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Full Length Research Paper

Assessment of surface water receiving sewage effluents for gardening irrigation purposes: A case study of Ona River in Ibadan Southwest Local Government area of Oyo State, Nigeria

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The analysis of chemical quality of Ona River in Ibadan Southwest Local Government (IBSWLG) area of Oyo State was undertaken in this study to assess its suitability for irrigation purposes by considering two major seasons in the ecological zone. In order to achieve the objectives, twenty sampling points were selected along the stream at about 20 m interval. The water samples collected were analyzed in the laboratory using methods of Ademoroti (1996). The result showed that despite the large content of sewage effluents characterized by some of the areas, the quality of the surface water remains within the safe limit for irrigation purposes; thus, Ona River water can be developed for all-year round crop production in the study area. However, the need to continuously monitor and assess surface water quality for irrigation is stressed.

Key words: Sewage, effluents, water quality, sampling points, quality assessment.

INTRODUCTION

The utilization of flood plain for irrigation in the urban areas drained by perennial rivers and stream is on the increase in Nigeria. This is due to the population and consequent increase in chemical for vegetable and some other animal crops. Furthermore, the erratic pattern of occurrence of rainfall as a result of global warming has made it absolutely necessary to augment water supply from rainfall with other available sources of water supply in order to meet the crop water requirement especially during the storage of supply.

Conceptually, water quality refers to the characteristics of a water supply that will influence its suitability for a specific use, that is, how the quality will meet the needs of the user. Quality is defined by certain physical, chemical, and biological characteristics. Specifically, we have different quality needs and one water supply is considered, if it produces better result or cause fever problems, then an alternative water supply is considered. The suitability of water for irrigation is determined not only by soil, climate, and crop but also by the skill and knowledge of water user (Beecroft, 1982). The soil problems most commonly encountered and used as a basis to evaluate water quality are those related to salinity (salt in water to an extent yield is affected), water infiltration rate (caused by relatively high sodium or low calcium), specific ion toxicity, for example, sodium chloride or boron and excessive nutrient. It is observed that urban drainage surface tend to flow all year round partly because they are fed by water from home and industries.

Surface water in cities may be advantageous for irrigation since it is largely sewage effluents that may contain valuable plant nutrients. Martins and Bello (1997) warned that wart-water that drains into surface water is likely to increase the quantities of solutes thereby voicing the concentration of certain ions that may ultimately lower the quality of water for irrigation.

Since variation is hydrologic parameter, particularly rainfall and evaporation affects the quality of stream runoff; it is necessary to examine the seasonal variation of chemical constituents of surface water receiving sewage effluent in order to ascertain their quality and suitability for irrigation purposes throughout the year. Therefore, attempts are made in this study to analyze the seasonal variation of surface water receiving sewage

Table 1. Results of some physicochemical parameters of Ona surface water receiving sewage effluents collected during the wet season.

pH	EC (dS m^{-1})	TDS (mg l^{-1})	Ca^{2+} (me l^{-1})	Mg^{2+} (me l^{-i})	Na^{2+} (me l^{-1})	CO_3^- (mel^{-1})	HCO_3^- (me l^{-1})	SO_4^{2-} (mel^{-1})	Cl (me l^{-1})	NO_3^- (mg l^{-1})	K^+ (mg l^{-1})
6.2	0.90	500	2.21	0.24	9.42	0.01	0.6	12.4	20.4	6.4	0.9
6.4	1.20	470	2.36	0.14	8.64	0.01	1.2	15.2	11.4	6.2	0.4
5.8	0.40	550	1.02	0.94	7.56	0.01	1.2	9.8	9.2	6.4	0.5
6.4	0.30	850	0.92	1.20	6.06	0.03	2.4	10.2	11.4	5.2	0.6
6.2	0.01	700	1.02	1.23	10.2	0.04	2.6	10.4	11.2	4.8	1.0
5.4	0.05	725	0.86	1.49	9.46	0.40	2.9	11.2	9.6	2.4	1.0
6.2	0.10	800	2.42	1.64	8.45	0.90	3.2	12.4	10.2	3.2	1.0
6.0	0.96	820	2.34	2.01	10.24	0.02	4.0	11.4	11.0	3.6	0.9
7.0	0.17	810	3.01	2.92	10.23	0.92	5.2	12.0	10.1	4.8	0.8
6.2	1.00	815	2.96	2.94	11.14	0.84	6.2	10.4	9.6	6.2	0.4
5.8	1.01	805	2.98	0.96	12.22	0.62	4.8	12.4	8.2	6.6	0.9
5.2	1.02	810	2.90	1.24	10.24	0.48	9.2	10.8	9.6	7.2	0.6
5.8	1.02	820	2.64	1.36	11.04	0.52	6.6	11.4	10.2	2.5	0.7
6.2	0.96	800	3.21	1.49	11.12	0.64	1.6	12.0	6.4	3.4	0.8
6.4	0.99	790	2.91	1.64	10.04	0.92	2.4	11.2	8.6	4.4	0.6
5.8	0.94	800	3.14	2.01	9.96	0.86	5.2	12.4	8.9	4.3	0.6
7.4	1.02	810	2.40	2.02	10.02	0.92	4.8	11.4	9.2	5.2	0.9
6.2	1.04	850	1.96	0.14	9.22	0.96	5.2	9.6	10.5	6.2	1.0
6.0	1.06	450	0.94	0.92	10.92	0.02	6.4	10.2	11.2	6.0	0.1
5.2	0.02	700	1.94	0.64	9.04	0.04	7.2	8.1	12.4	7.1	0.9
5.4	0.04	780	2.08	1.04	9.62	0.05	6.8	7.1	6.4	2.1	1.0
6.6	0.08	500	1.46	1.24	10.02	0.44	7.8	10.2	6.6	2.2	1.1
6.2	1.02	550	1.52	1.26	11.24	0.12	6.8	11.2	7.4	6.4	1.2
6.4	1.01	570	2.56	1.34	10.02	0.32	6.0	6.4	8.4	4.8	0.9
5.8	0.94	580	3.04	1.04	11.02	0.45	7.4	5.2	9.2	5.2	0.6
5.4	0.64	550	3.52	0.96	12.02	0.64	6.2	8.1	6.2	6.2	0.6
5.4	0.75	580	3.43	0.92	9.64	0.92	4.5	9.2	11.4	2.3	0.9
6.0	0.66	800	3.49	0.94	10.02	0.56	6.8	10.2	10.2	3.4	0.2
7.2	0.78	860	3.42	1.46	11.42	0.64	7.2	10.5	12.4	5.5	0.3
7.1	0.92	860	3.24	1.05	12.45	0.44	6.8	10.6	13.1	6.6	0.9
6.2	1.02	920	1.45	1.52	10.04	0.52	7.2	11.2	8.6	4.8	0.6
6.2	1.46	850	1.94	1.62	11.04	0.62	6.8	6.4	9.4	5.2	0.8
5.2	1.52	870	0.96	1.72	12.45	0.72	6.5	8.2	10.2	4.8	0.6
5.4	0.66	625	2.24	2.02	10.64	0.84	7.5	9.2	11.1	5.2	0.9
5.5	0.92	600	2.36	2.24	10.24	0.90	1.3	9.6	12.1	4.8	1.1
5.8	0.92	610	2.92	2.00	10.24	0.09	2.5	10.2	6.4	4.7	1.0
6.1	1.02	620	3.01	0.12	9.24	0.92	3.0	9.8	8.4	5.1	0.9
5.7	0.92	710	3.20	0.92	9.92	0.90	4.0	10.2	9.6	5.2	0.4
7.1	0.42	780	4.10	1.06	10.02	0.62	5.2	11.4	9.9	6.2	0.6
6.7	0.64	750	2.90	1.10	12.12	0.64	6.4	12.2	10.0	6.6	0.9

effluents vis-à-vis comparing it with Food and Agriculture Organization (FAO) standard for irrigation purposes.

MATERIALS AND METHODS

The study was carried out on Ona river in Ibadan Southwest Local Government Area (7°25"N, 3°25"E) Oyo State, Nigeria. The city has a tropical wet and dry climate with distinct dry period of about 130 days; mean annual rainfall and temperature are about 1205 mm and 28°C respectively while estimated potential evapotranspiration is 1100 mm (Martins and Bello, 1997). The city is underlain by crystalline pre-Cambrian basement complex of igneous and metamorphic origin (Fagoyinbo, 1966).

Twenty sampling points were located along the stream at about 20 m interval. Twenty samples were collected during each season (wet and dry) making a total of forty samples. The samples for wet season were taken at the peak of raining season (July 2010) while the sample for dry season was taken at the peak of the dry season (January 2011).

The water samples collected were analyzed in the laboratory using the method by Ademoroti (1996). The parameters considered for analysis includes electrical conductivity, total dissolved solids, calcium, magnesium, sodium potassium carbonate, bicarbonate, chloride sulphate, nitrate, phosphate, boron acid/ basicity and sodium absorption ratio. The results obtained from the analysis were compared with the Food and Agriculture Organization (FAO) standard for irrigation purpose to ascertain its suitability for irrigation purposes.

RESULTS AND DISCUSSION

Tables 1 and 2 showed the result of the investigation of

Table 2. Results of some physicochemical parameters of Ona surface water receiving sewage effluents collected during the dry season.

pH	EC (dS m^{-1})	TDS (mg l^{-1})	Ca^{2+} (me l^{-1})	Mg^{2+} (me l^{-1})	Na^{2+} (me l^{-1})	CO_3^- (me l^{-1})	HCO_3^- (me l^{-1})	SO_4^{2-} (mel^{l-1})	Cl (me l^{-1})	NO_3^- (mgl^{-1})	K^+ (mg l^{-1})
6.2	1.02	650	9.2	1.82	12.4	0.54	4.2	16.2	11.8	8.9	0.9
5.8	1.47	700	7.6	2.62	18.2	0.66	4.0	15.8	12.8	9.6	0.8
5.5	1.48	780	6.8	1.94	9.8	0.84	3.8	10.5	16.4	9.2	0.9
5.6	1.34	840	6.4	3.14	15.2	1.02	3.8	10.7	10.8	9.6	0.9
5.6	0.96	800	7.2	1.52	6.4	0.84	4.0	11.7	10.6	8.4	1.2
5.6	1.62	780	6.8	1.62	10.8	0.94	4.0	12.2	12.4	7.2	1.4
5.8	1.06	758	9.0	1.82	11.2	0.42	3.8	13.3	12.8	8.6	1.8
6.0	1.09	720	8.4	1.08	9.8	0.48	3.6	12.4	11.2	9.2	1.6
6.1	1.08	680	8.6	1.04	10.2	0.66	4.2	12.2	12.2	9.6	1.6
6.0	1.05	700	9.2	2.54	11.8	0.48	3.8	16.1	12.8	9.2	1.4
6.0	1.62	720	8.8	3.02	15.8	0.52	2.2	9.2	12.5	9.3	1.6
6.2	1.64	740	8.4	1.66	18.2	0.71	3.8	10.2	12.8	9.4	0.9
6.2	1.48	840	8.2	1.49	21.2	0.68	3.2	10.1	11.4	12.8	0.9
6.2	1.53	650	6.8	1.50	20.8	0.94	3.4	10.8	11.4	12.2	1.2
6.1	1.55	600	7.2	1.58	21.2	0.92	3.8	11.4	10.8	14.2	1.4
5.9	1.50	624	6.4	1.62	18.2	0.66	3.2	11.4	12.0	12.4	1.8
5.8	1.62	550	4.8	2.64	19.1	0.34	3.8	11.8	13.0	12.8	1.1
5.7	1.72	450	7.4	2.58	8.4	0.36	3.2	16.4	9.8	8.8	1.4
5.5	1.84	450	8.2	2.46	12.6	0.42	3.0	12.2	9.8	8.6	1.5
6.2	1.62	300	9.2	2.41	12.8	0.47	3.2	12.4	9.0	9.2	1.6
6.2	1.81	350	9.0	2.41	13.2	0.45	3.8	13.5	9.6	10.1	1.8
6.2	1.06	320	10.1	2.52	14.8	1.00	4.2	13.6	9.8	10.2	1.5
6.3	1.24	300	11.2	2.48	14.6	0.66	1.9	14.8	10.2	12.1	1.2
6.2	1.36	340	9.2	2.62	15.2	0.71	1.6	16.4	10.8	13.2	1.3
6.5	1.06	320	6.2	2.48	9.6	0.61	2.4	12.4	9.8	14.1	1.4
6.0	1.08	310	6.8	2.64	10.2	0.81	2.8	8.8	12.8	13.1	1.5
5.8	1.22	320	6.0	2.52	10.8	0.76	5.2	13.8	12.8	14.2	1.6
5.8	1.46	300	5.8	3.04	11.6	0.94	6.4	14.2	12.9	12.4	1.8
5.7	1.52	450	9.2	2.98	12.8	0.86	7.2	18.4	10.6	10.8	1.9
5.8	1.50	510	10.1	2.90	8.9	0.94	8.6	19.2	10.2	12.2	1.0
5.8	1.48	520	10.0	1.46	10.2	0.48	9.6	10.8	9.8	12.8	0.9
5.8	1.50	330	10.1	2.92	9.8	0.94	3.9	9.2	10.2	12.4	1.0
6.2	1.52	340	9.3	2.94	10.4	0.48	3.8	9.4	10.6	14.2	1.1
6.0	1.62	350	9.4	2.01	11.8	0.39	3.9	12.4	9.8	13.8	1.2
6.1	1.48	320	9.8	2.62	12.2	0.45	4.2	12.1	9.8	12.4	0.9
6.0	1.40	300	9.6	2.84	13.8	0.47	4.1	15.2	10.2	10.9	0.9
6.1	1.52	350	9.2	2.94	14.2	0.94	4.2	15.4	14.2	12.2	1.2
6.0	1.64	310	9.2	3.06	15.1	0.98	4.8	16.4	11.6	9.8	1.1
6.5	1.72	350	9.2	3.10	16.2	0.64	4.9	18.1	9.2	8.2	1.2
6.2	1.70	450	10.8	2.98	10.8	0.72	5.0	9.2	10.8	11.4	1.3

the quality assessment of Ona River water samples collected during the rainy season (July 2010) and the dry season (January 2011) respectively. The difference in the concentration may be due to the difference in the quantity (volume) of water during the two seasons. Result obtained shows that the concentrations of the physio-chemical parameters were higher during the dry season than during the wet season. The range of concentration of electrical conductivity, total dissolved solids, calcium, magnesium, sodium, carbonate, bicarbonate, chloride, sulphate, nitrate, potassium and Ph are 0.01 to 1.52 ds/m, 450 to 920 mg/l, 0.86 to 3.43 me/l, 0.12 to 2.94 me/l, 6.06 to 20.4 me/l, 2.1 to 7.2 me/l, 0.09 to 1.2 mg/l and 5.2 to 7.4 mg/l respectively during the dry season and were 0.96 to 1.84 ds/m, 300 to 84 mg/l, 5.8 to 11.2 me/l, 1.08 to 3.14 me/l, 8.4 to 21.2 me/l, 0.34 to 1.02 me/l, 1.6 to 9.6 me/l, 8.8 to 19.2 me/l, 9.0 to 16.4 me/l, 7.2 to 14.2 mg/l, 0.90 to 1.92 mg/l and 5.5 to 6.5 mg/l during the wet season respectively.

Result showed that during both rainy and dry season, the concentration of soluble cations and anions vis-à-vis the interacting effect on salinity and toxicity hazard of water are low and within acceptable levels for irrigation of crops.

Conclusion

It can be concluded that Ona River during both the rainy and the dry season are safe for irrigation for crops. Ona River can be developed for an all-year round irrigation for crop production in the study area.

However, the need to continuously monitor and assess surface water quality for irrigation purposes is hereby recommended.

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APPENDIX

Appendix 1. Guidelines for irrigation water standards

Water parameter	Usual range in irrigation water
Electrical conductivity (ds/m)	0 - 3
Total dissolved solids (mg/l)	0 - 2000
Acid /basicity (pH)	6.0 - 8.5
Calcium (Ca^{+}) (me/l)	0 - 20
Magnessium (Mg^{2+}) (me/l)	0 - 5
Sodium (Na^{+}) (me/l)	0 - 40
Boron (B) (mg/l)	0 - 2
Carbonate (CO_3) (me/l)	0 - 1
Biccarbonate (HCO_3) (me/l)	0 - 10
Chloride (Cl) (me/l)	0 - 30
Sulphate (SO_4^{2-}) (me/l)	0 - 20
Nitrate (NO^{3-}) (mg/l)	0 - 10
Ammonium (NH^{4-}) (mg/l)	0 - 5

Source: Food and Agriculture Organization (FAO) 1990.