Rashid ،Jalal & و ،Rasheed(2019 ،.

Survey data revealed widespread community dissatisfaction with the way water is governed in Diyala, due to mismanagement, weak infrastructure, and a lack of modernization commensurate with the population, in addition to instances of corruption. Demands for infrastructure renewal, dam construction, and policy reform were cited as urgent priority solutions.

This reflects international recommendations that addressing water security in fragile environments like Iraq requires infrastructure investment and governance reform. The household survey findings regarding frequent water outages and the lack of safe water are consistent with community concerns about government inefficiency and a lack of oversight.

The discrepancy between household realities and community perceptions reinforces the view that service reliability is the primary problem in Diyala. Previous studies on water in Iraq in general show that aging and deteriorating pipelines, waste of local water network resources, and weak water network infrastructure lead to significant deterioration in water supply, disruption, and poor quality.

Therefore, many local communities express dissatisfaction with water governance, citing mismanagement and corruption, and demanding regular infrastructure renewal, modernization, and maintenance, dam construction, and policy reform (Von Lossow, et al., 2022), (Mason, 2022), (Abbas, Wasimi, & & Al-Ansari, 2016) .

Conclusion and Recommendations

Conclusion

This study assessed the availability, quality, and health impacts of drinking water in urban and rural areas of Diyala Governorate, Iraq, using two integrated

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surveys involving 376 household heads. The results revealed:

• Low water availability - most households receive minimal water flow, representing less than four hours of water per day, with frequent interruptions and limited reliability.

• The government water network is the primary source of water for the population, while the widespread reliance on domestic water filtration systems reflects, in many ways, a lack of confidence in domestic water supplies due to water pollution and unsuitability for drinking.

• All water pollution embarrasses a major affront to public health, with (60%) of surveyed households announce symptoms of illnesses that may be united to their home water equipping, such as diarrhea, typhoid fever, and jaundice.

• Generality residents expressed disaffection with the way water is administer in Diyala, where governance, corruption and archaic, dilapidated infrastructure were identified as major hurdle to water quality and availability.

•• Can be considered Climate change is an emerging impedance and can directly contribute to declining water resource grade, causing droughts and growing pressure on water supplies to homes.

Recommendations

Policy and Governance

1. Must be rehabilitated infrastructure and Priority should be given to operate in water distribution networks and treatment plants or promotion them to optimal state and regular maintenance to ensure the continuity, its safety and quality.

2. 2. Questions of transparency, impartiality and strengthen monitoring and as well as for reducing inefficiencies and/or cases of corruption in public service and establish strict and clear oversight mechanisms for water management.

3. Reform of policies and the implementation of programmers for renewable energy Implement fair water distribution systems, continuous flow water flow, regulate the distribution of water tankers to remote areas, and implement domestic water quality standards.

Public Health

4. To work towards achieving Improve water safety measures at the source, ensure monitoring of chlorine levels, residual chlorine, and regular quality experiment at distribution points to reduce reliance on domestic treatment.

5.Strengthen public health and water surveillance systems and organize reporting systems for waterborne or suspected diseases to discover outbreaks and respond quickly to them.

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6. Community Awareness take steps to promote community engagement through various programs, promote and improve safe water handling, storage, and preservation practices, with ongoing system updates.

Climate Adaptation

7. Climate-resilient infrastructure should be resilient to withstand natural disasters and crises, building additional reservoirs, rehabilitating and upgrading irrigation systems, and developing contingency plans to manage drought seasons.

8. Promotion of applied integrated practices and technologies pertinent to sustainable water management and the development of a decision support system for an optimal water management and combine climate alteration projections into water plans to achieve and manage a balance need of the community with public safety. For homes, farms, industries, and other population requirements.

A public opinion poll corroborated this finding, in which the participants, among other things, expressed with participants expressing strong dissatisfaction with water management.

They cited the dilapidated state of the local water network infrastructure, its irregularity, and the inequitable distribution of water, causing disruption for many households and other sectors of the community and development of human resources and infrastructure conditions is top priority.

This convergence of evidence highlights a systemic problem, and inadequate monitoring and evaluation of programmers and projects. Inadequate equipment maintenance, and a failure to modernize the governorate's water supply network, as non-upgrading the storm water drainage system to avoid water accumulation during the rainy season

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Conflict of Interest

The authors declare no conflict of interest.

References

[1] (COSIT), C. O. (2023). *Population and Geographic Statistics for Diyala Governorate.* Baghdad, Iraq: Ministry of Planning, Republic of Iraq.

[2] (CSO)., e. S. (2023). *Iraq Statistical Abstract 2023. Ministry of Planning.* Baghdad: Republic of Iraq, .

DOI:doi.org/10.65766/alyj.2025.23.02.15

[3] (Iraq), M. o., (Iraq), C. S., & Iraq, U. (2021). How to improve access to water, sanitation and hygiene services in Iraq through financing: Policy brief. *UNICEF Iraq*.

[4] (UNDP), U. N. (2020). *Climate change impact on water resources in Iraq.* Iraq: United Nations Development Programme, Iraq.

[5] (UNEP), U. N. (2016). *Water pollution: Causes, effects and control.* Nairobi, Kenya: United Nations Environment Programme.

[6] (UNFPA)., U. N. (2022). *Iraq Governorate Profiles: Diyala. Baghdad: UNFPA and CSO.* Baghdad: United Nations Population Fund (UNFPA).

[7] (WHO), U. N. (2019). Progress on Household Drinking Water, Sanitation and Hygiene 2000-2017: Special Focus on Inequalities. *UNICEF and WHO*, ISBN 978-92-4-151402-7.

[8] Abbas, N., Wasimi, S. A., & & Al-Ansari, N. (2016). Impacts of climate change on water resources in Diyala River Basin, Iraq. *Journal of Civil Engineering and Architecture*, 1059–1074. doi:10.17265/1934-7359/2016.09.00

[9] Al-Ansari, N. (2013). Water pollution and management in Iraq. *Journal of Water Resource and Protection*, 210–218 , DOI: 10.4236/jwarp.2013.53022. doi:10.4236/eng.2013.58080

[10] Annette Prüss-Ustün, e. a. (2019). Burden of disease from inadequate water, sanitation and hygiene for selected adverse health outcomes: An updated analysis with a focus on low- and middle-income countries. *International Journal of Hygiene and Environmental Health,*, 222(5), 765-777. doi:https://doi.org/10.1016/j.ijheh.2019.05.004

[11] Association, W. M. (2013). World Medical Association Declaration of Helsinki: Ethical principles for medical research involving human subjects. *JAMA (Journal of the American Medical Association)*, 2191–2194. doi:10.1001/jama.2013.281053

[12] Environment., R. o.–M. (2021). *Iraq's Second National Communication to the UNFCCC.* Baghdad: Ministry of Environment.

[13] Hemmerling, S. A., Haertling, A., Shao, W., Di Leonardo, D., Grismore, A., & & Dausman, A. (2024). "You turn the tap on, the water's there, and you just think everything's fine": A mixed-methods approach to understanding public perceptions of groundwater management in Baton Rouge, Louisiana, USA. *Frontiers in Water*, Article 1289400.

[14] Hemmerling, S. A., Haertling, A., Shao, W., Di Leonardo, D., Grismore, A., & & Dausman, A. (2024). "You turn the tap on, the water's there, and you just think everything's fine": A mixed-

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methods approach to understanding public perceptions of groundwater management in Baton Rouge, Louisiana, USA. *Frontiers in Water*, Article 1289400 (open-access article, continuous pagination).

[15] Lin, L. Y. (2022). Effects of Water Pollution on Human Health and Disease Heterogeneity: A Review. *Frontiers in Environmental Science*, 880246. doi:10.3389/fenvs.2022.880246.

[16] Mason, M. (2022). Infrastructure under pressure: Water management and state-making in southern Iraq. *Geoforum*, 52–61. doi:10.1016/j.geoforum.2022.02.022

[17] Ministry of Water Resources, I. (2024). *Water Resources and Management Report in Iraq*. Baghdad, Iraq: Ministry of Water Resources, Republic of Iraq.

[18] Mustafa, B. M. (2024). Water contamination and its effects on human health:. *Journal of Geography, Environment and Earth Science International*, 28(1), 38–49. doi:org/10.9734/jgeesi/2024/v28i1743

[19] Organization, W. H. (2022). State of the world's drinking water: An urgent call to action to accelerate progress on ensuring safe drinking water for all. Geneva. *World Health Organization*, ISBN 978-92-4-006080-7 (electronic), 978-92-4-006081-4.

[20] Ramya, N., Reddy, M. M., & & Kamath, P. B. (2021). Community perception vs. biochemical confirmation: A mixed-methods study on water quality from South India. *Cureus*, e19104. doi:10.7759/cureus.19104

[21] Rashid, A. A., Jalal, S. D., & & Rasheed, A. H. (2019). The evaluation of residual chlorine from well drinking water in some quarters in Erbil city of north Iraq. *Science Journal of University of Zakho*, 1682–1687. doi:10.25271/sjuoz.2019.7.4.639

[22] Tumwesigye, N. M. (2024). Mixed-methods community assessment of drowning and water safety knowledge and behaviours on Lake Victoria, Uganda. *BMC Public Health (Springer Nature)*, Article 18475 (1–12 pages, open access). doi:10.1186/s12889-024-18475-9

[23] Von Lossow, T., Patrahau, I., Birkman, L., Kock, K., Schmeier, S., & & Kool, D. (2022). Water governance in Iraq: Enabling a gamechanger. *Water, Peace and Security (WPS) Partnership & Clingendael Institute*, 60.