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Impact of Seasonal Variation on some Heavy Metals Accumulation in Irrigation Water of some Selected Local Government Area of Kebbi State Nigeria

Abdulrasheed Aisha[1] Sanda, A. R[2]., and Ramatu Idris[2].

1. Department of Soil Science, Faculty of Agriculture, Kebbi State University of Science and Technology Aliero, Kebbi State.
2. Department of Crop Science, College of Agriculture, Federal University of Agriculture Zuru. Kebbi State, Nigeria.

Abstract

The study of the impact of seasonal variation on heavy metals accumulation in irrigation water was carried out in four local governments of Kebbi state namely Yauri, Bunza, Augie and Birnin Kebbi local government area, in each local government, sample of water were collected from three different sources in both wet and dry season. The source of irrigation water used in these areas are borehole, stream and borehole+stream. the analysis of the heavy metal present was carried out in the laboratory using atomic absorption spectrophotometer(AAS). The data gathered were compared according to Nigeria Industrial Standard for irrigation. It was observed that the stream water has the highest accumulation of the heavy metals studied (Pb, Cu, Zn, Cd, Co, Ni &Cr) in dry season, followed by borehole water and the least accumulation was found in borehole and stream at Yauri, & Bunza while Augie in Birnin Kebbi Local Government the stream water has the highest accumulation of the heavy metals studied (Pb, Cu, Zn, Cd, Co, Ni &Cr) in dry season, followed by borehole+stream water and the least accumulation was found in borehole. All the heavy metals (Pb, Cu, Zn, Cd, Co, Ni &Cr) determined in all three water source at the four local government in dry and wet season exceeded their allowable standard (5.0,1.01,2.0,0.1,0.2and 0.1) except for Zn and Pb which are within the permissible limit as stated by NIS

Keywords: irrigation water, heavy metals, wind speed, stream water, bore whole water

Introduction: Heavy metals are naturally occurring metals in the environment due to the natural weathering of bedrock. These naturally released heavy metals are usually contained in forms that are not readily available to plant roots (Malan *et al.,* 2014). However, in recent years, this has changed due to the increase in anthropogenic activities which release more biologically available forms of heavy metals into the environment (Malan *et al.,* 2014). Water is an essential resource for living systems, industrial processes, agricultural production and domestic use. Ninety-seven percent of the world's water is found in oceans. Only 2.5% of the world's water is non-saline fresh water (Itodo, 2010). However, 75% of all fresh water is bound up in glaciers and ice caps. Only 1% of fresh water is found in lakes, Rivers soils and 24% is present as ground water. The use of water increases with growing population, putting increasing strain on these water resources. There is a growing human population in the world which means there is need for an increase in food production. However, food production to feed this growing population is decreasing due to poor agricultural practice (Sivaranjani *et al.,* 2015). One means to ameliorate this problem is the use of irrigation practices; however, irrigation is associated with a number of problems ranging from water mis- management to use of poor quality irrigation water as a result of salinity, turbidity, heavy metals pollution and other chemicals constituents that make irrigation water of low quality for crop production (Sivaranjani *et al.,* 2015). Suitability of water for irrigation is determined by its chemical composition as regard to concentrations and types of soluble salts present (Sanda and Dibal, 2014). Heavy metal contamination in water is an increasing world-wide environmental concern (Mondol *et al.,* 2011). Water have been used much as a recipient of toxic and solid waste from domestic, industrial and agricultural run-off. Water-borne chemical pollution entering rivers and streams cause tremendous amounts of destruction. Water pollution by heavy metals due to human activities is causing serious ecological problems in many regions of the world (Sanda et al., 2014). Metals which are discharged into natural waters at increased concentrations in sewage, industrial effluents or from mining operations can have severe toxicological effects on human, crops and aquatic ecosystems. The main objective of study is to assess the impact of seasonal variation on some heavy metals accumulation in irrigation water sources of some selected Local Government Areas of Kebbi State, Nigeria.

Materials and Methods: The areas that was be selected for this study are four local government areas of Kebbi State namely Augie, Birnin-Kebbi, Bunza and Yauri with geographical coordinates of 12^0 54'2''N,20 36'2^{0}''E; 12^0 27'14''N, 4^0 11'51''E; 12^0 5'3''N, 4^0 1'15''E; 10^0 46'55''N, 4^0 48'28''E respectively. These study areas have Sudan and Sahel-savannah. Agriculture is the main occupation of the people especially in these areas. The parameters that was analyzed with the standard methods are shown in the table below.

Table 1: Water elemental analysis and Instruments used.

S/No.	Parameters	Mode of test	Instrument used	Model
1	Ph	Meter	pH Meter	Hanna pH
2	Lead	Colorimetric	AA Spectrophotometric	PG 990 AAS
3	Zinc	Colorimetric	AA Spectrophotometric	PG 990 AAS
4	Copper	Colorimetric	AA Spectrophotometric	PG 990 AAS
5	Chromium	Colorimetric	AA Spectrophotometric	PG 990 AAS
6	Nickel	Colorimetric	AA Spectrophotometric	PG 990 AAS
7	Cobalt	Colorimetric	AA Spectrophotometric	PG 990 AAS
8	Cadmium	Colorimetric	AA Spectrophotometric	PG 990 AAS

Results and Discussions: After the analysis of all the samples collected the results and their discussions are presented in the following tables and discussed below.

Table 2: Concentration of heavy metals in wet and dry season in Yauri local government and at three water source

Seasons	Water sources	**Pb**	**Cu**	**Zn**	**Cd**	**Co**	**Ni**	**Cr**	**pH**
Wet season	Borehole	0.78	1.57	1.12	0.57	0.66	0.44	0.63	6.49
	Stream	1.00	1.67	1.31	0.44	0.67	0.34	0.58	6.52
	Borehole + Stream	0.77	1.59	1.29	0.45	0.57	0.31	0.25	6.47
	Total mean value	**0.85**	**1.61**	**1.24**	**0.49**	**0.63**	**0.36**	**0.49**	**6.49**
Dry season	Borehole	0.89	1.73	1.38	1	0.87	0.75	0.71	6.57
	Stream	1.06	1.96	1.98	1.34	0.98	0.82	0.82	6.01
	Borehole + Stream	0.54	1	1.69	0.59	0.77	0.6	0.51	6.07
	Total mean value	**0.83**	**1.56**	**1.68**	**0.97**	**0.87**	**0.72**	**0.68**	**6.21**
	NIS	5.0	1.01	2.0	0.01		0.2	0.1	

As shown in Table 2 above, the heavy metals indices of both three samples areas; bore hole, stream and bore hole + stream during dry and wet season in Yauri local government areas. Result obtained shown that Zn has the highest concentration obtained during dry season(1.68mg/l) is higher compared with wet season(1.24mg/l), with stream having the highest value of Zn, followed by borehole + stream and the least obtained at borehole. Higher number Zn obtained during dry season may be as a result of low precipitation to dilute the improper disposal of solid and liquid waste around the stream and also the off-site effect of the use of agro-chemicals. Though, the concentration of both wet and dry season do not exceed allowable limit. The mean concentration of copper(1.61mg/l) in wet season is higher compare to its mean concentration in dry season (1.56mg/l) with stream having the highest concentration in both season and borehole having the least concentration in both season. The higher concentration of cu in wet season is as result of rainfall which wash seepage of industrial wastes and percolation of water through iron-containing rocks nearby before flowing into the stream in accordance with the study of Akinbile *et al*, (2013). Both wet and dry season concentration of cupper are found above standard. The mean concentration of lead in wet season(0.85mg/l) is higher compare to the mean concentration in dry season(0.83mg/l) with stream having highest concentration in both season and borehole having least concentration. Higher concentration of lead observe in wet season may be due to the various anthropogenic activities. Lead contamination of the stream water may be the result of entry from industrial effluents, household sewages containing phosphate fertilizers and human and animal excreta (Sanda et al., 2014). However, Cd concentration in both dry and wet

season are above standard(0.01mg/l), the mean concentration of Cadmium in dry season (0.97mg/l) is higher than the mean concentration of wet season (0.49mg/l) with borehole having the highest concentration in wet season and stream having highest concentration in dry season, while stream has least concentration in wet season and borehole + stream having least concentration in dry season. higher number of Cd observe in stream water in dry season is as a result of hazardous waste with ore and steel materials from smelting and mining industry, which was taken by wind and get deposited to stream and on ground. Also, the pH of the stream (6.01) which is acidic may increase the concentration of Cd. High concentration of Nikel was recorded in dry season (0.72mg/l) with stream having the highest concentration (0.82mg/l). This high concentration may be as a result of low rainfall to dilute its concentration, Ni get to stream through water from car wash, batteries, improper disposal of coins and cutleries to stream (Sanda et al., 2016). Though, Ni also occur naturally in the environment which increase its concentration. The concentration of Ni in both season are above standard. High concentration of chromium was recorded in dry season(0.68mg/l) with stream having the highest concentration, its concentration in wet season is low(0.49g/l). This concentration of chromium may be as a result of high wind speed which ranges from (0.5m/s-0.3m/s) in the study area.it is known that Cr are mostly present as fine dust particle, which eventually settle over land and water .Chromium can strongly attach to soil sediment and only a small amount is expected to dissolve in water and leach through the soil to groundwater. (Gad, 2014) In Bunza local government, the stream water has the highest concentration of the heavy metals studied (Pb, Cu, Zn, Cd, Co, Ni & Cr) in dry season compare to wet season, followed by borehole and the least concentration of (Pb, Cu, Zn, Cd, Co, Ni & Cr) are found in borehole+stream.

The borehole+stream water has the least concentration of Nikel (0.6mg/l) in dry season compare to wet season (1.67mg/l) followed by borehole and the steam having the highest concentration. The least concentration of Ni in borehole+stream water in dry season is as a result of low presence of iron and manganese in the soil sediment which nickel can attach itself to before taking to the underground water. Despite its low concentration in borehole+stream water in dry season, its concentration exceeded the allowable standard (0.2mg/l) as stated by NIS. In Augie local government, also the stream has the higher concentration of the heavy metals (Pb, Cu, Zn, Cd, Co, Ni &Cr) study in dry season followed by borehole+stream with borehole having the least concentration compare to in wet season. The higher concentration of the heavy metals (Pb, Cu, Zn, Cd, Co, Ni &Cr) in stream water in dry season may be as a result of wind speed which ranges from (0.5m/s-0.3m/s) of the study area that carry the available heavy metals in the environment and deposit it on stream., absence of rainfall(0.00mm) to dilute the available metals in the stream water might also be the cause for it high concentration in dry season. All the heavy metals (Pb, Cu, Zn, Cd, Co, Ni &Cr) determined in all three water source at Augie in dry and wet season exceed their allowable standard (5.0,1.01,2.0,0.1,0.2and 0.1) except for Zn and Pb which are within the permissible limit as stated by NIS

Table 5: Concentration of heavy metals in wet and dry season in Birnin Kebbi local government and at three water source

Seasons	Water source	Pb	Cu	Zn	Cd	Co	Ni	Cr	Ph
Wet season	Borehole	0.76	1.67	0.92	0.46	0.73	0.81	0.72	6.49
	Stream	0.80	1.66	0.99	0.45	0.81	0.76	0.75	6.58
	Borehole + Stream	0.74	1.58	1.25	0.44	0.75	0.70	0.71	6.57
	Total mean value	**0.76**	**1.64**	**1.05**	**0.45**	**0.77**	**0.76**	**0.73**	**6.55**
Dry season	Borehole	1	1.15	1.2	0.95	0.89	0.95	0.88	6.54
	Stream	1.87	2.08	1.97	1.16	1.36	1.57	1.47	6.18
	Borehole+ stream	1.12	1.16	1.25	0.89	1.06	1.01	0.6	6.58
	Total meanvalue	**1.33**	**1.46**	**1.47**	**1.00**	**1.10**	**1.18**	**0.98**	**6.43**

In Birnin Kebbi local government, the stream has the higher concentration of the heavy metals (Pb, Cu, Zn, Cd, Co, Ni &Cr) studied in the dry season followed by borehole+stream with borehole having the least concentration compare to those in the wet season. The higher concentration of the heavy metals (Pb, Cu, Zn, Cd, Co, Ni &Cr) in stream water in dry season may be as a result of wind speed which ranges from (0.5m/s-0.3m/s) of the study area that carry the available heavy metals in the environment and deposit it on stream., absence of rainfall (0.00mm) to dilute the available metals in the stream water might also be the cause for it high concentration in dry season. All the heavy metals (Pb, Cu, Zn, Cd, Co, Ni &Cr) determine in all three water source at Birnin Kebbi in dry and wet season exceed their allowable standard (5.0,1.01,2.0,0.1,0.2and 0.1) except for Zn and Pb which are within the permissible limit as stated by NIS

Summary and Conclusion:: It was observed that the stream water has the highest accumulation of the heavy metals studied (Pb, Cu, Zn, Cd, Co, Ni &Cr) in dry season, followed by borehole water and the least accumulation was found in borehole & stream at Yauri, & Bunza while Augie in Birnin Kebbi Local Government the stream water has the highest accumulation of the heavy metals studied (Pb, Cu, Zn, Cd, Co, Ni &Cr) in dry season, followed by borehole+stream water and the least accumulation was found in borehole. All the heavy metals (Pb, Cu, Zn, Cd, Co, Ni &Cr) determined in all three water source at the four local government in dry and wet season exceeded their allowable standard (5.0,1.01,2.0,0.1,0.2and 0.1) except for Zn and Pb which are within the permissible limit as stated by NIS

Reference

Akinbile, C.O., Yusuf, M.S., Talib, S.H.A., Hassan, Z.A., Haque, A.M.M. and Shamsuddin, U.B (2013). Qualitative analysis and classification of surface

water in Bukit Merah reservoir in Malaysia. Water Sci-Technol 13(4):1138-1145

Gad, S.C. (2014). Encyclopaedia of Toxicology, 3rd ed. Elsevier Inc. USA.

Itodo, I. (2010). Estimation of specific surface area using Langmuir isotherm method. *Journal of Applied Science and Environment Management* Vol 14, No. 4 (2010).

Malan, M., Müller, F., Cyster, L., Raitt, L. and Aalbers, J. (2014). Heavy metals in the irrigation water, soils and vegetables in the Philippi horticultural area in the Western Cape Province of South Africa. Department of Biodiversity and Conservation Biology, University of the Western Cape, Private Bag x 17, Bellville 7535, South Africa.

Mondol, M. N., Chamon, A. S., Faiz, B. and Elahi S. F. (2011). Seasonal variation of heavy metal concentrations in water and plant samples around Tejgaon Industrial Area of Bangladesh. *Journal of Bangladesh Academy of Sciences*, Vol. 35, No. 1, 19-41.

Sanda, Ahmad Rabo and Dibal, Jibrin (2014): Analysis of Irrigation water quality at Kadawa Irrigation Project for improved productivity. *International Journal of Environment. Vol.3, issue-3, pp.235-240.*

Sanda, AR., Samson Francis, Musa Ahmed, A. and Ahmad Idris (2014). Assessment of Irrigation Water quality of the Jega Flood plains and their Influence on some Soil Properties. *International Journal of Agricultural and Soil Sciences. Vol.2 (6). Pp. 94- 98.*

Sanda, A.R., Ahmad, I. and Gaye, C.A. (2016) Heavy Metal Content of Abattoir Waste and Municipal Sludge in Soil and Water along Jakara River in Kano, Kano State, Nigeria.*OpenAccessLibraryJournal*,**3**: e2896.http://dx.doi.org/10.4236/oalib.1102896

Sivaranjani, S., Amitava, R. and Samrath, S. (2015). Quality Assessment with Water Quality Indices. *International Journal of Bio resource Science Vol 2 l Issue 2 l July 2015;* Soil and Water Conservation, Dept. of Soil Science and Agric. Chemistry, IAS., RGSC BHU, Mirzapur- 231001.

Table 4: Concentration of heavy metals in wet and dry season in Augie local government and at three water source

Seasons	Water source	Pb	Cu	Zn	Cd	Co	Ni	Cr	Ph
Wet season	Borehole	0.77	1.20	1.10	0.51	0.57	0.69	0.64	6.46
	Stream	0.80	1.69	1.30	0.51	0.51	0.71	0.59	6.69
	Borehole + Stream	0.78	1.32	1.32	0.50	0.48	0.69	0.57	6.62
	Total Mean Value	**0.78**	**1.40**	**1.24**	**0.51**	**0.52**	**0.70**	**0.6**	**6.59**
Dry season	Borehole	0.87	1.58	1.49	0.85	0.85	0.95	0.82	6.84
	Stream	1.2	1.87	1.76	1.4	1.36	1.56	0.99	6.01
	Borehole + stream	0.92	1.65	1.59	1.05	0.87	0.88	0.65	6.34
	Total mean value	**1.00**	**1.7**	**1.61**	**1.1**	**1.03**	**1.13**	**0.82**	**6.40**

Table 3: Concentration of heavy metals in wet and dry season in Bunza local government and at three water source

Seasons	Water source	Pb	Cu	Zn	Cd	Co	Ni	Cr	pH
	Borehole	0.81	1.40	0.97	0.57	0.86	0.84	0.97	6.76
	Stream	0.87	1.55	0.68	0.61	0.83	1.04	0.33	6.71
Wet season	Borehole + Stream	0.88	1.38	0.79	0.58	0.86	1.67	0.33	6.62
	Total mean value	**0.85**	**1.44**	**0.81**	**0.59**	**0.85**	**1.18**	**0.54**	**6.69**
	Borehole	0.89	1.73	1.38	1	0.87	0.75	0.71	6.57
Dry season	Stream	1.06	1.96	1.98	1.34	0.98	0.82	0.82	6.01
	Borehole + stream	0.54	1	1.69	0.59	0.77	0.6	0.51	6.07
	Total mean value	**0.83**	**1.56**	**1.68**	**0.98**	**0.87**	**0.72**	**0.68**	**6.02**