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Determination of Sodium Absorption Ratio (SAR) for Irrigation and Other Agricultural Purposes in Agwagwune Farm Land, Biased Local Government Area of Cross River State, Nigeria.

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ABSTRACT

This study was carried out to determine sodium absorption ratio (SAR) contents in water used for irrigation in Agwagwune farm land Biased, Cross River State Nigeria. The major ions analyszed were Mg^{2+}, Na^{+}, and Ca^{2+}. This major ions were used to determine the value of SAR in the water to ascertain its quality for irrigation and agricultural purposes. The study results show that the ion (Na^{+}) is normal resulting to relatively a standard value of SAR content in the water. The study revealed that sodium in the soil has relatively average value of 66ml/l, lower than WHO standard (<200ml/l). The relative values for calcium (Ca^{2+} = 38ml/l) and magnesium (Mg^{2+} =19ml/l) were quite within WHO standard. The analysis also shows that the calculated value of SAR is 3.47. Water temperature, P^{H}, Biological Oxygen Dissolve, Oxygen Dissolve (DO) and Total Dissolved Solids (TDS) were also analyzed.These were all within WHO recommend standard for agricultural purposes.

INTRODUCTION

The need for good water quality for agricultural purposes has grown considerably over the years and the supply from water sources is grossly inadequate due to the hardness property and sodium absorption ratio (SAR) content in some surface water. Some people have therefore sort of other alternatives of water supply. This sorting to construction of boreholes (underground water) and the excessive use of surface water. Since streams, and boreholes can be used for irrigation during agricultural purposes, especially for plants cultivation, there is need for this water to be assessed for quality and to know how extend a particular stream or borehole is good for agricultural uses. Though, the borehole is significantly protected from surface pollutants as the earth media is composed of different surface layers as a natural filters yet, it could be very obvious that the metal ions causing hardness could be too high or low. Supply of water for irrigation should be as good as the quality permits.The construction situation, operation and its distribution system must be such as exclude any possible pollution of the water which may hinder the growth and production of crops, (WHO, 2011). Water provides energy in form of hydroelectricity and certain countries like Nigeria are nearly 97% dependent on hydro power for their electricity production and for irrigation. Even for thermal and nuclear power station. Substantial amount of good water is necessary to dissipate heat. Industry cannot function without water, and water is invariably the focal point for many types of reactions and recreations. (Lohair & Thanh, 1978) The study of environmental water pollution in particular has therefore been of considerable importance not only to water analytical agriculturist, but also to engineers, hydrologist, toxicologist and pathologist since most of these determinants pose danger threat to man's life including other living organisms and plants. Thus, it is very essential to analyze any water pose to use for irrigation and other forms of agricultural purposes, either to increase the need parameters or reduce to the required dose to avoid endangering the crops production and render is aesthetically suitable for optimum yield. Unlike oil and most other strategic resources, good quality water has no substitute in most of its uses. It is essential for growing food crops and other agricultural purposes, manufacturing goods and safeguarding human health. Therefore, the development of groundwater or surface water constitute a viable supplement to the earth concrete dam. Fresh water with low SAR is suitable for irrigation and other agricultural uses.

MATERIALS AND METHODS

Descriptive research approach was employed in this study. The data for this research study were obtained from samples collected from four (4) irrigation channels from different locations denoted A, B, C and D as shown in table 1 for the purpose of this study and for easy characterization. The sampling points are given designations as ICHA, ICHB, ICHC and ICHD, meaning irrigation channels at point A, B, C and D respectively as presented in table 2. The monitoring was carried out during the rainy season. Period where farmers carry out their cultivation and irrigation processes in the area.

Samples collection

The water samples were collected from their sources in sterile bottles, properly corked to avoid incoming air into the bottles containing the samples and transported to the laboratory within twelve hours from the time of collection. The sampling site were chosen between distance of 50 meters apart within the irrigated farm lands in Agwagwune, Biased Communities in Southern Cross River State of Nigeria. The Cross River State Water Board (CRSWB) laboratory was used for this Analysis.

Study area description

The study area is Agwagwune Farm Land in Biased Local Government Area 0f Southern Cross River State, Nigeria. Geographically, it is situated between latitude 5°00 47N' and longitude 8° 06 and 8°11E. It occupies a land mass of 1,310Km². The area is in the Easthern Niger Delta of Nigeria. Two seasons by fluctuation of precipitation predominate in the area are dry and wet seasons from April to October (wet season) and November to March (dry season). The area (Agwagwune) where samples were collected located North-Eastern part of Biase. It is characterized by humid tropical climate (high temperature, humidity and precipitation). Annual rainfall range is 1,963-3143mm per annum and annual temperature range is 27°C-33°C.The area also experience a relative humidity of about 80-90% (Ayoade, 2004)

Population of the study area

The study area (Biase Local Government Area) is one of the oldest local government areas in Cross River State. The area though, due to her large land mass, it is not densely populated but witness a serious population explosion, industrial and agricultural growth. It has 169,183 people as at (2000) extrapolated from 2006 National population census. The population rate and the agricultural activities directly deteriorate the quality of water resources in the area.

Selection of sites for sampling

Agwagwune is one of the major communities in Biase Local Government Area of Cross River State. Due to the geographical location of many of the communities, many streams in some of these communities do not survive the dry season and as such, samples were not collected in these areas. Samples were only collected in the areas that have the representative or average characteristics of other sources used for irrigation in the farm land. However, certain criteria were applied in selecting sample sites as follows:

i. Sampling sites were selected such that the samples taken are representative of the different sources from which water enters in the streams.

Ii. Sampling sites were considered in such a way to take account of the number of irrigations served by each source.

III. Sampling sites were of more interest considering the agricultural activities other than irrigations in the locations

TABLE 1: Showing sample locations including source and designations in Abi Local Government Area Cross River State of Nigeria.

S/N	COMMUNITY	LOCATION	SOURCE	SAMPLE CODE
1	Agwagwune	Point A	Stream	ICHA
2	Agwagwune	Point B	Stream	ICHB
3	Agwagwune	Point C	Stream	ICHC
4	Agwagwune	Point D	Stream	ICHD

Sampling size

The maximum sampling size varies widely depending on the range of variation to be considered and the analytical methods to be employed. The volume required for the individual analysis are summarized in table 2 (WHO, 2017)

Sampling procedure:

Samples from streams:

i. The sample cups and bottles were sterilized.

ii. The water samples were filled into the bottles using the sample cups.

III. The samples after collection are packed in a cooler containing ice bags.

iv. The samples were then taken to the laboratory within the shortest time.

Data analysis

TABLE 2: **Sample volumes required for individual analysis**

ANALYSIS	SAMPLE VOLUME (ml)
Sodium	100
Calcium	50
Magnesium	50

Calcium (Ca^{+2}) mg/l

Calcium dissolves out of almost all rocks and is consequently detected in many water. Water associated with granite or siliceous sand will contain less than 10mg/l of calcium. Many waters from limestone areas may contain 30-100mg/l and those associated with gypsiferous shade may contain several hundred milligrams per liter. Calcium contributes to the total hardness of water. On heating, calcium salts precipitate to cause boiler scale. Some calcium carbonate is desirable for domestic water because it provides a coating in the pipes which protect them against corrosion.

EDTA titrimetric method was used for this Analysis. When EDTA was added to water containing calcium and magnesium ions, it reacts with the calcium before the magnesium. Calcium can be determined in the presence of magnesium by EDTA titration. The indicator used is one that reacts with calcium only. Murexide indicator gives a colour change when all of the calcium has been complexes by EDTA at a PH of 12-13 (Balance, 1990).

The following materials and reagents were used: porcelain dishes 100ml capacity, Burette 50ml, Pipette 25ml, Stirring rod, Graduated Cylinder, 100ml. Sodium Hydroxide (NaOH) 1mol, Murexide Indicator. The colour change from pink to purple at the end-point.

Sodium (Na^+)

Method: Gravimetric/Photometric

Procedure: The analysis of sodium sometime can be used as an indication of purity of water for example, in stream condensation, the sodium concentration can be used to indicate water carrying over for boiler system into the stream. Sodium determination will indicate the completeness of cation exchange. The sodium concentration of a typical water sample can be estimated by subtracting the sum of cations (Mg2+, K+, Ca2+) earlier determined from the sum of anions (Cl-, SO²4) in milli equivalent (mg/l) obtained by dividing their concentration in mg/l by their respective atomic weight. The corresponding difference of value obtained from subtraction was multiplied by the atomic weight of the sodium obtained.

Magnesium (Mg^{2+})

Titan yellow reagent was used for the determination of magnesium, unsatisfactory by many investigation, magnesium which amount up to 180 mg/l has been determined spectrophotometrically using P-Nitro phenylazo-1-nphthol, this reagent form a colour complex with magnesium having absorption band at 405 and 480um (American Society for Testing and Materials, 2009). Magnesium ion was achieved by subtracting from the total hardness of the sample, the original value of calcium in mg/l of each water sample which was multiplied by the atomic weight of calcium 20g prior to the subtraction.

TEMPERATURE

The temperature was determined by dipping the mercury in glass thermometer into the sample and the reading taken as the mercury thread rise to a steady point.

pH

pH meter PHS-25, E-201-E (Searchtech) was used. The meter was set on and adjusted to zero and then dipped into the sample and the reading was recorded.

DISSOLVED OXYGEN (OD)

Dissolved oxygen meter was used. The equipment was placed in such a way that it was not exposed directly to heat radiation from the sun. The switch was turned to the normal percentage saturation position,and the display allowed to show a stable value. The display was the adjusted by turning the small screw on the upper right corner until the display showed the ro, the meter was then ready for measuring both saturation as well as part per million (PPM) mg/l. The probe was dipped into the water sample covering about 2/3 of its length. The switch was again turned to the ppm-mg/l position, the result was then recorded in mg/l at a stable value of the display.

Biological Oxygen Dissolve (BOD)

The biological oxygen dissolved in sample was determined by dissolved oxygen meter. The probe was dipped into the sample to cover the probe to about 2/3 at length. The switch was turned to the ppm-mg/l position. The display was allowed to show a stable value and the result was taken and recorded in mg/l. The sample was incubated for 5 days at 20°C and the dissolved oxygen content remeasured.

Calculation

BOD = (a-b) mg/l. Where, a = Initial dissolved oxygen in the sample and b = Final dissolved oxygen in the sample.

TABLE 3. THE SUMMARY OF THE MAJOR IONS OF THE AREA ANALYZED ARE SHOWN IN THE TABLE BELOW.

S/N	Sample point	Na^+ml/l	Ca^{2+}ml/l	Mg^{2+}ml/l	SAR	Dissolve Oxygen	BOD	TEM°C
1	ICHA	66	37	18	3.42	8.2	91	25
2	ICHB	63	38	19	3.32	8.6	98	26
3	ICHC	68	39	21	3.36	8.8	101	25
4	ICHD	67	38	18.5	3.57	8.7	95	25
5	Mean Value	66	38	19	3.47	8.6	96	25

Sodium adsorption ratio (SAR). The SAR was calculated using the formula

SAR. =. $Na^{+}/\{(Ca^{2+})(Mg^{2+})/2\}^{1/2}$

CONCLUSION

The analyses indicate that the major ions content (66 to 39) in the water, soft (total ardness <500mg/l) and fresh. On the basis of of alkaline hazard, Na^{+} is <100mg/l. The waters are regarded excellent for irrigation, and most classes of livestock, poultry and fisheries cultivation. With the value of Ca^{2+} and mg^{2+} all within WHO standard, the mean values of all the parameters analysed were within the international standard for irrigation and other agricultural purposes. The quality evaluation scheme as shown in table 2 indicates that water body are generally good and within WHO standard. The water results in terms of SAR shows degree of excellent quality for irrigation and other agricultural uses.

RECOMMENDATION

The surface water is extremely good for irrigation, this is because the sodium adsorption ratio is relatively low. Some locations like STA, STB, STC and STD have SAR of 3.62, 3.32, 3.36 and 3.57 respectively which indicates excellent quality SAR content. The lower the SAR the better the water for irrigation. Therefore, the surface water should be used for irrigations and other agricultural purposes.

Unwanted materials be recycled more often instead of being dumped into water bodies, as this may lead to sewage and alteration in the value of SAR.

Finally, routine assessment of physico-chemical analysis of water be carried out frequently on seasonal basis as means of controlling the hygienic safety streams and boreholes of supply of water for irrigation and other agricultural purposes.

REFERENCES

Saleh, H.N. et Al. (2019): Carcinogenic and non-carcinogenic Risk Assessment of Heavy Metals in Underground Water (Boreholes) in Neyshabur Plain, Iran, Biol, Trace Elem, Res170, 251-261

Agnesi, A., Tibyangye, J., Tamale, A., Agwu, E.& Amongi, C. (2019): Contamination Potentials of Boreholes Water Handling and Storage Practices in Kirundo, Subcounty Kisoro District, Uganda, J. Environ. Public Health Article ID7933193, 8 pages.

WHO(2021): Guidelines on Recreational Water Quality. Vol.1 Coastal and Fresh Waters. Geneva. World Health Organization.

APHA (1975): Standard Method for the Examination of Water and Waste Water., 14th ed. American Public Health Association (APHA), American Water Works Association (AWWA) and Water Pollution Control Federation (WPCF), Washington, DC

Bartram, J.B. (1990): Drinking Water Supply Surveillance. Robens Institute, University of Survey, Guildford.

Chapman, D. ed. (1996): Water Quality Assessment. A Guide to the Use of Biota, Sediment and Water in Environmental Monitoring. 2nd ed. Chapman and Hall, London.

Edet, A. E , Uka, N. K., Offiong, O.E. (2001): Chemistry and Discharge Characteristics of Odukpani Junction Springs, Calabar Flank South-Eastern Nigeria. Environment Geology. 40, 1214-1215

UNGA (2010): Resolution 64/292; The Human Right to Water and Sanitation. In: 108th plenary Meeting, 28th July, 2010. United Nation General Assembly).

Eja, M.E. (2001): Water Pollution and Sanitation for Developing Countries. Seaprint, Calabar.

Cotruvo, J. A. et al (2010): Desalination Technology, Health and Environmental Impacts, Boca Raton, FL, CRC Press.

Krishnan, K., Carrier, R. (2013): The use Exposure Source Allocation Factor in the Risk Assessment of Drinking Water Contaminants. Journal of Toxicology and Environmental Health, Part B. Critical Reviews, 16(1); 39-51

Etu-Efoetor, J. O. (1998): Hydro-chemical Analysis of surface and Ground Water of Gwagwalada Area of Central Nigeria. Global Journal of Pure and Applied Science. 4(2); 153-159

APHA, AWWA, WEF. (2017) 7110C: Coprecipitation Method for Gross Alpha Radioactivity in Drinking Water. In: Baird RB, Eaton, AD, Rice EW, ed. Standard Methods for the Examination of Water and Wastewater, 23rd ed. Denver American Public Health Association, American Water Works Association, Water Environment Federation.

ISO (2017): Standard ISO 9696 Water Quality-Measurement of Gross Alpha Activity in Non-saline Water, Thick Source Method. Geneva. International Organization for Standization.

Ford, T.E. (1993): Aquatic Microbiology, Cambridge. Man's Blackwell Scientific Publication Inc.

Esu, E.O & Amah, E.A. (1999): Physico-chemical and Bacteriological Quality of Natural Waters in part of Akwa Ibom and Cross River States, Nigeria. Global Journal of Pure and Applied Science 5(4); 525-532.

Richard, J., Wagman, M.D. F.A.C.P.(2000): The New Complete Medical and Health Encyclopedia. (3); Freguson Publishing Company, Chicago.

2013).

IRRIGATION | Methods: [online] Kimberly, ID, USA: Elsevier, p.9.Available at: https://eprints.nwisrl.ars.usda.gov/1568/1/1524.pdf [Accessed 17 Oct.2019].Jha, K., Doshi, A. and Patel, P. (2018). INTELLIGENT IRRIGATION SYSTEM USINGARTIFICIAL INTELLIGENCE AND MACHINE LEARNING: A COMPREHENSIVEREVIEW.

International Journal of Advanced Research: [online] 6(10), pp.1493-1502.Available at: https://www.researchgate.net/publication/329098253_INTELLIGENT_IRRIGATION_SYSTEM_USING_ARTIFICIAL_INTELLIGENCE_AND_MACHINE_LEARNING_A_COMPREHENSIVE_REVIEW.Kumar, G. (2014). RESEARCH PAPER ON WATER IRRIGATION BY USING WIRELESSSENSOR NETWORK.