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# ASSESSMENT OF THE IMPACT OF PHYSICOCHEMICAL QUALITIES OF SOILS IN GREYWATER USED FOR IRRIGATING LETTUCE PLANT (*Latuca sativa*)

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## ABSTRACT

The study aimed at assessing the effects of physicochemical properties of soils in greywater use for irrigation.Six weeks seeds of Lettuce (Latuca sativa) were sown in plastic flower pots containing loamy soil, plant monitoring routine was done weekly and data were anlayzed using excel while sampling of both water and soil were conducted before and after planting of which the samples were taken for analysis to the laboratory for physical and chemical parameters. The data obtained were analyzed using descriptive statistics.The pH, Ca, Mg, K, and Na levels in water and soil samples were all within WHO (1984) recommended ranges, indicating that greywater had no impact on soil quality. According to the report, research should be conducted on a regular basis to investigate the qualities of some physic-chemical properties and harmful compounds found in greywater irrigation and their impact on plant growth.

**Keyword:** Grey Water, physicochemical, Irrigation and Latuca sativa

## INTRODUCTION

Greywater is defined as the urban waste water that includes water from baths, showers, hand wash basins, washing machines, dish washers and kitchen sinks, but excludes input from toilets (Prathapar *et al.,* 2005; Jamrah *et al.,* 2006; Alfa *et al.,* 2014). Thus, while blackwater, which include human faeces coming from toilets, are excluded, most of the effluents from a household are produced in bathtubs, dishwater, lavatories, or even washing machines, being denominated as greywater. Since greywater contains much less microbial pollution, it can be considered as a cost-effective effluent to be treated and reused. According to WHO (2006) it is estimated that 10% of the world's population consumes foods which are irrigated with wastewater. Therefore, treatment of wastewater and reusing it for irrigation may supply for the increasing demand on freshwater and improve the food production capacity of farms. However, there are significant concerns about the safety of reusing wastewater for irrigation. The main concern is the potential for damaging effects of poor-quality water on soil, plants and finally human's health.

According to Al-gheethiet al. (2019), an increase in the level of natural water contamination is caused by the rapid increase in the total population of developing countries and their activities, as well as a lack of clean water resources and advanced technology required to produce high quality treated wastewater. Water, on the other hand, is a limited resource, and securing a reliable water supply, particularly in light of climate change scenarios, has become a major concern worldwide (Pinto et al., 2010).

The use of grey water for irrigation could be a valuable resource since, in addition to irrigation, it can lower the cost of commercial fertilizer and eliminate environmental risks. Wastewater irrigation has raised agricultural yield, improved water and nitrogen usage efficiency, and provided plant nutrients (Hussain and Saati, 1999). It also solves the problem of wastewater effluent disposal

(WHO, 1980).As a result, well-planned wastewater utilization in agriculture will boost food production by increasing irrigation coverage, minimize contamination of river water, and lower the cost of wastewater disposal by municipal councils (Scott et al., 2004). According to studies, using irrigated greywater instead of scheme water improves unit development in plants (Finley et al., 2009; Misra and Sivongxay, 2010; Pinto et al., 2010). The use of treated greywater for crop irrigation in Jordan's Karak project, for example, has shown to be successful.

Regardless of chemical concentrations in rural areas, greywater is discharged directly on the ground near residential areas, posing a number of environmental and health risks, including wetlands pollution, underground water supply contamination, and salt, oil, and grease infiltration into the soil, which effectively reduces the infiltration rate of the soil (Travis et al., 2008). Owing to the voluminous amount of generated greywater, the properties and reuse of greywater needs to be explored. However, the information of greywater reuse and or the asessment of greywater effects on soil quality, thus the need for this research. Therefore, the current study is undertaken to assessment impact of Physico chemical qualities of soils in greywater irrigated with (Latuca sativa).

## MATERIALS AND METHODS

### Study Area

The experiment was carried out from May to June of 2015 at in the orchard of the department of Agronomy Bayero University Kano New Site campus at latitude $11^0$ 58' 48.29''N and longitude $8^0$ 25' 16.41''E as shows in the Figure 1. The study was conducted within 6 Weeks in screen house under a controlled experiment using greywater and tap water to irrigate lettuce sown seeds in plastic flower pots to assess the effects of the irrigated water types on soil quality used.

### Soil Collection and Laboratory Analysis

Soil sample was collected from each plot after last harvest. Physical and chemical soil analyses were carried out after drying the samples in the laboratory and preparing them for analysis, i.e grinding and sieving then using a 2mm sieve. The samples were stored in air tight clean polythene bags for analysis with proper labeling. Then physical and chemical properties such as Soil texture, soil pH, electrical conductivity (EC), organic matter (OM), total nitrogen (N), available phosphorus (P), potassium (K), Sodium Absorption ratio (SAR) following APHA (2005) standard methods.

Soil physical and chemical data obtained were subjected to statistical analysis. This was presented in tables and descriptive statistics using SPSS statistical software version. The mean value were compared with the recommended water quality limits of WHO for irrigation.

## RESULTS AND DISCUSSIONS

### Physical Properties of Greywater

Table 1 shows the physical properties for grey water sample observed to be partly grey (Ash colour), offensive smell of the water samples was also observed due to the anaerobic condition of the samples with regards to odour, and the turbidity for greywater was obtained as 80NTU and 30NTU for tapwater sample which indicates the murkiness and amount of microbes present in the samples of water that in turn affects the soil hydraulic conductivity and pollutes the soil surfacethrough surface flow of the water used for irrigation. This study is in dis agreement with the work of (Olowookere *et al*., 2018) who reported higher than the WHO limit of 0.5 - 5NTU . TDS for greywater was obtained

to be excellent at 486.00mg $L^{-1}$ while tapwater of 1312.00mg $L^{-1}$was unsuitablewhich indicates the salinity of the water for irrigation as recommended by WHO.

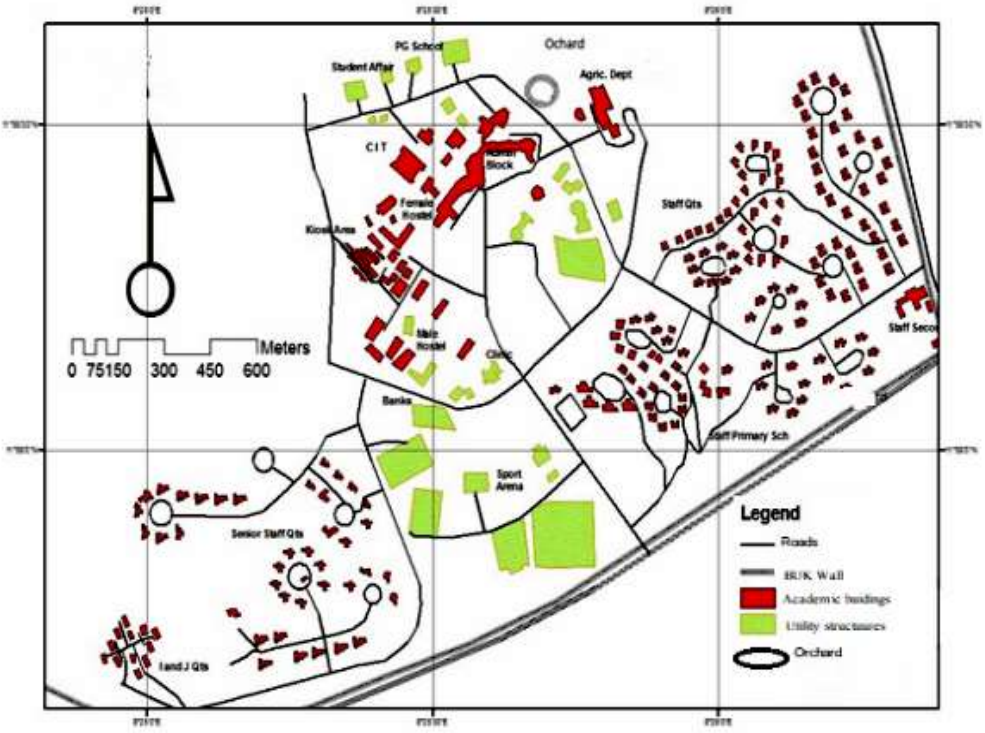


**Figure 1:** Map showing the study Area
Sources: BUK Cartography Lab, 2019

**Table 1:** Physical Properties of Grey water

| Type of water | Colour | Odour | Turbidity | TDS(mg $l^{-1}$) |
|---|---|---|---|---|
| Greywater | Ash | Offensive | 80NTU | 486.00 |
| Control | Clear | Non-Offensive | 30NTU | 1312.00 |

Laboratory Analysis (2019).

**Physio Chemical Properties of Soil**

Table 2 shows the chemical and physical properties of soilbefore and after planting forboth greywater and tapwater irrigation of lettuce undercontrolled conditions shows that pH is slightly acidic ranged between 6.09 to 5.98 before and after planting while increases the EC level of the soil (1.0 ) after planting was higher than before planting (0.67) and therefore result in low productivity as also reported by (Rusan, *et al.,* 2007).EC which indicates that the salinity of the soil was voluminously increased after the irrigation. Moisture content (5.01>1.35; 0.67%) in soil before was higher because there was no lettuce growth as a result of water absorption by the plants. K (0.14<0.44;0.89cmol/kg) in soil before was lower than soil after, the drastic increase shows the higher chances of photosynthesis and diseases resistance in the plants were higher due to the irrigation, which is similarly reported by Kamau (2011). Similarly, SAR (0.0.50<0.98;0.95) in soil before is lower than soil after which shows the evaluated relative proportion of sodium to calcium and magnesium of the soils, which this gives effects such as nature of toxin and nutrient of plants in the soil as reported by (Gross *et al.,* 2007; Maimon*et al.,* 2010).

**Table 2:** Summary of Soil Chemical Properties before and after Planting

| | | Greywater | Tapwater |
|---|---|---|---|
| **Sample** | Soil Before | Soil After | Soil After |
| pH | 6.98 | 6.09 | 5.98 |
| K (cmol/kg) | 0.14 | 0.44 | 0.89 |
| Na (cmol/kg) | 0.42 | 0.10 | 0.23 |
| EC (cmol/kg) | 0.63 | 0.67 | 1.00 |
| M.C (%) | 5.01 | 1.35 | 0.67 |
| SAR | 0.50 | 0.98 | 0.95 |
| % Sand | 76.00 | 84.00 | 76.00 |
| % Silt | 18.96 | 6.8 | 12.8 |
| % Clay | 5.04 | 9.20 | 11.2 |
| TEX. Class | Sandy loam | Sandy loam | Sandy loam |

Laboratory Analysis (2019).

**Chemical analysis of water**

From Table 3 a comparison of water chemical properties for both greywater and tapwater to the recommended limit for irrigation shows that EC (0.73; 0.22ds/cm), Magnesium (14.58; 24.48mg $1^{-1}$), Calcium (41.39; 31.11mg $1^{-1}$)and Bicarbonate (70.00; 30.00mg $1^{-1}$) values were all in excellent quality for irrigation, similarly pH (6.90; 6.57) wasin good quality for water used while Sodium (201.99; 178.77mg $l^{-1}$) in greywater was unsuitable but in tapwater was in good quality. Contrarily,SAR (38.18; 33.90mmol $l^{-1}$)for both greywater and tapwaterare both unsuitable although the samples of water were till used due to the fact that much of emphasis for this study was on the quality of the soil not the plant as regards the effect of unsuitable sodium and SAR impact.

## CONCLUSION

The finding revealed that the concentration of physico-chemical properties of the soils before after planting (PH, electrical conductivity, Na, Ca, Mg, SAR) in both experimental and control were thin the WHO (2008) recommended value. The study dis agree with Travis *et al.,* 2010) who reported that that raw grey water may significantly change soil properties that can impact the movement of water in soil and the transport of contaminants in water zone.

Recommendation

a) Research work should be regularly carried out to study the qualities of some physic-chemical properties and toxic chemicals present in greywater use for irrigation and their effect in plant growth.

b) Extension service to should regularly organize seminar and workshop on ways of improving irrigation farming in the study area.

## REFERENCES

Adamu, M., Ismail, I.Y., Muhammad, A., Aliyu, B.N., Fatima, A.G.D., Yahaya, A.A.U., and Bello, U.M (2014).Overview of the Physical and Chemical Setting of Kano Region, Nigeria.*Journal of Geography* 1(5).

Alfa, M. I., Igoro, S .B., Ajayi, S. A., Dahunsi, S. O., and Chigbo, B.O. (2014). Assessment of the Antimicrobial Efficiency of Moringa Oleifera seed extracts in the treatment of grey water. *Nigeria. British Journal of Applied Science & Technology, 4* (3), 558-567.

Al-gheethi, A. A. S., Noman, E. A., Maya, R., Radin, S., Bala, J. D., Hashim, A., & Kassim, M. (2019). *Qualitative Characterization of Household Greywater in Developing Countries :*

*A Comprehensive Review*. Springer International Publishing.

Al-Hamaiedeh, H. and Bino, M. (2010). Effect of treated grey water reuse in irrigation on soil and plant. *Desalination, 256*(1-3), 115-119.

Al-Jayyousi, O. (2003). Greywater reuse; towards sustainable water management. *Desealination.*

Ayers, R.S. and Wescot, D.W. (1994)Water Quality for Agriculture; FAO Irrigation and Drainage. Paper 29. Revision.1.pp 1-30.

Bhausaheb, L. P., Saroj, B. P., and Sane, M.G. (2010). Design and Economical Performance of Grey Water Treatment Plant in Rural Region, *International Journal of Civil and Environmental Engineering, 2 (1).*

Brades, M. (1978). Characteristics of effleuents from seperate septic tanks treating grey water and black water from the same house. *Water Pollution Control Federation, 50*(11), 2547-2559.

Burnat, J. and Eshtayah, I. (2010). In S. a. McIlwaine (Ed.), *Grey water use in the Middle East: Technical, Social, Economic and Policy Issues* (pp. 17-28). Practical Action.

Finley, S., Barrington, S., and Lyew, D. (2009). Reuse of Domestic Greywater for the Irrigation of Food Crops. *Water, Air, and Soil Pollution, 199*(1), 235-245.

Gorgich, M. (2016). *A Study on the Possibility of Using Greywater in Irrigation of Agricultural Products*.

Gross A., Kaplan, D., and Baker, K. (2007). Removal of Chemical and Microbiological Contaminants from Domestic Grey water Using a Recycled Vertical Flow Bioreactor (RVFB). *Ecol. Eng, 31*, 107-114.

Hill, A. R. (1976). The environmental impacts of agricultural land drainage. *J. Environ. Mgmt, 4*, 251-274.

Holgate, L. C., Atikenhead-peterson, J. A., and Gentry, T. J. (2011). Irrigation Water Chemistry: Impact on Microbial Community Composition and Biogeochemical Leaching Under Perennial Ryegrass (Lolium perenne [L]). *ISRN Ecology*, 1-9.

Holtzhausen, L. (2005). Grey water recycling: From grey to green: Reusing greywater for food. *The Water Wheel*, 10-12.

Idris-nda, A., Aliyu, H. K., & Dalil, M. (2013). The challenges of domestic wastewater management in Nigeria : A case study of Minna , central Nigeria. *International Journal for Development and Sustainability*, *2*(2), 1169–1182.

Jamrah, A. Al-omari, A., Al-qasem, L., and Ghani, A. (2006). Assessment of availability and characteristics of greywater in Amman. *Water International*, 31(2)210-220.

Kamau, K. S. (2011). *An Assessment of pH, Toxic and Essential Plant Elements in Greywater from Selected Households in Kenyatta University, Kenya.(Unpublished master's dissertation).Kenyyatta University, Kenya.*

Karlen, D. L., Mausbach, M. J., Doran, J. W., Cline, R. G., Harris, R. F., & Schuman, G. E. (1997). Soil Quality: A Concept, Definition, and Framework for Evaluation (A Guest Editorial). *Soil Science Society of America Journal*, *61*(1), 4.

Kekere, O., Ajibade, F. A., and Ologundudu, F. (2018). Recycling of greywater for agricultural irrigation: panacea to household waste water management. *International Journal of Development*, *5*(2), 38–51.

Maimon, A. D. I., Tal, A., & Friedler, E. (2010). Safe on-Site Reuse of Greywater for Irrigation - A Critical Review of Current Guidelines. *Environ.Sci. Technology*, *44*(9), 3213–3220.

Misra, R. K., and Sivongaxy, A. (2009). Reuse of laundry grey water as affected by its interaction with saturated soil. *J. Hydrol., 366*(1-4), 55-61.

Mojiri, A. Aziz, H. A., Aziz, S. Q., Gholami, A., and Aboutorab, M. (2011). Effects of municipal wastewater on physical and chemical properties of saline soil. *J. Biol. Environ. Sci, 5*(14), 71-76.

Mojiri, A. A. (2013). Impact of urban wastewater on soil properties and Lepidium sativum in an arid region. *Intern. J. Sci. Res. Environ. Sci, 1*(1), 1-9.

Nwaokobia, K., Ogboru, R. O., & Idibie, C. A. (2018). Effects of grey water irrigation on the cultivation of African spinach (Amaranthus hybridus). *International Scientific Journal*, *18*(April), 133–145.

Ogunshe, A.A.O., Fawole, A.O. and Ajayi, V.A. (2010).Microbial evaluation and public health implicationsof urine as alternative therapy in clinic Pediatriccases.*Pan AfricanMedical Journal* 5: 12.

Scott CA, Faruqui NI, Raschid-Sally L (2004). Wastewater use in irrigated agriculture: Management challenges in developing countries. In: Scott CA, Faruqui NI, Raschid- Sally, L. (Eds.), Wastewater Use in Irrigated Agriculture, CABI Publishing, UK.

Prathapar, S. A., Jamrah, A., Ahmad, M., Al-Adawi, S. Al-sidairi, S., and Al-Harasi, A. (2005). In *Overcoming constraints in treated greywater reuse in Oman* . 1, 177-186.

Rusan, M. J., Hinnawi, S., and Rousan, L. (2007). Long term effect of wastewater irrigation of forage crops on soil and plant quality parameters. *Chemosphere, 215*(13), 143-152.

Hussain G, A1-Saati AJ (1999). Wastewater quality and its reuse in agriculture in Saudi Arabia. Desalination. 123: 241-251.

Travis, M. J. (2008). Accumulation of oil and grease in soils irrigated with greywater and their potential role in soil water repellency. *Science of the Total Environment,, 394*(1), 68 – 74.

Travis, M. J., Wiel-Shafran, A., Weisbrod, N., Adar, E., & Gross, A. (2010). Greywater reuse for irrigation: Effect on soil properties. *Science of the Total Environment*, *408*(12), 2501–2508.

Ukpong, E.C. & Agunwamba, J. C. (2012). Grey Water Reuse for Irrigation. *International Journal for Applied Science and Technology*, *2*(8), 97–113.

World Health Oraganization. (2006). Guidelines for the Safe Use of Wastewater, Excreta and Greywater Waste Water in Agriculture, 2, 177-182.

WHO (World Health Organization) (1980). Health Aspects of Treated Sewage Reuse. Report on WHO Seminar, Copenhagen.

Yahaya, M. N., Umar, F. G., Jibrin, D. M. and Idris, U. D. (2015). Assessment of Water Quality of River Minjibir for Irrigation Purposes in Kano State, Nigeria. *Nigerian Journal of Agriculture, Food and Environment.*, *11*(3), 97–101.