The International Journal of Engineering and Science (IJES)
|| Volume || 7 || Issue || 6 Ver. II || Pages || PP 48-52 || 2018 ||
ISSN (e): 2319 – 1813 ISSN (p): 23-19 – 1805

Appraisal of the Quality of Amaenyi River in Anambra State of Nigeria for Irrigation Purpose

OjedeleO.S.[#1], Ezejiofor N.R.[*2], EhiomogueP. O.[*3], Orji F.N.[*4], NnejiL.N.[*5]
[#1, *3, *4,*5]*Michael Okpara University of Agriculture, Umudike*
P.M.B. 7267, Umudike, Abia State, Nigeria
[*2] *National Agricultural Extension Research and Liaison Service,*
Ahmadu Bello University, Zaria
Corresponding Author: OjedeleO.S.

----------ABSTRACT----------
The quality of surface water, which is Amaenyi River, was investigated for its suitability for irrigation purpose in Oyi local government area of Anambra state, Nigeria. The water samples were collected at four different points, namely, two different points at the upstream and downstream level of the river respectively. The water samples were analysed for their physical, chemical, and biological properties, and the average of each tested parameter was recorded in the designed table.The average pH value of the river was 7.12, indicating a slightly alkaline nature.Theaverage values of electrical conductivity and total dissolved solids from Amaenyi River were 20.6 µScm^{-1} and 13.4mg/lrespectively.The total suspended solids of the river fell at the average level of 17.7mg/l, indicating low turbidity (2.75mg/l) and coloration of the waterrespectively.The average Sodium Absorption Ratio (SAR) for the river is 0.91mg/l,which means they can be used for all crops, since there is no risk of sodium buildup.The average values of the nitrate (NO_3^-), phosphate, bicarbonate and boron of the river in mg/l were 0.04, 0.12, 1.31 and 1.00 respectively. It means the river is at the safe limit according to World Health Organisation standard.

KEYWORDS:*Quality, Amaenyi, River, Irrigation, Sodium Absorption Ratio.*

Date of Submission: 06-06-2018 Date of acceptance: 21-06-2018

I. INTRODUCTION

Water quality refers to the physical, chemical, biological and radiological characteristics of water. Water quality is necessary information that needs to be investigated on a particular water source before using it for domestic and irrigation purposes. Irrigation may be defined as the application of water to soil for the purpose of supplying water and nutrients when insufficient for plant growth and development.

Whatever may be the source of water, viz groundwater and surface, there is always presence of dissolved salt, which vary in concentration depending on the water source (Michael, 2005). These minerals have their useful functions for plant growth and development. The main soluble cations are calcium, magnesium, and sodium, while the anions are carbonate, bicarbonate, chloride and sulphate. Furthermore, ions of some other elements such as silicon, lithium, Bromine, iodine, Nikel, Cobalt, fluorine, Boron, Lead, Molybdenum, Selenium, and Phosphate and organic matter are present in minor quality (James 1993). These elements usually do not affect the quality of irrigation water as far as the total salt concentrate is concerned, but some ions such as selenium, molybdenum and fluorine, if absorbed by plants in excessive amounts, may be harmful to the life of animals taking the water.

There are requirements that must be met by water set by Food and Agriculture Organization (FAO) to be recommended as suitable for irrigation purpose, and any source of water that do not meet these requirements may not be classified to have good quality.

The quality and quantity of irrigation water can greatly affect the success of your crop, and that is the necessity to assess the suitability of AmaenyiRiver for irrigation purpose.

Plant thrives very well when the necessary minerals and elements are present in the water and in the right quality. The research work on Amaenyi river in onyi, Anambra state will give useful information to the farmers in the given area on the quality of the water and if there is necessary treatment before being used for irrigation.

It has been observed that there need to improve the food security of the nation through farming activities. Farming activities are not sufficient enough during the dry season among the communities surrounded by Amaenyi River. Therefore, there is necessity to create awareness to the farmers, in order to increase their annual farm produce output through irrigation by using water source from Amaenyi River during as alternative source of water. Hence, the main objective is to assess the physical, chemical and biological properties of

Amaenyi River for irrigation purpose. The study from the research provides information on the quality of the river to the farmers to use the water for irrigation activities.

II. MATERIALS AND METHODS

2.1 STUDY AREA

Figure 1: Map showing oyi L.G.A in Anambra State, Nigeria

Source: www.nigerianstat.gov.ng

The study Area, which is Amaenyi lies within latitude 5 °15'N and longitude6 °13'E. It has two seasons which are wet and dry season respectively. The annual rainfall is between 1,828mm– 1,991mm with the annual average temperature of 27°C.The Amaenyi river flow is steady and available all year round.Oyi is a local government area in Anambra State of Nigeria as shown in figure 1. It is home to the oyi people, and the towns that make up oyi local government are Nkwelle-Ezunaka, Awkuzu, Ogbunike, Umunya and Nteje.(https://en.wikipedia.org/wiki/Oyi**) 2.2 RIVER SAMPLING METHOD**

Water sample was collected from two positions (upstream and downstream) of AmaenyiRiver in the month of October 2017, during the dry season of the area as indicated in appendix A. The water sample was taken at 10:00am to the laboratory for testing.The river was selected for this research work due to the observation that farm lands are located near the river, and farmers use the river for irrigation.

Two liters of water each from upstream and downstream were used for the laboratory test within 24 hours; clean plastic bottles rinsed with distilled water were used to carry the water sample to the laboratory.

2.3 IRRIGATION WATER ANALYSIS

The irrigation water analysis was carried out at Optimum Laboratory, Umuahia, Abia State of Nigeria. All the analyses were based on the standard method as appropriate for irrigation water quality parameter as prescribed in the APHA (1998).The various parameters that were tested at the laboratory were: The biological oxygen demand (BOD), Electrical conductivity, turbidity, total suspended solids (TSS), total hardness (TH), sodium, calcium, nitrate, phosphate, bicarbonate, copper, boron, pH, salinity, sodium adsorption ratio, magnesium and total dissolved solids(TDS).

III. RESULTS AND DISCUSSION

3.1 RESULTS

The water samples were taken at two points from the up and down stream and the average of the four readings from the laboratory tests was calculated as shown in table 1.

Table 1: Summary of Parameters for the Water Samples and Standard Values

Parameter	Upstream		Downstream		Average	Standard Values
	A	B	C	D		
Sodium (Na^+)	4.12mg/l	4.61mg/l	3.20mg/l	3.99mg/l	3.98mg/l	0-20mg/l
Calcium (Ca^{2+})	0.90mg/l	1.04mg/l	0.72mg/l	0.46mg/l	0.03mg/l	0-200mg/l
Magnesium (Mg)	1.43mg/l	1.55mg/l	0.91mg/l	1.11mg/l	1.25mg/l	0.5mg/l
Copper	0.32mg/l	0.30mg/l	0.41mg/l	0.41mg/l	0.36mg/l	1.0mg/l
Boron	0.57mg/l	0.59mg/l	0.68mg/l	0.66mg/l	0.625mg/l	1.0mg/l
Nitrate	0.013mg/l	0.011mg/l	0.065mg/l	0.071mg/l	0.04mg/l	0-10mg/l
Phosphate	0.108mg/l	0.12mg/l	0.124mg/l	0.130mg/l	0.1205mg/l	15mg/l
Bicarbonate	1.58mg/l	1.34mg/l	1.10mg/l	1.22mg/l	1.31mg/l	0-mg/l

Total Dissolved Solid (TDS)	11.5mg/l	12.5mg/l	14.0mg/l	15.5mg/l	13.4mg/l	1300mg/l
Turbidity	2mg/l	2mg/l	3mg/l	4mg/l	2.75mg/l	50mg/l
Total Suspended Solid (TSS)	16.17mg/l	17.37mg/l	18.27mg/l	19.00mg/l	17.7mg/l	≤500mg/l
Total Hardness (TH)	10.34mg/l	10.50mg/l	5.47mg/l	6.02mg/l	8.08mg/l	500mg/l
pH	7.74	7.80	7.11	7.81	7.12	6.5-8.5
Biological Oxygen Demand (BOD)	0.7mg/l	0.7mg/l	0.5mg/l	0.6mg/l	0.6mg/l	0-10mg/l
Sodium Adsorption Ratio (SAR)	0.90	0.94	0.81	0.98	0.91	6.0
Electrical Conductivity (EC)	22.5mg/l	21.5mg/l	19.0mg/l	19.5mg/l	20.6mg/l	≤2000 µScm^{-1}
Salinity	3.20mg/l	3.11mg/l	3.92mg/l	4.00mg/l	3.56mg/l	APPENDIX C

Source: Authors and W.H.O./AWA (Australian Water Association, 2003)

Calculation of Sodium Absorption Ratio (SAR)

SAR = $\frac{Na^+}{\sqrt{Ca^{2+}+Mg^{2+}/2}}$

At Upstream A, Na^+ = 4.12 mg/l

Milliequivalent = $\frac{4.12}{23}$= 0.18eq/l

Ca^{2+} = 0.90 mg/l

Milliequivalent = $\frac{0.90}{40}$= 0.02eq/l

Mg^{2+} = 1.43 mg/l

Milliequivalent = $\frac{1.43}{24}$= 0.06eq/l

SAR = $\frac{0.18}{\sqrt{(0.02+0.06)/2}}$ = 0.90

At Upstream B, Na^+ = 4.61 mg/l

Milliequivalent = $\frac{4.61}{23}$= 0.20 eq/l

Ca^{2+} = 1.04 mg/l

Milliequivalent = $\frac{1.04}{40}$= 0.03eq/l

Mg^{2+} = 5.5 mg/l

Milliequivalent = $\frac{1.55}{24}$= 0.06eq/l

SAR = $\frac{0.20}{\sqrt{(0.03+0.06)/2}}$ = 0.94

At Downstream C, Na^+ = 3.20 mg/l

Milliequivalent = $\frac{3.20}{23}$= 0.14eq/l

Ca^{2+} = 12.0 mg/l

Milliequivalent = $\frac{0.72}{40}$= 0.02eq/l

Mg^{2+} = 5.73 mg/l

Milliequivalent = $\frac{0.91}{24}$= 0.04 eq/l

SAR = $\frac{0.14}{\sqrt{(0.02+0.04)/2}}$ = 0.81

At Downstream D, Na^+ = 3.99 mg/l

Milliequivalent = $\frac{3.99}{23}$= 0.17eq/l

Ca^{2+} = 0.46 mg/l

Milliequivalent = $\frac{0.46}{40}$= 0.01eq/l

Mg^{2+} = 1.11 mg/l

Milliequivalent = $\frac{1.11}{24}$= 0.05eq/l

SAR = $\frac{0.17}{\sqrt{(0.01+0.05)/2}}$ = 0.98

3.2 DISCUSSION

PH values: The average value of the pH is 7.12, which means it is still at the accepted range.Research has shown that pH has profound effect on water quality. It affects metal solubility, alkalinity, hardness of water and

microbial degradation activities. These make aquatic animals' life sensitive to pH variation, because most of their metabolic activities are pH dependent (Haines, 1981). Biodegradation of organic matter releases nutrient elements that are essential to the growth and reproduction of aquatic plants and animals which depend on surrounding water to provide these nutrients.

Electrical Conductivity (EC) and Total Dissolved Solids (TDS):The accepted range of EC is 0 – 1000µScm^{-1} for irrigation activity. The respective average values of 20.6 µScm^{-1}and 13.4mg/l ofelectrical conductivity and total dissolved solidsfromAmaenyi River are very low. Low salinity water tends to leach surface soils free of soluble minerals and salts, especially calcium, reducing their strong stabilizing influence on soil aggregates and soil structure. Without salts and without calcium, the soil disperses and the dispersed finer soil particles fill many of the smaller pore spaces, sealing the surface and greatly reducing the rate at which the water infiltrates the soil surface. Infact, very low salinity water (<200 µScm^{-1}as shown in appendix B) almost invariably results in water infiltration problems regardless of the relative sodium ratio (Ayers and Westcot, 1994). Hence, there is need to increase the salinity of the river for irrigation.

Total suspended solidsof the river fell at the average level of 17.7mg/l.TotalSuspended solids (TSS) bring about turbidity and coloration of the water. They may clog soil pores, thus reducing water filtration and soil aeration.

Cationic Concentrations: The composition of concentration of dissolved substances or solutes containing mainly calcium, magnesium and sodium ions among other things determine the quality of irrigation water. The respective average values for sodium (Na^+), calcium (Ca^{2+}), and magnesium (Mg^{2+}) in mg/l were 3.98, 0.03, and 1.25, indicating that the water falls within the safe limit for irrigation with regards to the cations as shown in table 1. Hence, such water may be used on coarse texture soil with good permeability (Oyebode, 1999).The average Sodium Absorption Ratio (SAR) = $\frac{Na^+}{\sqrt{(Ca^{2+}+Mg^{2+})/2}}$ for the river is 0.91mg/l.The four samples were below 10 in SAR value, which means they can be used for all crops as indicated in Appendix C, except those that are slightly sensitive to sodium. Sodium salts are generally present in irrigation waters but if in a high proportion, they may be absorbed on the soil particles resulting in impeding the movement of water and air when the soil is wet and formation of hard clods when the soil is dry. (Sharma *et.al.*, 1992).

Anionic Concentrations: Theaveragevalues of the nitrate (NO_3^-), phosphate, bicarbonate and boron of the river in mg/l are 0.04, 0.12, 1.31 and 1.00 respectively.Itmeans the river is at the safe limit of World Health Organisation standard. Hence the river may be considered safe for irrigation in terms of anionic concentration.

IV. CONCLUSION AND RECOMMENDATION

AmaenyiRiver is suitable for irrigation terms of quality base on the findings. It can be concluded that the pH value (7.5) shows that the water is slightly alkaline in nature. Also, the average of 0.91mg/l of the Sodium Absorption Ratio (SAR) value of the river shows that the river is in excellent condition if it will be used for irrigation. Sodium salts is necessary for irrigation, but high concentration of it may result in impeding the movement of water and air when the soil is wet and formation of hard clods when the soil is dry. In addition, the low nitrate concentration in the water indicates that nitrogen can be applied inform of fertilizer to the farm.

It is recommended that periodical test has to be carried out to ascertain any change in values in the future use of the river for irrigation, and chemicals should be avoided as means of harvesting fishes in the river.

REFERENCES

[1]. APHA, AWWA and WPCF (1998), standard methods for the examination of water, 20th edition Washington DC., 1961).
[2]. Ayers, R.S. and Westcot, D.W. 1994.Water quality for agriculture.Calvin, V. D. and Kenneth, E.S: 1969. Handbook of applied Hydraulics, 3rdedition , M.C Graw Hill book company, New York
[3]. Haines, T. A (1981). Acidic Precipitation and its consequences for aquatic ecosystems, a review,Transactions American Fisheries Society. Vol 110, No 6, pp 669-707.https://en.wikipedia.org/wiki/Oyi
[4]. James, L.G; 1993. Principles of farm irrigation seem Design. Washington state university
[5]. Michael A. M. 2005. Irrigation principles and practice.Fifth edition, John Willy and sons, Inc New York.
[6]. Oyedobe, Y. O (1999).Water Quality and Surveillance Proceeding of Natural Seminar on Industrial Hygiene and Sarcety for Nigeria, Kaduna.
[7]. Sharma R.K. and T.K. Sharma.(2002). Irrigation Engineering.Published by S. chand and company ltd, Ram Nagar, New Delhi-110055, 2002.
[8]. W.H.O. (2003).Guidelines for Irrigation Water Quality. Vol.1: Recommendations, 2nded., World Health Organization, Genevawww.nigerianstat.gov.ng

APPENDIX A

Picture showing Amaenyi River

APPENDIX B

IRRIGATION WATER AS CLASSIFIED FOR SALINITY LEVEL

SERIAL NUMBER	SALINITY LEVEL	ELECTRICAL CONDUCTIVITY
1	Low salinity	250 μScm^{-1}
2	Medium salinity	250-750 μScm^{-1}
3	High salinity	750-2250 μScm^{-1}
4	Very high salinity	2250 μScm^{-1}

Source: Calvin (1969)

APPENDIX C

QUALITY CLASSIFICATION OF WATER BASED ON SODIUM ABSORPTION RATIO

SERIAL NUMBER	SAR	WATER CLASS
1	10	EXCELLENT
2	10-18	GOOD
3	18-26	FAIR
4	26	POOR

Source: H.L. Saly (1968)

Ojedele O.S."Appraisal of the Quality of Amaenyi River in Anambra State of Nigeria for Irrigation Purpose." The International Journal of Engineering and Science (IJES) 7.6 (2018): 48-52