IRAQI Academic Scientific Journals

Samarra Journal of Pure and Applied Science

SJPAS

www.sjpas.com

p ISSN: 2663-7405
e ISSN: 2789-6838

The Assessment Suitability of Using Greywater for Irrigation in Kirkuk Governorate – Iraq

Yawooz Hameed Mahmood[1*], Abdul-hameed M. Hamoody[2], Rushdi Sabah Abdulqader[3]

1- Biology Department, College of Education, University of Samarra, Iraq
2- Medical Laboratory Technologies Department, Al-Salam University College, Iraq.
3- Biology Department, College for Pure Sciences Education, University of Kirkuk, Iraq.

https://doi.org/10.54153/sjpas.2023.v5i2.480

Article Information

Received: 01/03/2023
Accepted: 26/03/2023

Keywords:

Wastewater, Greywater, Kirkuk.

Corresponding Author

E-mail:
yavuz.h86@uosamarra.edu.iq

Abstract

The population of Iraqi is increasing rapidly. This has increased pressure on water supply and water management. The Kirkuk Governorate and other Governorates of Iraq are facing serious challenges in this regard. The objectives of this study included evaluating the quality of greywater that generated from residential areas in the in Kirkuk Governorate and determining the suitability of reusing it for irrigating plants without treatment. The results show concentrated pH, Ec, TDS, K, Na, Ca, Mg, and SAR (7.3, 1590, 613, 16.5, 57, 79, 19.2, 1.5) respectively were greywater samples is in Iraqi standards ranges but TSS, BOD, COD, Cl, NO_3 and PO_4 (103, 292, 710, 42, 89, 21.5) respectively were exceeding permissible and standard value. So, it is preferable to use this type of greywater as for irrigate plants and discharge into environment after a primary treatment.

Introduction:

The term greywater refers to all wastewater resulting from various household uses such as laundries and showers. It also includes ablution water in mosques, water from restaurants, hygiene in schools and universities, public utilities, bathing water and kitchens in hotels and others, except for toilet water that contains human waste, which is called black water [1]. It is called greywater because when left for a period its colour turns grey [2].

The residential areas greywater contains the kitchens food residues, oils, fats, and cleaning materials, shampoo, soap, toothpaste and other body care products, may also contain pathogenic microorganisms as bacteria, viruses and parasites. The greywater from the households is considered the least polluted type of water [3].

Greywater is characterized by has much lower treatment costs than black water, and grey water constitutes between 50% - 80% of domestic water uses [4]. Chemical, physical and biological properties determine the suitability of grey water for various uses, including irrigate plants [5].

Due to the increase in the world population and the high standard of living, the world and Iraq suffer from a scarcity of water suitable for human use in recent years, which has led to a noticeable rise in the demand for water. Therefore, it has become imperative to reuse all available water resources, as sewage and greywater. To confront these problems [6], most developed countries turned to treating grey water and reusing it for irrigation of trees and green spaces and other uses such as washing cars, washing water cycles and others, and this in turn helps in providing a large part of it is fresh water [7]. Hence, this study determines identification Greywater Quality collected from selected household in Kirkuk Governorate – Iraq.

Description of Study Aera:

The study area is located within the borders of Kirkuk Governorate, Khasa River, which penetrates the city of Kirkuk from its center to divide it into two sides, east and west, with a length of approximately 190 km, 16 km of which is in the center of the city of Kirkuk [8]. The graywater that comes out from the different areas in Kirkuk Governorate, flows through the outfalls of the sewage networks into a Khasa River, (figure 1). The table shows the coordinates (X & Y) and regions from which gray water samples were taken

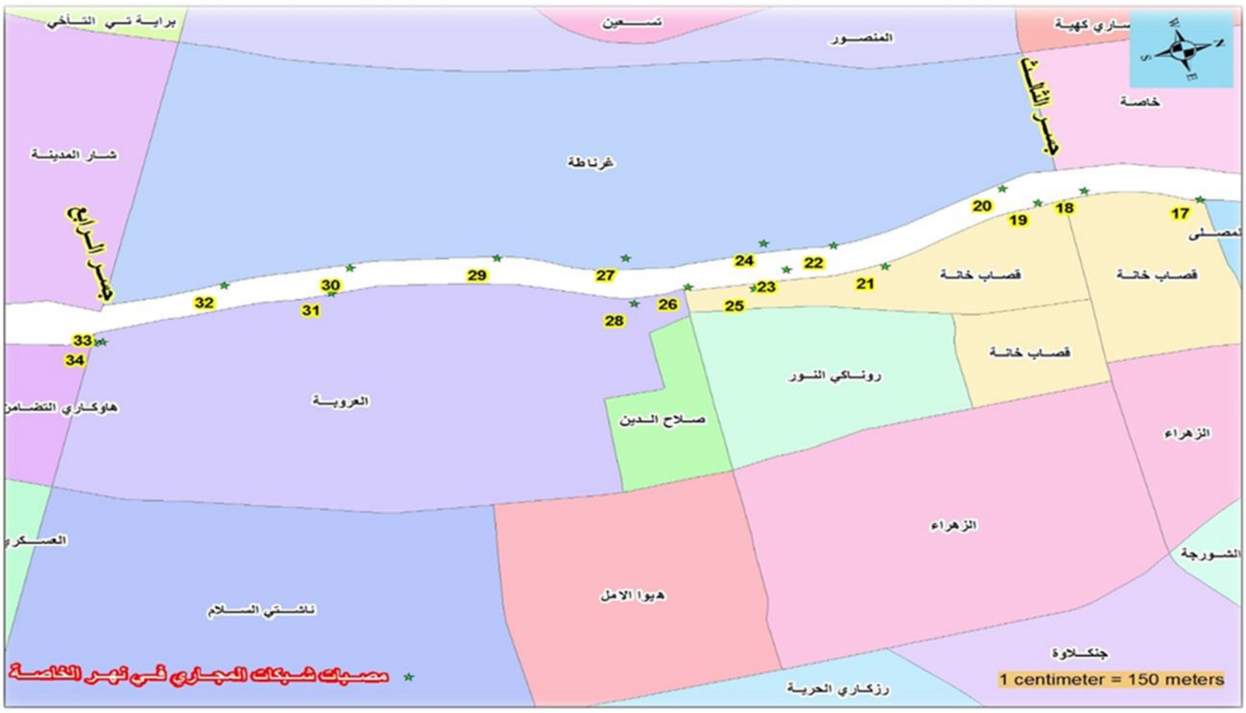

Fig. 1 Greywater sample collection areas in Khasa River.

Table 1: The coordinates (X & Y) and regions of Study

ID	X	Y	Region
14	444800.5119	3924947.864	Sarikahya
15	444748.6317	3923933.843	Musalla
16	444642.7956	3924018.646	Sarikahya
17	444663.5833	3923697.956	Musalla
18	444521.9828	3923309.621	Kasaphane
19	444535.3344	3923136.905	Kasaphane
20	444439.0442	3923029.868	Grnata
21	444683.9732	3922537.473	Runaki
22	444545.0253	3922384.027	Grnata
23	444612.4033	3922191.927	Runaki
24	444473.0221	3922145.838	Grnata
25	444667.7013	3922059.238	Runaki
26	444603.942	3921833.328	Runaki
27	444417.8782	3921651.99	Grnata
28	444628.4803	3921629.332	Uruba
29	444304.2629	3921209.921	Grnata
30	444217.9359	3920692.469	Grnata
31	444313.2844	3920599.015	Uruba
32	444183.4399	3920237.232	Grnata
33	444331.4778	3919754.556	Uruba
34	444328.8249	3919726.04	Uruba

Materials and Methods:

For the largest number of outfalls, which is estimated at 70 outfalls, the outfalls located in the center of Kirkuk Governorate between the third bridge and the fourth bridge were chosen, and their number is 18 outfalls (14 to 34) to take samples from the greywater were collected from the outfalls randomly of sewage networks in Khasa River channels and in three replications during spring 2022 in Kirkuk Governorate by sterilized polyethylene bottles washed with sample water before filling them, and the samples were kept in a refrigerated container away until reaching the laboratory. in order to physical and chemical measurements. analyzed for pH, Turbidity (NTU), Electrical Conductivity (EC), Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD_5), Chlorides (Cl), Total Hardness (TH), Calcium (Ca), Magnesium (Mg), Sodium (Na), Potassium (K), Total Suspended Solids (TSS), Total Dissolved Solids (TDS), Phosphate (Po_4), Nitrate (NO_3) and Organic Matter (OM). All grey water samples were analyzed according to standard methods for the examination of wastewater [9]. The ions included in the all following equations are in mEq/L. The potential salinity (PS) calculate by the following equation [10].

$PS\ (meq\ /l) = Cl + 1/2\ SO_4$

Reduce Sodium Carbonate (RSC) calculate by the following equation [11].

$RSC\ (meq\ /l^{-1}) = [(HCO_3^{-} + CO_3^{-2}) - (Ca^{+2} + Mg^{+2})]$

(Na%) calculate by the following equation [12].

$Na\ \% = (Na+K)/(Na+K+Mg+Ca) \times 100$

Sodium Adsorption Ratio (SAR) calculate by the following equation [13].

$SAR=Na/\sqrt{((Ca+Mg)/2)}$

Kelly Ratio (KR) calculate by the following equation [14].

$KR=Na/(Ca+Mg)$

Permeability Index (PI) calculate by the following equation [15].

$PI=Na\ [\ (HCO_3)^{1/2}\ /\ (Ca + Mg + Na)] \times 100$

Magnesium Adsorption Ratio (MAR) calculate by the following equation [14].

$MAR=Mg \times 100\ /\ Ca +Mg$

The Water Pollution Index (WPI) was used 12 standards (pH, Ec, HCO_3, NO_3, Na%, SAR, RSC, KI, PI, MAR, Cl, PS) to assess the quality of irrigation water [16].

PLi pollution loads are calculated, after that, the quality index (WPI) is calculated as per the following equations [17].

$PLi =1+ (Ci-Si)\ /Si$

$WPI = 1/n \sum PLi$

Ci: value of the measured parameters.

Si: standard limits.

Results and Discussion:

In this paper, The results shown in Table (2) indicate some physical and chemical properties of untreated greywater in Kirkuk Governorate and the values of each pH, TDS, K, Na, Mg, Ca, and SAR were in accordance with Iraqi standards for treated wastewater in irrigation [18] and the pH, Ec, TDS, TSS, BOD_5, Na, Ca, Mg, SO_4 and total alkalinity was within the suitable limits for irrigation while the COD (710) mg/l, K (16.5) mg/l, PO_4 (21.5) and NO_3 (89) mg/l recorded high values depending on the Standards and relationships.

The current study recorded high values of TSS (103) mg/l to Iraq standards in irrigation assumed the (10) mg/l is higher level for TSS, may this rise is due to this activities of humans (pollutants) is responsible for decreasing greywater quality and common human pollution include detergents, food particles and bacteria.

In this study recorded high values of BOD_5 (292) mg/l this rise is due to the presence of organic matter from the water generated from the kitchen, which contains dissolved food particles that are biodegradable [19].

In general, BOD_5 and COD are the two indicators that characterize the concentration of organic pollutants in wastewater. In this study the result shows the value of BOD5 is below than the value of COD this means there are more compounds can be chemically oxidized than the number which can be biologically oxidized [20], to Iraq standards in irrigation assumed the (100) mg/l is higher level for COD but the COD in the greywater samples of Kirkuk (710) mg/l indicates high level contaminations, the reason for this may be due to the use of various chemicals and detergents in the household.

The Cl, PO_4 and NO_3 values is recorded (42) mg/l, (21.5) mg/l and (89) mg/l respectively these results considered too high values according to Iraq standards in irrigation due to the use of detergents contain a high concentration of chloride, ammonium and phosphate all in laundry and hand washing operations [21].

Generally, the results shown in irrigation Index's as PS, Na%, SAR, PI, and WPI it was within the good limits while the RSC, KR, MAR it was within the suitable limits.

We can understand from current study the greywater in Kirkuk Governorate of Iraqi it can be safe limits for irrigation after a primary treatment, if we used this greywater for irrigate plants or discharge into environment without treatment may lead to serious problems in public health, environment, plants and soil.

Table 2: Physical and Chemical Characteristics of Greywater in Kirkuk Governorate

Parameter	Greywater	Iraqi standards for treated wastewater in irrigation [18]	Standards and relationships	
pH	7.3	4 – 8.6	6.5-8.5	[22,23]
Ec(μs)	1590	-	2250	[24]
TDS (mg/l)	613	2500	3000	[25]
TSS (mg/l)	103	10	200	[26]
BOD_5 (mg/l)	292	10	300	[26]
COD (mg/l)	710	40	500	[26]
K (mg/l)	16.5	20	12	[22,23]
Na (mg/l)	57	230	200	[22,23]
Ca (mg/l)	79	400	300	[22,23]
Mg (mg/l)	19.2	60	30	[22,23]
Cl (mg/l)	42	0.5	250	[26]
PO_4 (mg/l)	21.5	12	15	[26]
NO_3 (mg/l)	89	50	50	[26]
SO_4 (mg/l)	103.7	-	250	[22]
Total Alkalinity ($HCO_3 + CO_3$) (mg/l)	182.5	-	200	[22,23]
PS (mEq/l)	2.26	-	25 > Good 25-75 Suitable 75 < poor	
RSC (mEq/l) [27]	-2.59	-	<1.25 Suitable 1.25-2.25 Marginally suitable 2.25 < Unsuitable	
Na% [28]	34.4	-	20 > Excellent 20-40 Good 40-60 Permissible 60-80 Doubtful 80 < Unsuitable	
SAR (mEq/l) [29]	1.5	< 6	0-10 Good 10-18 Suitable 18-26 Doubtful 26< Unsuitable	
KR (mEq/l)	0.44	-	1.0 > Suitable	

[30]			1.0 < Unsuitable		
PI (mEq/l) [31]	53.38	-	25 > Good 25-75 Suitable 75 < poor		
MAR (mEq/l) [32]	28.57	-	50 > Suitable 50< Unsuitable		
WPI	0.66	-	< 0.5	Excellent	Class: I
			0.75 - 0.5	Good water	Class: II
			0.75 - 1.0	Mod. Quality	Class: III
			> 1.0	Sever polluted	Class: IV

Conclusions:

Greywater reuse presents a potential option for water demand management that can contribute to the reduction of freshwater consumption for irrigation. It can be concluded from the current study the concentration of some physical and chemical factors exceed the standard and permissible value according to Iraqi standards. Therefore, it is preferable to use graywater from residential areas in Kirkuk Governorate to irrigate plants after primary treatment, otherwise it will lead to damage to the soil and plants.

References

1. Shaikh, I. N., & Ahammed, M. M. (2020) Quantity and quality characteristics of greywater: a review. Journal of environmental management, 261, 110266.
2. Marjoram, C. (2014). Graywater research findings at the residential level (Doctoral dissertation, Colorado State University).
3. Health Department of Western Australia (HDWA) (2002) Draft guidelines for the reuse of greywater in Western Australia.
4. Wu, B. (2019) Membrane-based technology in greywater reclamation: A review. Science of the total environment, 656, 184-200.
5. Khalid Bani-Melhem and Edward Smith. (2021) Grey water treatment by a continuous process of an electrocoagulation unit and a submerged membrane bioreactor system. Chemical Engineering Journal, 198- 199.
6. Al-Ansari N., Ali A.A., Knutsson S. (2014) Present Conditions and Future Challenges of Water Resources Problems in Iraq. Journal of Water Resource and Protection, 6, 1066-1098.
7. Al-Jayyousi, O.R. (2002) Focused Environmental Analysis for Greywater Reuse in Jordan.Env. Eng. Policy. 3 (2): 67-73.
8. Kazem, Ali Abdulhussein and Zayed, Jabbar Abd. (2017) Atlas and introductory pamphlet for the water resources survey program in Iraq. Ministry of Health and Environment, Planning and Follow-up Department, Iraq.

9. American Public Health Association (APHA). (2005) Standard Methods for the Examination of Water and Wastewater, 19th Edition, Washington DC.
10. Hwang, J.Y. ; Park, S. ; Kim, H.; Kim, M. ; Jo, H. ; Kim, J. ; Lee, G. ;Shin, I. and Kim, T. (2017). Hydrochemistry for the assessment of groundwater quality in Korea. J. Agri. Chem. and Environ., 6(1): 1-29.
11. Nag, S. K., and Das, S. (2017). Assessment of groundwater quality from Bankura I and II Blocks, Bankura District, West Bengal, India. Applied Water Sic., 7(6): 2787-2802. DOI 10.1007/s13201-017-0530-8 DOI. 10.1007/s13201-017-0530-8.
12. Wilcox, L. V. (1955) Classification and use of irrigation waters, USDA, circular 969, Washington DC, USA.
13. Chegbeleh, L. P., Akurugu, B. A., and Yidana, S. M. (2020). Assessment of Groundwater Quality in the Talensi District, Northern Ghana. The Scientific World J., 2020(8450860)., :1-24. doi.org/10.1155/2020/8450860.
14. Bhat, M. A., Wani, S. A., Singh, V. K., Sahoo, J.,Tomar, D. and Sanswal, R. (2018). An overview of the assessment of groundwater quality for irrigation. Journal of Agricultural Science and Food Research,9(1):1-9. https://www.researchgate.net/publication/324536967.
15. Xu, Y., Seshadri, B., Bolan, N., Sarkar, B., Ok, Y. S., Zhang, W., Rumpel, C., Sparks, D., Farrell, L., Hall, T., and Dong, Z. (2019). Microbial functional diversity and carbon use feedback in soils as affected by heavy metals. Environment International, 125, 478–488. https://doi.org/10.1016/j.envint.2019.01.071.
16. Shukla S, Saxena A (2020a) Sources and leaching of nitrate contamination in groundwater. Curr Sci 118:883–891. https://doi.org/10.18520/cs/v118/i6/883-891 – DOI.
17. Khan, Ramsha; Saxena, Abhishek; Shukla, Saurabh; Goel, Pooja; Bhattacharya, Prosun; Li, Peiyue; Ali, Esmat F;S haheen, Sabry M..(2022). Appraisal of water quality and ecological sensitivity with reference to riverfront development along the River Gomti, India. Applied Water Science. https://doi.org/10.1007/s13201-021-01560-9.
18. IME, Iraqi Ministry of Environment. (2012) Specifications of treated water used for irrigation water. Iraqi standards - No. 4260.
19. Rakesh, S. S., Ramesh, P. T., Murugaragavan, R., Avudainayagam, S., & Karthikeyan, S. (2020) Characterization and treatment of grey water: A review. IJCS, 8(1), 34-40.
20. Kwak, J. Khang, B. Kim, E. and Kim, H. (2013) Estimation of Biochemical Oxygen Demand Based on Dissolved Organic Carbon, UV Absorption, and Fluorescence Measurement, Journal of Chemistry, vol 2013, Article ID 243769, 9.
21. Al-Fatlawi, A. H., & Mohammed, B. A. A. (2018) Estimation and Characterization of Grey Water in Karbala City During.
22. WHO, (2008) Guidelines for Drinking-Water Quality, Second addendum, Vol. 1, Recommendations, -3rd ed., ISBN 9789241547604, pp. 1-515.
23. ISIRI, Institute of Standards and Industrial Research of Iran. (2009) Physico-chemical characteristics of water (Standard Number: 1053), Fifth Edition, pp. 1-18.
24. USDA. United States Department of Agriculture (1955) classification and use of irrigation waters, Washington D.C. circular No. 969.
25. Davis, S.N. and De Weist, R.J.M. (1966) Hydrogeology. John Wiley and Sons, New York, 463 p.
26. INWRDAM, Inter-Islamic Network on Water Resources Development and Management. (2008) Guidelines for Reuse of Reclaimed Domestic Grey water in Periurban Areas in Jordan.

27. Todd, D.K. and Mays, L. (2005). "Groundwater Hydrology". 3rd. ed.,John-Wiley and Sons, Ins. 636.
28. Gungor, A and Arslan, H. (2016). Assessment of water quality in drainage of Carsamba plain, Turkey, through water quality index and graphical methods. Global NEST Journal, 18(1): 67-78.
29. Richards, L. A. (1954) Diagnosis and improvement of saline and alkali soils, U.S.
30. Kelly, W.P. (1940) Permissible composition and concentration of irrigated waters, In: Proceedings of the ASCF66. P: 607.
31. Doneen, L. D. (1964) Water quality for Agriculture, Department of Irrigation, University of California, Davis, 48 pp.
32. González-Acevedo, Z. I., Padilla-Reyes, D. A., and Ramos-Leal, J. A. (2016). Quality assessment of irrigation water related to soil salinization in Tierra Nueva, San Luis Potosí, Mexico. Revista Mexicana de Ciencias Geológicas, 33(3): 271-285.http://www.redalyc.org/articulo.oa?id=5724879900.

IRAQI Academic Scientific Journals

Samarra Journal of Pure and Applied Science

SJPAS
مجلة سامراء للعلوم الصرفة والتطبيقية

www.sjpas.com

p ISSN: 2663-7405
e ISSN: 2789-6838

تقييم مدى ملائمة استعمال المياه الرمادية للري في محافظة كركوك – العراق

ياوز حميد محمود [1]* عبد الحميد محمد حمودي [2] رشدي صباح عبدالقادر [3]

1. قسم علوم الحياة، كلية التربية، جامعة سامراء، العراق.
2. قسم تقنيات المختبرات الطبية، كلية السلام الجامعة، العراق.
3. قسم علوم الحياة، كلية التربية للعلوم الصرفة، جامعة كركوك، العراق.

معلومات البحث:

تأريخ الاستلام: 2023/03/01
تأريخ القبـــول: 2023/03/26

الكلمات المفتاحية:

مياه الصرف الصحي، المياه الرمادية، كركوك.

معلومات المؤلف

الايميل:
yavuz.h86@uosamarra.edu.iq

الخلاصة:

تهدف الدراسة الحالية الى تقييم جودة المياه الرمادية الناتجة عن المناطق السكنية في محافظة كركوك وتحديد مدى ملائمة إعادة استعمالها لري بدون أي معالجة. أظهرت النتائج الدراسة أن الأس الهيدروجيني، التوصيلية الكهربائية، المواد الصلبة الذائبة الكلية ، البوتاسيوم ، الصوديوم ، الكالسيوم ، المغنيسيوم ، و نسبة امتصاص الصوديوم (7.3 ، 1590 ، 613 ، 16.5 ، 57 ، 79 ، 19.2 ، 1.5) على التوالي كانت في ضمن المعايير العراقية بينما كانت نتائج المواد الصلبة العالقة الكلية ، المتطلب الحيوي للاوكسجين ، المتطلب الكيمياوي للاوكسجين ، الكلوريد ، النترات و الفوسفات (103 ، 292 ، 710 ، 42 ، 89 ، 21.5) على التوالي أعلى من الحد المسموح بها ضمن المعايير العراقية الخاصة بالري. لذلك، يفضل استعمال هذا النوع من المياه لري اوتصريفها الى البيئة بعد المعالجة الأولية.