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Physico-chemical analysis of irrigation soil in Babani Quarters in Bauchi metropolis, Nigeria

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Abstract
There are locations at Babani Quarters of Bauchi Metropolis, along Gombe road that are used for irrigation activities and there is the fear that the soil used could be hazardous, as such there is a need for a study to be carried out on the Physicochemical parameters, heavy metals and trace metals in the soil used for growing vegetables for consumption by Bauchi populace. Thirty soil samples were randomly collected from five different sampling locations in July 2013 the soil was analyzed using Atomic Absorption Spectrophotometer. The results showed that pH had mean level of 7.29±0.01 – 7.31±0.02, while electrical conductivity recorded 65.98±0.02 μScm^{-1} – 85.62±0.00 μScm^{-1}. The metals analyzed were lead, chromium, cadmium and arsenic using Cecil 1000 model atomic absorption spectrophotometer at various mean concentrations. The results indicated all the physicochemical parameters, and metals are within the permissible limits of WHO (2005).

Keywords: Babani quarters, Atomic absorption spectrophotometer, total dissolved solids

Introduction
Irrigation is the artificial application of water to land for the purpose of agricultural production. Effective irrigation will influence the entire growth process from seed bed preparation, germination, root growth, nutrient utilization, plant growth and quality. While soil is the product of weathering of rocks which forms the uppermost layer of the earth. This provides support and nutrients for plant growth, and habitat for most animals (NBTE, 2008) [1]. Increase in population, unemployment, demand for food, poor road network and unavailability of facilities to embark on commercial scale farming have necessitated the development of diverse agricultural systems like irrigation around urban centers (Mello, D., 2013). The consequences of urbanization and the deposits of domestic wastes in soil used for crop production lead to contamination or pollution of the soil (Gin, 2013). Plant growth on soil largely depends on different elements as natural components of the earth crust or introduced as a result of anthropogenic activities. These elements are usually found in the form of mineral salts and other compounds that can be absorbed by plants in the form of ion (Rooney *et al*, 2006 and zhao *et al*, 2006) [2, 3]. These minerals can ease off into the atmosphere by volatilization and can be mobilized into the surface water or ground water. Metals cannot be easily degraded, destroyed naturally or organically since living beings do not have specific metabolism function for them (Abollino *et al*, 2002).

Material and method
Sampling point
The sampling points are located at about 50m apart and they include Lambun Baban Rabi, Lambun Malam Amadu, Lambun Malam Yahaya, Lambun Malam Yunusa and designated S_A. S_B. S_L. S_D. and S_E respectively. While the control samples were obtained about 100 meters away from the sampling points.

Sample collection
Soil samples were randomly collected in July 2013 from five (5) sampling points at Babani quarters of Bauchi metropolis, at about 15cm depth, triplicate measurements were made at each sampling point to get samples that are true representative of the area. Control samples were also collected.

Soil preparation and analysis
Soil samples were collected, air dried and oven dried at 105^{o}c for 24 hrs. Samples were ground into fine powder and sieved with sieve mesh of about 0.18mm. 0.5g of dried soil sample was put into a graduated cylinder, mixed with 2.00mL of aqua regia (1:3 concentrated HCl and HNO_3). The mixture was then digested at 95^{o}c for 1hr and allowed to cool at room temperature. Distilled water was used to dilute the mixture and made to 10mL and allowed to settle overnight (Mwegoha and Kihampa, 2010) [4]. The filtrate was collected and analysed with atomic absorption spectrophotometer and the concentration 0f the elements were determined.

Results
The results obtained from the analysis of Physicochemical Parameters and Metals Analysis are tabulated as follows.

Table 1: Physicochemical Parameters and Metal analysis of irrigated soil at Babani quarters

Sampling unit	pH	EC	Pb	Cd	Cr	As	Fe	Zn	Ca	Mg	Mn	K	Cu	Na	Control
S_A	7.31±0.02	85.62±0.00	3.60±0.05	0.80±0.01	15.00±0.04	0.20±0.03	2.90±0.05	1.80±0.04	0.60±0.01	4.50±0.11	0.10±0.01	1.10±0.03	2.10±0.06	1.60±0.03	0.01±0.00
S_B	7.30±0.01	69.04±0.00	1.00±0.02	1.40±0.01	30.00±0.05	1.00±0.01	1.30±0.05	2.80±0.05	1.20±0.00	2.40±0.07	0.90±0.02	2.60±0.03	2.10±0.11	2.50±0.06	0.02±0.06
S_C	7.32±0.03	82.41±0.00	2.40±0.04	1.90±0.03	19.00±0.20	0.60±0.01	2.50±0.07	0.90±0.01	2.30±0.06	1.60±0.01	1.60±0.03	1.50±0.01	3.10±0.06	0.30±0.01	0.01±0.00
S_D	7.29±0.02	77.56±0.01	3.00±10.03	2.00±0.02	21.00±0.11	1.20±0.03	3.00±0.02	4.10±0.04	2.00±0.07	2.90±0.02	2.70±0.03	3.00±0.04	2.50±0.30	4.00±0.06	0.03±0.01
S_E	7.31±0.01	65.78±0.02	1.10±0.04	2.20±10.02	26.00±0.01	0.70±0.02	1.80±0.02	1.30±0.02	3.30±0.02	1.10±0.04	3.10±0.05	2.80±0.03	0.40±0.05	3.40±0.06	0.02±0.01

Discussion

In the course of this study, the following concentrations in mg/kg were recorded for the physicochemical parameters: pH 7.29 – 7.31, Electrical conductivity (EC) 65.98 μScm^{-1}– 85.62 μScm^{-1}. The results showed that the soil is alkaline as the pH values were above 7.00 and within 7.29 and 7.31. The values obtained for the physico-chemical parameters indicated that the soil is safe for the growth of plants at all the sampling location as reported by (Jalali *et al*, 2008).

The heavy metal analysis carried out at Babani quarters showed the following range of concentrations at sites S_A - S_E. Lead (Pb) 1.00 – 3.6mg/kg, Cd 0.8 – 2.20mg/kg, Cr 15.00 – 30.00mg/kg, as 0.20 – 1.20mg/kg, Fe 1.30-3.00mg/kg and Zn 0.90-4.iomg/kg. Others included Ca 0.60-3.30mg/kg, Mn 0.10-4.50mg/kg, K 0.10-3.00kg/kg, Cu 0.40-3.10mg/kg and Na 0.30-4.00mg/kg as indicated in table above. The analysis carried out showed that chromium concentrations were higher than any other heavy metals at the sampling locations. Heavy metal accumulation in agricultural soils can be a serious problem when waste water is used for irrigation for many years. The concentrations of Pb, Cd, and Cr, As, Fe, Ca, Mg, Mn, Cu, and Na were consistent with the study carried out by (Bowen, 1979) [5]. This showed that the values do not pose any treat to life as the concentrations were within the permissible limits of 5-1, 500mg/kg, 1-900mg/kg, and 7500mg/kg (WHO, 1993) and (Bowen, 1979) [5] respectively. The variables obtained from this analysis were subjected to statistical measurements using one-sample t-test, at 95% confidence interval. It was observed that there was a significant difference between most of the variables, the metals and physicochemical parameters do not exert any significant influence on one another based on parameters that were tested.

Conclusion

The study carried out on the physicochemical parameters and heavy metal analysis of irrigation soil at Babani quarters of Bauchi metropolis showed that all the indices analyzed were found to be within permissible limits of (WHO, 1992, 1993) and (Bowen, 1979) [5] respectively. This study revealed that there is need to further safe guard the soil around this quarters from anthropogenic activities such as dumping of refuse and municipal solid wastes and car wash which is prevalent.

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